

Does inhibition have a key role to play in overcoming intuitive interferences in science?

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Introduction

- Over the past few decades, a major research concern in science education has been the topic of pre-instructional misconceptions concerning various phenomena that students bring to class (Duit, 2007). In particular, students have erroneous and persistent conceptions about density (Smith, Maclin, Grosslight & Davis, 1997; Roach, 2001).
- Stavy and Tirosh (2000) suggested that some students' firmly held misconceptions could stem from the interference caused by intuitive reasoning.
- Within the actual social context, educators and policymakers are concerned about students' difficulties in science. Examining their reasoning process can provide useful insights for understanding how they overcome their intuitive conceptions.

Theoretical background

- Inhibition might play a central role in situations where learners must overcome spontaneous and inappropriate strategies or answers (Houdé & al, 2011).
- Within the developmental psychology field, it is relatively well established that inhibition mechanisms develop through childhood, accompanied by an increase of performance in tasks that involve overcoming interferences (Bedard et al., 2002 ; Christ, White, Mandernach et Keys, 2001).
- Recent research suggest that students' capacity to overcome their intuitive conceptions in science depend on their ability to inhibit them. (Dunbar et al, 2007; Masson, 2012)
- The significant changes experienced by the prefrontal cortex (which various studies link to inhibition) during childhood may be responsible for students' ability to success in tasks involving intuitive interferences.
- Stimuli in which learners must overcome their intuitive conceptions take more time to be answered (Babai & Amsterdamer, 2008; Babai & al., 2006), probably because of the underlying inhibition processes.

Hypothesis

- We know that inhibitory control mechanisms that develop through childhood might be involved in overcoming intuitive interference in science. (Houdé, 2004)
- Therefore, our hypotheses are :
- Tasks involving intuitive interference (counter-intuitive stimuli) might be responded to more slowly than tasks with intuitive stimuli.
 - Counter-intuitive stimuli might be better answered with age.
 - Correctly answered stimuli involving intuitive interference should be answered more rapidly through childhood.

Method

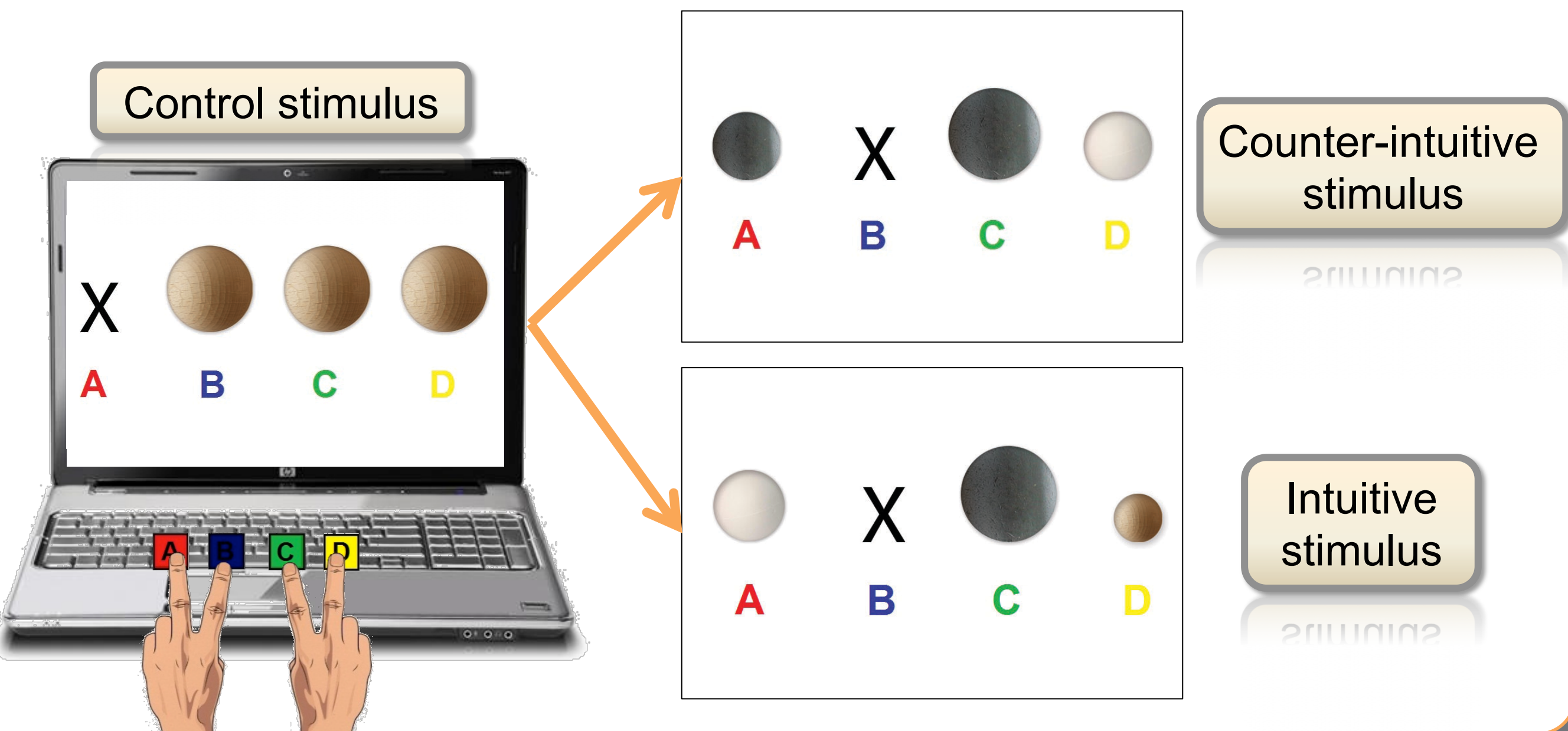
- A computerized task eventually usable in brain imaging devices was developed to aim to understand mental processes associated with overcoming intuitive interference in science.
- Empirical data (reaction time and accuracy of responses) was collected with the E-Prime® software.

Participants (n = 694 ; 593 right-handed)

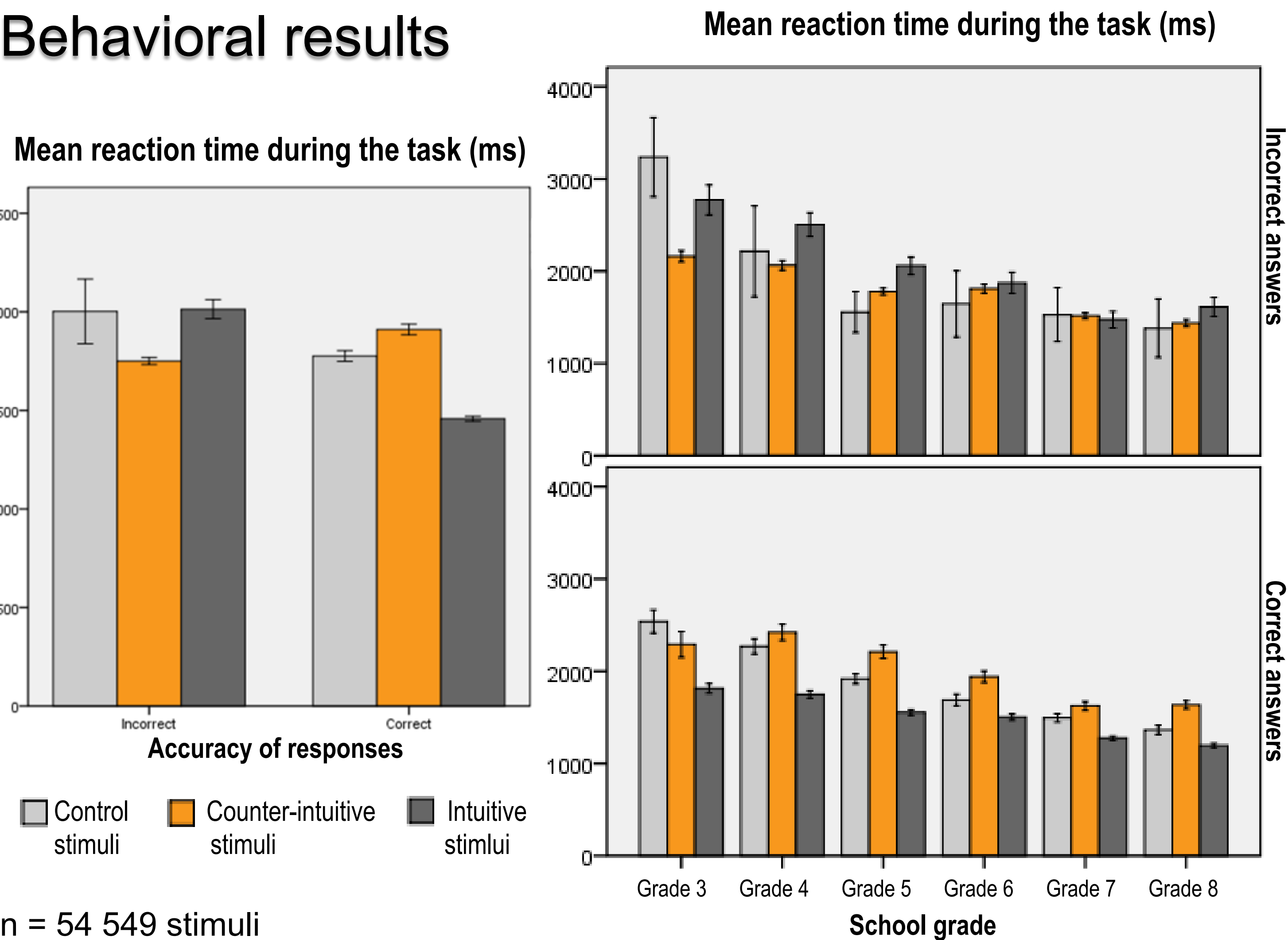
	Grade 3 (8-9 y.o.)	Grade 4 (9-10 y.o.)	Grade 5 (10-11 y.o.)	Grade 6 (11-12 y.o.)	Grade 7 (12-13 y.o.)	Grade 8 (13-14 y.o.)	Total
Boys	35	44	64	41	51	60	295 (43,1%)
Girls	25	50	81	61	103	69	389 (56,9%)
Total	60 (8,8%)	94 (13,7%)	145 (21,2%)	102 (14,9%)	154 (22,5%)	129 (18,9%)	684 (100,0%)

Task

Three types of stimuli were used to investigate students' capacity to overcome intuitive interference. For each stimulus, participants had to say which ball will sink more (if there is no difference between balls, they had to choose X).

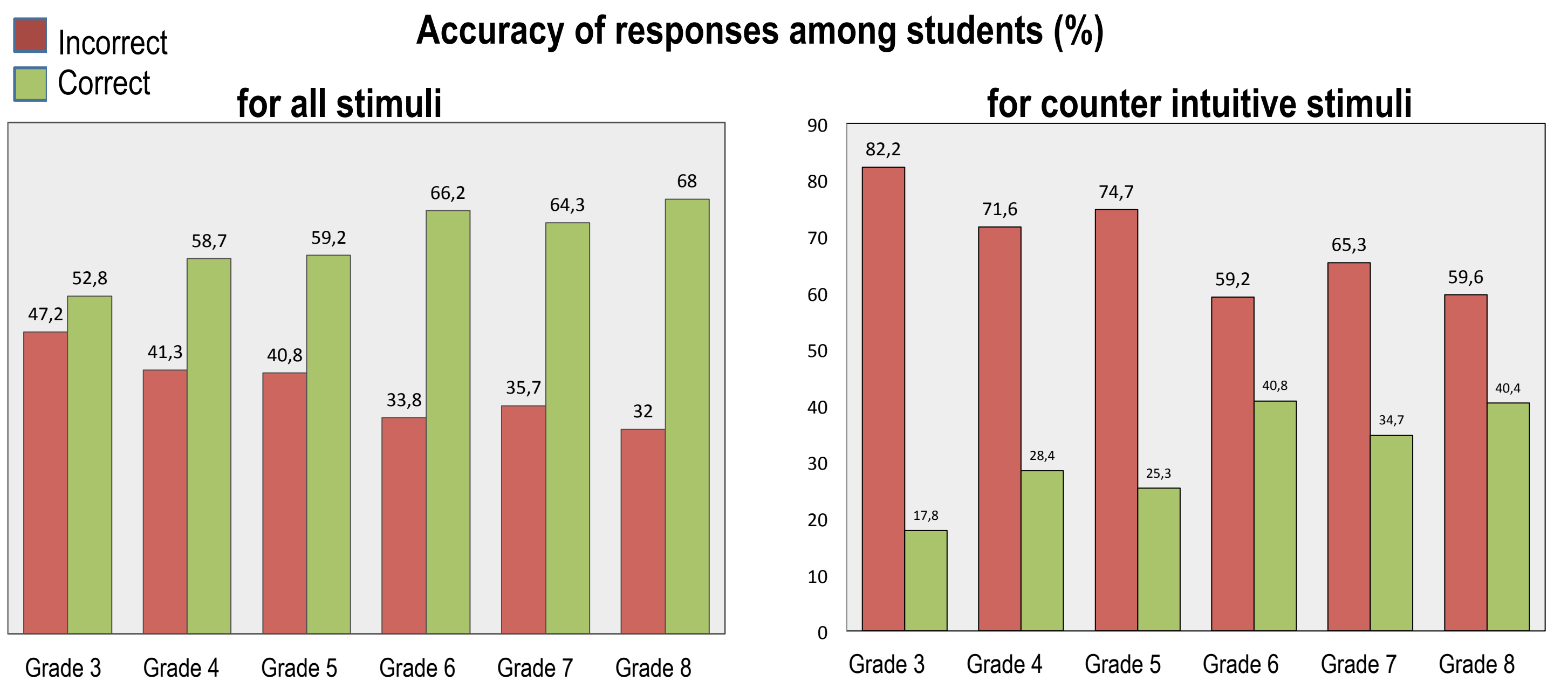


Behavioral results



n = 54 549 stimuli

- Students responded to counter-intuitive stimuli more slowly than to intuitive stimuli.
- Correctly answered counter-intuitive stimuli are answered more rapidly with age.
- Older students' answers are more accurate than youngers students' answers.



Discussion

- Younger students are less able and need more time to evaluate correctly counter-intuitive stimuli. This might be due to their less developed capacity of inhibition.
- When evaluating incorrectly counter-intuitive stimuli, students take more time then when they evaluate wrongly intuitive ones, suggesting that their intuitive conception interferes in their reasoning.
- This could mean that students still have their naive conception (the biggest the ball, the more it will sink) and have to inhibit it to answer correctly. Thus, data do not support conceptual change models that postulate that conceptions are erased after conceptual change.

Conclusion

- When they evaluate counter-intuitive stimuli, students are slower than when evaluating intuitive stimuli, suggesting that they must inhibit their intuitive answer.
- Thus, students' intuitive conceptions might not be transformed into something else after conceptual change, but rather might be inhibited.
- Future studies could test the latter task with brain imaging devices, to establish a relationship with these behavioral results and to verify if brain networks related to inhibition are activated.