

Parsing under pressure: The role of performance pressure in cognitive control and syntactic ambiguity resolution

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Background & Hypotheses

The Role of Cognitive Control in Sentence Processing

- Psycholinguistic studies^{1,2} emphasize the importance of cognitive control during sentence processing, especially when readers/listeners must override early, incorrect interpretations due to late-arriving conflicting input.
- Extreme populations, including young children^{3,4} and patients^{5,6} with damage to left lateral prefrontal cortex, have difficulty resolving incompatible representations during cognitive control tasks (e.g., Stroop)^{2,5}. This general cognitive control difficulty is also reflected in garden-path recovery^{2,4,5}.

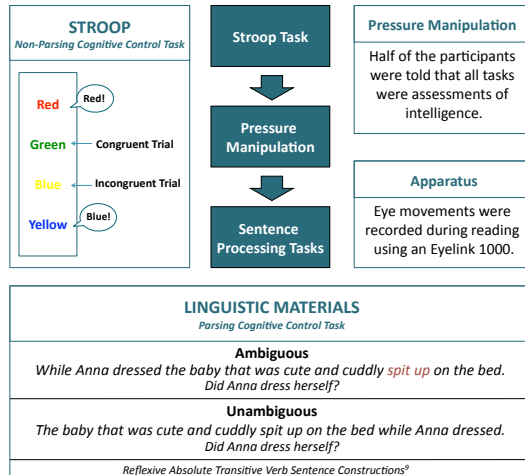
Cognitive Control and Motivation

- Recent research demonstrates that performance on cognitive control tasks (e.g., Stroop) is affected by motivational state⁷:
 - Approach State:** motivated by reward-associated cues to attain positive outcomes
 - Avoidance State:** motivated by threat-associated cues to withdraw from aversive outcomes
- Similarly, performance on cognitive control tasks decline when individuals' motivational states change, such as when they are pressured to perform well⁸.

Current Predictions

- If cognitive control helps readers implement reanalysis during sentence processing, then manipulating the demands for control by inducing pressure should result in measurable differences during sentence processing.
- Specifically, readers under performance pressure might show greater difficulty revising early interpretation commitments.

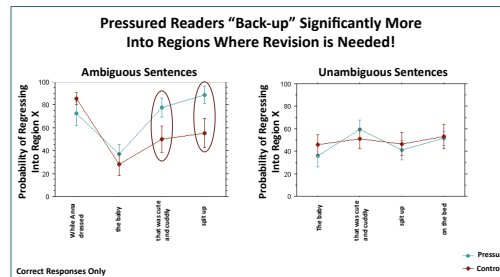
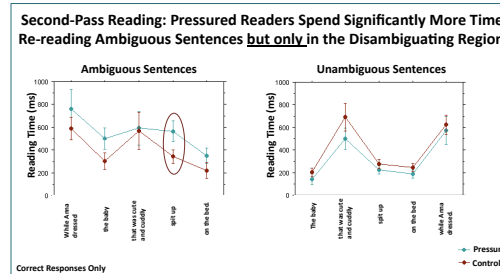
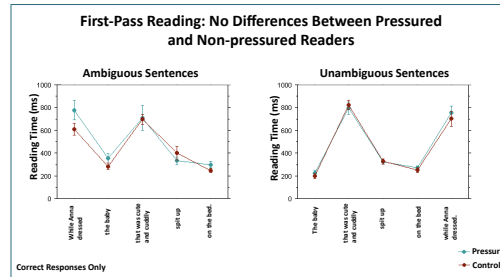
Methods



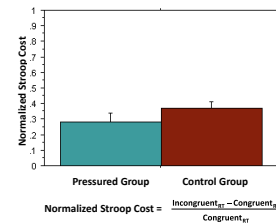
Results

N = 21 (11 Control; 10 Pressured)

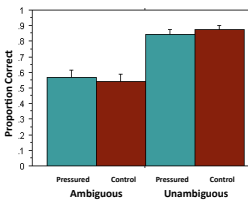
Error Bars = SEs



No Group Differences on Stroop Prior to Pressure Manipulation



No Effect of Pressure on Off-line Comprehension Measure



Summary & Conclusions

- Individuals under pressure (as compared to controls) show increased processing difficulty while reading temporarily ambiguous sentences.
- Notably, this difficulty is confined to sentence regions where the input conflicts with one's developing interpretation, triggering controlled revision processes.
- Stroop performance suggests that these findings are not due to baseline cognitive control differences between the groups.
- The current manipulation revealed only online effects of pressure during syntactic ambiguity resolution. Future studies should focus on offline lingering garden path effects, perhaps by using a moving window paradigm.
- These findings extend research integrating motivation and cognitive control: Real-time sentence processing is influenced by pressure under selective conditions, namely when control must be initiated to recover from misinterpretation.
- Future work will involve better measures of motivation, state/trait verification, individual difference components, as well as studies of spoken comprehension and lexical access.

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PARSING UNDER ADVERSE CONDITIONS: THE ROLE OF PERFORMANCE PRESSURE IN COGNITIVE CONTROL AND SYNTACTIC AMBIGUITY RESOLUTION

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Research on individual differences in sentence processing traditionally concentrates on how general cognitive traits, like working memory ability, contribute to syntactic ambiguity resolution. Recent research highlights the importance of cognitive control—primarily general conflict resolution abilities—when readers/listeners commit to an interpretation, but must override that interpretation when late-arriving input conflicts with it [1]. This view is inspired by evidence that children and patients with circumscribed Broca's area damage have trouble revising parsing commitments [2,3]. Both populations also fail to resolve incompatible representations during non-parsing cognitive control tasks like Stroop [3,4,5]. Here, we examine whether introducing extra demands on healthy adults' cognitive control, by inducing performance pressure, influences syntactic ambiguity resolution during reading. This is motivated by prior findings showing that pressure impairs individuals' cognitive abilities, particularly on difficult processing tasks [6]. We therefore hypothesize that variation should emerge between "pressured" and "non-pressured" readers in sentence regions where new evidence conflicts with one's developing analysis (the disambiguating region), necessitating cognitive control to implement recovery processes. Consistent with this, we show increased processing difficulty related to garden-path recovery for pressured participants across two real-time measures.

Twenty-one healthy adults completed a non-syntactic cognitive control task (Stroop) followed by a syntactic ambiguity resolution task. Participants were divided into two conditions: performance pressure (N=10; administered after Stroop) versus controls (N=11). We induced pressure by instructing participants that the present tasks were designed to measure intelligence. Controls received no instruction. We recorded eye-movements during the reading task, which manipulated ambiguity using reflexive/transitive materials (see Examples; [7]). In (A), spit up conflicts with one's developing transitive interpretation (Anna dressed the baby). Readers must then recover the alternative reflexive analysis (Anna dressed herself); such revision is hypothesized to involve cognitive control [1]. No such conflict is present in unambiguous forms (B). No group-differences emerged in pre-pressure Stroop performance, suggesting participants were well matched on verbal cognitive control ability prior to the pressure manipulation. Differences between pressured and control participants on ambiguous sentences emerged in second-pass reading times: 'pressured' participants spent significantly more time than 'non-pressured' participants re-reading the disambiguating region (spit up) ($p < .05$). Additionally, pressured participants were marginally more likely to regress into the disambiguating region ($p < .10$). Importantly, no group-differences emerged elsewhere. Moreover, no group-differences emerged for unambiguous sentences in any region. Thus, anxious participants behaved differently from others but only in terms of greater trouble recovering from incompatible analyses. These results extend research integrating cognitive control and parsing: real-time sentence processing is adversely affected under increased cognitive control demands, particularly when control is initiated to recover from misinterpretation. This function is mediated by performance pressure, which can burden verbal cognitive control processes [8].

A. While Anna dressed the baby that was cute and cuddly spit up on the bed. (Ambiguous).

B. The baby that was cute and cuddly spit up on the bed while Anna dressed. (Unambiguous).

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