Reviewer's report

Title: A Gaze-independent Audiovisual Brain-Computer Interface for Detecting Awareness of Patients with Disorders of Consciousness

Version: 0 Date: 12 Nov 2017

Reviewer: Theresa L Pape

Reviewer's report:

Overall manuscript: The topic is very important and timely, but there are several methodological details that are unclear or not specified. These details are important for interpreting the findings. Thus, confidence in reported findings cannot be examined without clarification of methods. Please see specific issues under methods section.

Introduction

The introduction section is relatively clear and well written and I have only a few questions/issues needing clarification, as follows:

Instructions provided to the patient and healthy control subject. The instructions in the text/narrative (page 8 lines 50 - 52) differ from the instructions provided in Figure 1. Page 9 lines 1 - 6 also specify different instructions. Since there are different instructions for each experiment, make the instructions clear and consistent. Also, presumably the instructions provided in the figure, were provided in the patient's native language. When translating that to English, the word "congruent" for patients in VS/MCS will require a very high level of semantic processing. Clarify what the instructions were that were provided to patients and healthy control subjects.

Page 9 line 9: Clarify please. This is a passive paradigm, so the patient / health control were not responding in anyway to determine accuracy. Thus, was it determined correct if the algorithm recognized the pair as congruent?
Line 16 page 4: provide a clearer example than "characters in a speller". As written the reader doesn't understand what this means. Either set up the example so the reader does know what this is or elaborate on this example to make it clearer to the reader. As is, the example does not illustrate or clarify the point being made.

The BCI figure (Figure 1) should be referenced in the Introduction. This will help the reader follow the methods and results sections. It is not referenced until the methods section, but to improve readability it should be referenced in the introduction section.

Line 29 page 6: There appears to be a cut and paste error in this sentence. If it is not a cut and paste error, then it should be clarified.

Lien 2 page 6: "free of centrally …" clarify if you titrated them off of these sedating medications and for how long? Provide answers to this question: How do you know they were free of these medications? For example, specify the medication, the half-life of the medications and titration schedule.

Methods

This section is missing several important details and/or reported details need clarifications. These issues are as follows:

Study Sample Recruitment for Patients: A paragraph is needed to describe study eligibility criteria and recruitment strategies. Were there any exclusion criteria regarding cause of severe brain injury (i.e., traumatic only, non-traumatic allowed)? What was the time post brain injury allowed? Table 1 clearly indicates mixed etiology and this should be stated up front. This same table suggests that there was no exclusion on time after brain injury. Again this should be stated in a recruitment methods paragraph. Was it a convenience sample?

Similarly, who were the healthy controls? Were they age and gender matched to the patients? How did you recruit them? What was their level of familiarity with the task? They were trained on it, but were they never exposed to the task previous to the training?
Who administered the CRS-R to make the diagnoses? Were the evaluations only completed one time to make the diagnoses? Were they evaluated while on sedating medications? Provide more details on diagnostic procedures relative to within patient variability.

Lines 19 - 23 page 7: The hierarchy of test items for the CRS has been examined with a partial credit model, but the hierarchy has never been examined by accounting for rater severity/leniency which is distinctly different than reliability. The A. Tenant article on the CRS-R publishes a partial credit model behavioral hierarchy. While this is an important first step, there is a great deal that we do not know about the behavioral recovery hierarchy. Thus, the sentence in these lines is misleading and should be revised to more accurately reflect the point the authors are trying to make.

Line 33: The word "attended" is unclear. DO you mean "participated in"?

EEG Data Acquisition: was time locking used? This is stated later during motion artifact, but should be specified also under data acquisition. Also, specify How blink and motion artifact measured/detected? It is stated that 32 electrodes were used, but did you also place electrodes vertically and horizontally at each eye? Then analytically how did you identify and eliminate the blink and motion artifact from other artifact (e.g., white noise)?

Analyses: Since mean ERPs were examined using way repeated measures ANOVA, how was missing data handled? ANOVA skips cases when there is missing data and for patients it is not likely that a ERP was elicited with each congruent and non-congruent task. Thus, how was missing data handled?

Page 11 line 50: There is a "." when a ":" is indicated

Page 11 line 54; it is still unclear how a "hit" was detected.

Results

Table 1: Time since onset in table 1 - does that mean time after brain injury? Clarify this by clarifying the column heading.
While the findings are intuitive and logical (i.e., audiovisual produces clearer / higher amplitude ERPs), the missing methodological details makes it impossible to determine if these findings are under or over estimates.

**Are the methods appropriate and well described?**
If not, please specify what is required in your comments to the authors.
Unable to assess

**Does the work include the necessary controls?**
If not, please specify which controls are required in your comments to the authors.
Unable to assess

**Are the conclusions drawn adequately supported by the data shown?**
If not, please explain in your comments to the authors.
Unable to assess

**Are you able to assess any statistics in the manuscript or would you recommend an additional statistical review?**
If an additional statistical review is recommended, please specify what aspects require further assessment in your comments to the editors.
I am able to assess the statistics

**Quality of written English**
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Acceptable

**Declaration of competing interests**

Please complete a declaration of competing interests, considering the following questions:

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If you can answer no to all of the above, write 'I declare that I have no competing interests' below. If your reply is yes to any, please give details below.

I am currently examining a protocol using Brain Stem AEP, MMN and P600 as a possible outcome for a clinical trial. It is a project that I have added on to my ongoing clinical trial with severe TBI. I have not published any of my data as I am still collecting it. I do not think that this provides a conflict, but to be transparent I mention it here.

I agree to the open peer review policy of the journal.