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Elsevier Editorial System(tm) for Biological Manuscript Draft Manuscript Number: Title: Re: Systematic Overestimation of Reflection Impulsivity in the Information Sampling Task - Age dependency in children Article Type: Correspondence Corresponding Author: Dr. Patrícia P Silveira, MD PhD Corresponding Author's Institution: McGill University First Author: Irina Pokhvisneva, MSc

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# Re: Systematic Overestimation of Reflection Impulsivity in the Information Sampling Task Age dependency in children

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**Key words**: IST, reflection impulsivity, CANTAB, children, age, discrimination errors **Word number**: 568

### To the Editor:

We read with great interest the letter recently published in Biological Psychiatry regarding the systematic overestimation of reflection impulsivity in the Information Sampling Task (IST) (1). The IST is a task in which the participants gather a variable amount of information prior to making a decision about an uncertain outcome (2). One of the main outcomes in this task is the *P correct*, that estimates the level of uncertainty tolerated by the participant at the point of decision. Bennet et al. (1) proposed a new way to compute the IST outcome measure (*P correct*) and the use of this new formula was encouraged by the original designers of the task (3). However, as we have been using IST (incorporated into the Cambridge Neuropsychological Test Automated Battery)(4, 5) in our community-based birth cohort for many years now (6), we observe that the relationship between the original and revised *P* correct is age specific. As impulsivity is a core feature in many prevalent neuropsychiatric conditions affecting the youth, such as ADHD (7), eating disorders (8), substance use disorders (9), and is a marker of prefrontal executive deficits (10), the adequate use of IST is particularly interesting for developmental studies.

In our cohort of children tested in the IST from 48 to 72 months of age, we see indeed that the original *P correct* overestimates reflection impulsivity in the IST as demonstrated by Bennett et al (1). However, this is true only when there are no discrimination errors (Figure 1A, blue dots). Whenever there are discrimination errors, the original *P correct* in fact underestimates reflection impulsivity (Figure 1A, green dots). As pointed out by both Bennett and Clark (1, 3), the error size ( $\Delta P \ correct$ ) has a direct relationship to the number of boxes opened. However, the <u>presence of discrimination errors modifies the relationship between the</u> original and the revised *P correct*. When there are no discrimination errors, as more boxes are opened, the original *P correct* increases approaching the revised P correct; but when there are discrimination errors, the original *P correct* decreases as the number of boxes opened increases (Figure 1B, compare to Bennet's Figure 1 (1)).

Discrimination errors happen when a participant chooses a color that is not at that point in time in the majority, thus making a decision illogical based on the available evidence. Discrimination errors run contrary to the task instructions and are uncommon in studies using IST in older samples (9), but are common in children. We can see in our cohort tested yearly in the IST that <u>the number of discrimination errors show a relationship with the developmental stage, and dramatically decreases from 48 to 72 months</u> (Figure 2). Similarly, the percentage of children that open all 25 boxes decreases from 73% at 48 months to 44% at 72 months of age considering the decreasing condition, although this is not as clear in the fixed condition (77% at 48 months to 75% at 72 months of age), where the participant does not loose points if more boxes are opened. Even if we analyze children that did the test only at that specific time point (either at 48, 60 or 72 months), to discard learning or habituation effects from the repeated testing, we see the same pattern. Therefore, both discrimination errors and the number of boxes opened are crucial for the interpretation of IST results, particularly in children, and should be always considered.

#### **Acknowledgements and Financial Disclosures**

This work was sponsored by grants from the JPB Foundation and the Sackler Foundation. The authors report no biomedical financial interests or potential conflicts of interest.

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## **Figure Legends**

**Figure 1: A)** Relationship between original (x axis) and revised (y axis) *P correct* according to the presence (blue dots) or absence (green dots) of discrimination errors. *P correct* overestimates the reflection impulsivity (i.e. has lower scores) only when there are no discrimination errors. When there are errors, reflection impulsivity is in fact underestimated by original *P correct*. **B**) Relationship between the number of boxes opened and the error size ( $\Delta P \text{ correct}$ ) depends on the presence (blue dots) or absence (green dots) of discrimination errors. The yellow dots represent the situation where an equal number of boxes of each color is opened; in this case, both original and revised *P correct* are equal to 0.5.

**Figure 2:** Trajectory of the number of discrimination errors during the IST task in 48, 60 and 72 month-old children.



