Domain specific alterations in cognitive conflicts and adjustments after sleep deprivation related to subclinical ADHD-symptoms

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Conclusions:
Sleep deprivation has a negative impact on executive functions (EF) in healthy subjects and the magnitude of the effects relates to the severity of sub-clinical symptoms of ADHD and emotional instability. The result also suggests domain specificity in line with the cognitive core capacity model of top-down dysregulation [1].

Introduction:
A core theory of ADHD has evolved around deficits in executive functions (EF) [2]. ADHD-symptoms have been associated with poor results in EF-tests [3]. Less is known about intra-individual differences depending on stress factors such as sleep loss.

Aim:
Using a neutral/emotional Stroop-task [4], we tested whether reaction time (RT) and reaction time variability (RTV) were negatively affected by sleep deprivation in relation to ADHD- and emotional instability traits in a non-clinical population. We specifically focused on cognitive conflicts and adjustments, i.e. well-defined EF-components [4].

Method:
180 healthy subjects were assessed for ADHD-symptoms (Attention) and emotional instability symptoms (Emotion) using Brown ADD-RS [5]. They were randomly divided into two groups: one group was sleep deprived (SD) and one was not (NSD). The subjects then performed a computerized neutral and emotional version of the Stroop-task, consisting of simultaneously presented faces and words that could be either congruent or incongruent (Fig. 1) [4]. Participants were asked to identify the sex or the emotion of the faces, while trying to ignore the distracting word. They reported their responses by pressing one of two possible buttons.

Cognitive Conflicts were defined as RT/RTV for the first incongruent trial vs preceding congruent trial and Adjustments were defined as RT/RTV for first incongruent trial vs second incongruent trial. We calculated intra-individual RTV for Conflicts and Adjustments.

Results:

Neutral Stroop vs Attention:
A linear regression model showed a significant positive regression between Attention and RTV for Conflict in the neutral Stroop for SD (r=0.344;p=0.001) but not for NSD (r=0.015;p=0.888) (Fig. 3A). The interaction effect between group (SD or NSD) and Attention was significant (p=0.0226). The effect remained significant when controlling for mean-RT and emotional instability (Emotion), suggesting domain specificity.

A similar regression model showed a significant positive regression between Attention and RTV for Adjustment in the neutral Stroop for SD (r=0.295;p=0.0055) and a trend effect for NSD (r=0.194;p=0.073) but no significant interaction between group (SD or NSD) and Attention (p=0.488) (Fig. 3B).

Emotional Stroop vs Emotion:
A linear regression model showed a trend regression between Emotion and RTV for Conflict in the emotional Stroop for SD (r=0.197;p=0.068), a non-significant effect for NSD (r=0.059;p=0.59) and non-significant interaction between group (SD or NSD) and Emotion (p=0.246) (Fig. 3C).

A similar model showed a significant regression between Emotion and RTV for Adjustment in the emotional Stroop for SD (r=0.299;p=0.005) but not for NSD (r=0.013;p=0.903) and a significant interaction between group (SD or NSD) and Emotion (r=0.0386) (Fig. 3D). The significant effects survived when controlling for mean RT and ADHD-symptom (Attention) suggesting domain specificity.

No significant interaction effects between Group (NSD/SD) and Brown scores (Attention or Emotion) were observed for RT.

Fig. 1
Emotional Stroop
Neutral Stroop

Fig. 2
Cognitive conflict and Behavioral adjustments following conflict
Mean reaction times (+ SEM) split up for all possible combinations of previous x current trial types. The grey or black line discriminates the current trial as being congruent (grey) or incongruent (black). The x-axis discriminates the previous trial type when is congruent (left side) or incongruent (right side). On the y-axis RT means are reported (right responses). We observed an interaction between congruency and previous trial type (p=0.011) as has been shown in other studies [4].

Fig. 3

References:

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