Diagnosis of Asperger Syndrome in Socially High-Functioning Individuals Based on Cognitive Load

Alexandra Dyalee

Faculty of Mathematics, Physics and Informatics CU BA
Mlynská dolina 842 48 Bratislava
alexandra.dyalee@mensa.sk

Abstract

This paper introduces a novel cognitive assessment tool aimed at improving the identification of individuals with Asperger syndrome, particularly those whose traits are not overtly visible through conventional communication channels but are present at a meta-level of information processing. The test expands on the structure of the Reading the Mind in the Eyes Test (RMET) by incorporating cognitive load measurements to distinguish between implicit and explicit social cognition strategies. The development rationale, test design, and hypotheses are outlined, and preliminary proof-of-concept results from a small sample ($n = 5$) are presented. Initial findings suggest the potential effectiveness of the method for detecting socially high-functioning forms of Asperger syndrome.

1 Introduction

Socially high-functioning Asperger Syndrome (SHF AS) is an interesting cognitive phenomenon, portraying to us that AS is not tied merely to the social cluster of symptoms but rather represents a system-wide difference in thinking style that includes explicit instead of implicit social cognition. Positive aspects of being on this side of the spectrum can include an enhanced view into social phenomena due to conscious social thinking (Callenmark et al., 2014), which may imply a strong moral sense or mental maturity at a young age. However, as these individuals tend to be naturally socially intelligent, they often adapt masking behavior for their diverse thinking style and are therefore easily misdiagnosed and possibly mistreated (Cook et al., 2021). Also, burnout is common due to the combination of low social motivation and larger brain activation during the execution of social behavior (Higgins et al., 2021).

2 2-Phased RMET

As a reaction to the

1) difficulty to identify socially high-functioning AS,
2) its negative consequences for the lives of oftentimes talented people, and
3) a clinical load in ADOS 4 diagnostics with
4) a lack of professionals qualified for diagnostics of AS in SHF adults,

We decided to make use of the neural substrates and consequences of the use of explicit cognition for social tasks instead of implicit cognition (Dyalee, 2024). We developed software for a 2-phased RMET testing combined with measurement of cognitive load, such that there are five measuring steps

STEP 1: measurement of the baseline cognitive load in a participant,

STEP 2: PHASE 1 of 2-phased RMET: the participant is asked to fill RMET with a time limitation of 5 seconds,

STEP 3: measurement of cognitive load after PHASE 1 of 2-phased RMET,

STEP 4: PHASE 2 of 2-phased RMET: the participant is asked to fill RMET without a time limitation,

STEP 5: measurement of cognitive load after PHASE 2 of 2-phased RMET.

The method for the measurement of cognitive load used was reaction time. The intent of the particular structure of testing was inducing cognitive load in a participant with SHF AS by forcing them to use implicit cognition in a social task (STEP 2) and letting them use explicit cognition in consequence (STEP 4), combined with comparing performances in respective phases of the test.

3 Hypotheses

We expected the empirical data to be following according to the theoretical framework of the outlined test:

Hypothesis 1 *We expect the score in PHASE 1 to be*

lower in participants with AS compared to controls. This is due to the fact that participants with AS are expected to require more time to answer respective questions.

Hypothesis 2 *We expect the score of participants with SHF AS to be high in PHASE 2. This is due to their expected ability to successfully use explicit cognition in tasks where controls use intuitive thinking.*

Hypothesis 3 *We expect no significant changes in cognitive load in controls after the respective phases of the testing. This is due to the fact that intuitive thinking should not require significant mental effort.*

Hypothesis 4 *We expect the cognitive load of people with AS to be increasing after being tested. This is due to the fact that the use of explicit cognition does require significant mental effort.*

4 Proof-of-concept testing

We did the first testing on five people, of whom two participants (SČ and OS) had clinically diagnosed AS and exhibited SHF profile, one was self-diagnosed with AS (PM) and exhibited SHF profile, and two (TK and TJ) were without a diagnosis of SHF AS. Scores in participants with an AS diagnosis matched the expectation that their performance in PHASE 2 will be significantly better than that of PHASE 1.

For evaluation of the scores N, we used a sigmoid

$$performance(N) = \frac{1}{1 + e^{(24-N)}}$$

(Fig.), satisfying $performance(28) \approx 1$, $performance(24) \approx 0,5$ and $performance(20) \approx 0$, with respect to results published in paper by Callenmark et al. (2014).

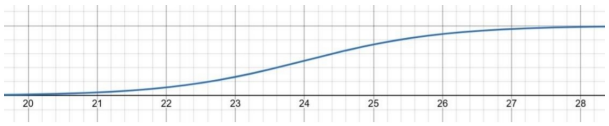

Fig. 1: function $perf(N)$

Important for our test was the difference between performances in respective phases, so we calculated percentage-based ratio of the difference between performances in PHASE 2 (N_2) and PHASE 1 (N_1) as

$$diff(N_2, N_1) = \frac{e^{24}(e^{N_2} - e^{N_1})}{e^{24}(e^{N_2} + e^{N_1}) + e^{N_1+N_2} + e^{48}}.$$

In participants with SHF AS, the differences (percent) amounted to $diff(30, 23) = 72,529\%$ (OS), $diff(27, 5) = 95,257\%$ (SČ) and $diff(29, 15) = 99,319\%$ (PM). In participants without SHF AS, differences were equal to $diff(16, 15) = 0,0012\%$ (TJ), suggesting AS without the SHF profile, and $diff(23, 20) = 25,023\%$ (TK), suggesting neurotypical to slightly neurodivergent profile.

Differences in average reaction times $\Delta L = RT_2 - RT_1$ did match our expectations as well, satisfying that participants with SHF AS showed sharper increase in cognitive load with respective phases of the testing. In particular, in participants with SHF AS, differences were $\Delta L = 50\ ms$ (OS), $\Delta L = 11.14\ ms$ (SČ) and $\Delta L = 10.4\ ms$ (PM). In participants without SHF AS, differences were $\Delta L = -7.69\ ms$ (TJ) and $\Delta L = 3.85\ ms$ (TK). Below we include a correlation graph of values ΔL and $diff$ for respective participants, illustrating the region we propose to further search for, above an illustrative $bifurcation$ function.

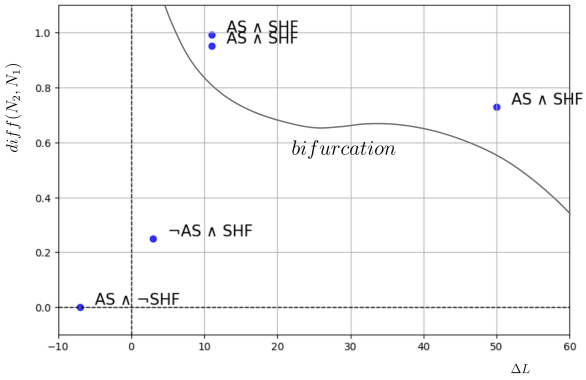

Fig. 2: $bifurcation$ outline

5 Conclusions

The results of the empirical tests were in line with expectations, providing preliminary support for the idea that the proposed test structure for distinguishing between individuals with and without socially high-functioning Asperger's syndrome is reasonable. To validate this concept, we tested five individuals to assess whether these expectations would be confirmed. A limitation of the current version was the use of the manual ruler-drop task as a proxy for cognitive load measurement, as there is a rather high error rate combined with possible background noise affecting the results. A further recommendation is that reaction time be measured by software if validated as a reliable measure in larger samples.

The aim of the proposed test is to differentiate between softer forms of social neurodiversity, not necessarily satisfying the category of being a disorder, or a socially high-functioning phenomenon of Asperger syndrome, which is often present in late-diagnosed females. This may be valuable for individuals who do not meet formal diagnostic criteria but experience consistent cognitive or social divergence, as is often present in pro-

fessional communities. Also, this approach is beneficial for a deeper conceptual understanding of the autism spectrum and its various cognitive expressions as naturally embedded in human brain function.

From a technical standpoint, the aim of the proposed test is to provide an answer to a binary diagnostic question as to whether a participant is (likely) to have SHF AS/social neurodiversity or not (unlikely). It is further recommended that this be evaluated by correctly deciding on a bifurcation threshold based on the correlation between the ratio of the respective performance differences and the corresponding differences in average reaction times.

References

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