Arithmetic deficits in Parkinson's Disease? A registered report

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https://osf.io/j8phr/?view_only=9ddf45dcfdd846f3998cfb0d842dcf16 version Manuscript_Loenneker_reg_rep_acalculia_PD_revision3
Submitted by Hannah Dorothea Loenneker 29 Jun 2021 19:23

Abstract

Elderly people and patients with neurodegenerative diseases such as Parkinson's Disease (PD) immensely rely on arithmetic skills to lead an independent life. Activities such as medication management, financial transactions or using public transport require intact abilities to manipulate numbers with different arithmetic operations. However, research on cognitive deficits in PD has been focussing on domain-general functions such as executive functions, attention or working memory so far – largely neglecting potential domain-specific aspects of numerical cognition (e.g., carry or problem size effect). These aspects should be addressed, as PD-immanent deterioration of domain-specific numerical areas and domain-general functions suggests mechanisms of both primary and secondary (mediated by other cognitive deficits) arithmetic deficits, respectively. The current study will systematically investigate arithmetic performance and effects in PD patients differing in cognitive impairment for the first time, targeting domain-specific cognitive representations of arithmetic as well as the influence of domain-general factors. Besides healthy controls (HC), PD patients with normal cognition (PD-NC) and PD patients with mild cognitive impairment (PD-MCI) will be compared in arithmetic performance in the four basic operations (addition, subtraction, multiplication, division). Discriminant analysis will be employed to assess whether performance in arithmetic tasks can differentiate between a healthy control group and both PD groups. The study results will help us to understand the underlying mechanisms of arithmetic deficits faced by PD patients in daily life.

Keywords: Parkinson's disease, mild cognitive impairment, arithmetic operation, calculation, place × value system

Round #4

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by Zoltan Dienes, 21 Jan 2022 12:01
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Revision for "Arithmetic deficits in Parkinson's Disease? A registered report"

Dear Hannah

The Tattan-Birch calculator assumes the same units for both mean and SE for the likelihood AND for the parameters of the model of H1. That is, you can model H1 with a Cauchy centered on 0 as you do, but the scale factor should be in units of the mean difference. (On that point always state your units, e.g. "Mdifference = -5.3": 5.3 what? %, ms, etc.) Thus, a rule of thumb is that if the best estimate from past studies is about 5 (of whatever units, e.g. %), then use 5% as the scale factor. Note this is different from e.g. JASP (in most cases) or the Rouder online calculator which can only use Cohen's d (or dz) units for the scale factor. You could use the JASP/Rouder/Morey calculator with Cohen d units and hence use a scale factor of 1; or use the Tattan-Birch(/McLatchie/Colling/Dienes) with scale factor 5. This will change the interpretation of your Table indicating the robustness of the results, and whuich values you will likely want to put in the table.

best

Zoltan

Dear Zoltan,

We are very sorry for yet another misunderstanding of the robustness check on our side, we feel a little bit ashamed.

The mean difference in Zamarian et al. (2006) stems from the absolute sum scores per group (HC vs. PD-NC). As we use a different scale for our arithmetic tasks, this absolute mean difference is not a meaningful estimate for our scale factors. Therefore, we now transformed the results from the study by Zamarian et al. (2006) into standardized values (following formulae introduced by Hedges & Olkin, 1985):

Original results:

PD-NC (M = 10.2, SD = 4.3, n = 15) vs. HC (M = 15.5, SD = 4.6, n = 28), $t(41)$= -3.70, $p < .001$

Standardized mean difference (Cohen’s d) = 1.18

Standard error of Cohen’s d = 0.34

Based on these results, we conducted the robustness check using JASP with the following parameters:

Sample results
Likelihood distribution = non-central d
Mean difference = 1.18 in Cohen’s d units
Observations = 43

Hypothesis under test
Model of hypothesis = Cauchy
Mode of distribution of hypothesis = 0
Hypothesised mean difference = 1
One-tailed test

This results in the following table:

Table 3. Robustness considerations of scale factors (in d units) for Bayesian analysis.

Model for alternative hypothesis		
Location	Scale	BF_{10}
0	1	19,370,000
0	0.1	3,530,000
0	0.01	356,145.75
0	0.001	35618.52
0	0.0001	3561.87

Now that we will define our prior based on Cohen's d, we will have to transform our data into this standardized measure, so we added another sentence in the analysis section as well that after transforming raw data to match a normal distribution (as already explained in the pre-processing section) we will further transform it into the scale of the prior.

We hope that this is finally correct and we do not need to bother you with more methodological misunderstandings. Thanks a lot for all your statistical counseling and your patience with all our misunderstandings!