The Role of Working Memory in Scalar Implicature Computation in ADHD and Non-ADHD Individuals

This study investigates the real-time processing of scalar implicatures in people with or without ADHD. A scalar implicature arises when the logical meaning of a sentence departs from its pragmatically enriched reading. The most well-known example of scalar implicatures are observed in sentences with under-informative quantifiers. For example, the scalar term 'some', can mean "some, and possibly all", but speakers typically compute an implicature and interpret it to mean "some, but not all". Studies have demonstrated that accessing the latter, pragmatically enriched interpretation, requires more cognitive effort as it relies on greater use of working memory resources (De Neys & Schaeken, 2007; Dieussaert, Verkerk and Gillard, Schaeken, 2011; Marty, Chemla, Spector, 2013; Antoniou, Cummins and Katsos, 2016; Cho, 2020). We also know that working memory deficits are a clinical characteristic of ADHD, and individuals with ADHD struggle more under cognitive load than neurotypical individuals (Kofler, Rapport, Bolden, Sarver and Raiker 2010; Kim, Liu, Glizer, Tannock and Woltering 2014).

Taking these findings into account, in this present study, we wanted to investigate how working memory load impacts scalar implicature computation in a sentence verification task, for both non-ADHD individuals and individuals with ADHD. We hypothesised that if working memory plays a role in scalar implicature computation, and if adults with ADHD have more a limited working memory capacity compared to neurotypical adults, then the working memory load should affect their performance more than neurotypical adults' performance. Our aims were to: 1. Replicate the finding that working memory limitations impair scalar implicature derivation, and 2. Find out whether adults with ADHD differ in scalar implicature computation compared to neurotypical adults. We collected data from 81 participants (41 ADHD, 40 non-ADHD) from the Prolific platform to complete our study. Participants completed an ADHD trait scale, in addition to a dual Truth Value Judgement and Memory Load Task to measure scalar implicature computation. This study was a direct replication of the original De Neys & Schaeken (2007) study, but with the addition of an ADHD group. For examples of sentences and to see the structure of a single trial *refer to Figures 1 and 2*, respectively.

We observed no effects of memory load ($\beta = 0.621$, $SE = 0.322$, $z = 1.93$, $p > 0.05$) or diagnostic status ($\beta = -0.872$, $SE = 0.915$, $z = -0.953$, $p > 0.05$) on the acceptance of under-informative statements. However, we did observe a significant interaction between ADHD status and memory load ($\beta = 1.27$, $SE = 0.431$, $z = 2.94$, $p < 0.01$), such that the non-ADHD participants were more likely to accept these sentences as true under high memory load, compared to the ADHD participants who had a baseline tendency to accept these sentences as true irrespective of memory load condition *(see Figure 3).* These findings suggest that individuals with and without ADHD might differ in their computation of scalar implicatures. This aligns with what we predicted based on the previous findings that people with ADHD have a lower working memory capacity and therefore might be less likely to generate scalar implicatures due to insufficient working memory resources.

To our knowledge, this study was the first to test scalar implicature computation in this population. This not only enhances our understanding of the role of working memory in scalar implicature computation and how diverse cognitive abilities affect scalar implicature computation, it also allows us to understand how individuals with ADHD process language in real-time and how executive dysfunction, specifically working memory deficits, might impact pragmatic language comprehension more generally.

Target Utterance	*Utterance Status*	*Expected Response*
Some trout are fish	***True but under-informative***	***True or False***
Some birds are magpies	*True and informative*	*True*
Some pigeons are insects	*False*	*False*

Figure 1. Example Sentences from Truth Value Judgement Task: True but under-informative, True and False

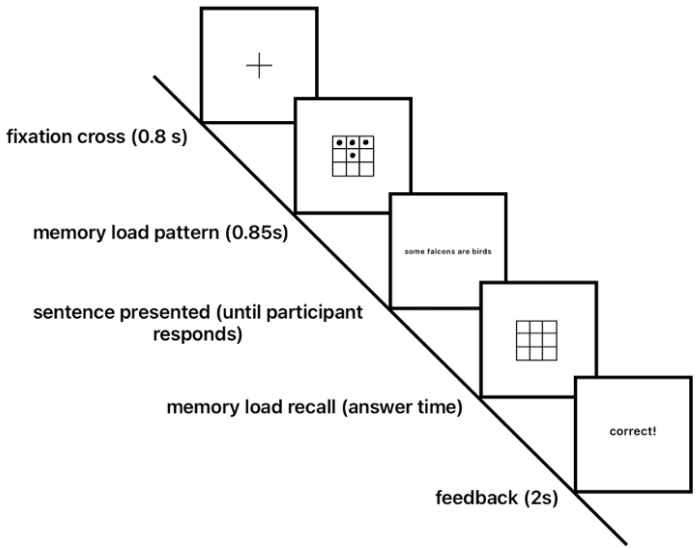

Figure 2. Structure of a Single Trial (High Load)

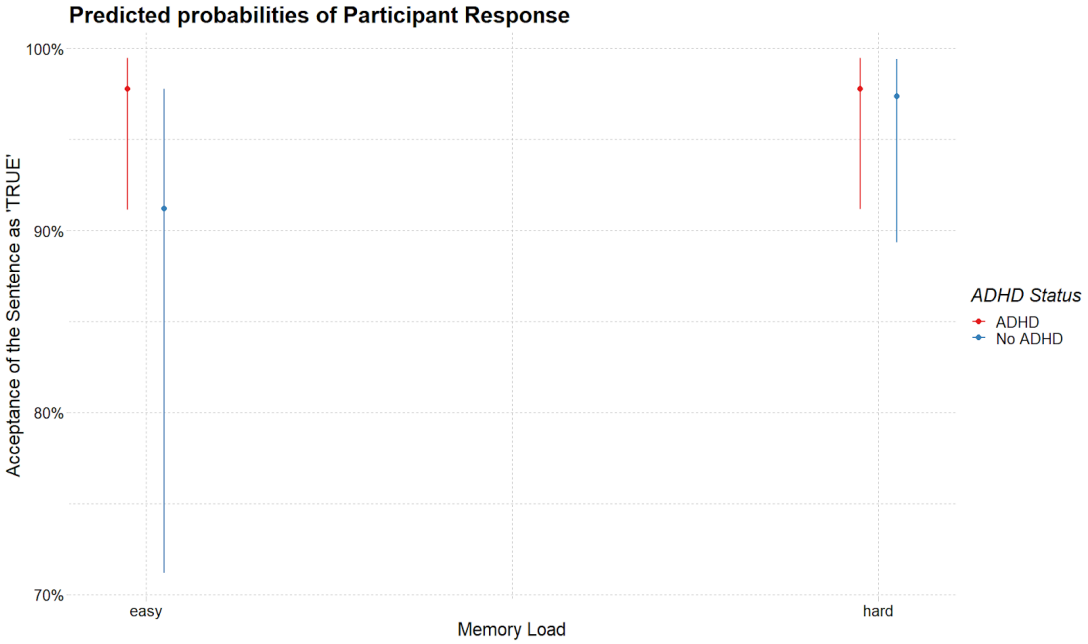

Figure 3. Plot showing the interaction between Memory Load Condition and Diagnostic Status on Participants Acceptance of Under-Informative Statements.