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Stimulus processing and error monitoring in more-able kindergarteners with Autism Spectrum Disorder (ASD): A short review and a preliminary ERP study

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Editor: Sophie Molholm

1st Editorial Decision 24 January 2017

Dear Dr. Kim,

We have now received two reviews of your paper. Both see the merit of the work, and the quality of the writing is noted. There are major concerns however regarding the small sample size. The reviewers offer ways to address this concern, as well as asking for additional information on why the study sample is so small. The suggestion to write a review of executive functions in ASD children, with the ERP study included as preliminary data, seemed a particularly good way to address the issue of sample size. Reviewer 2 also suggests performing non-parametric tests to deal with the small sample size and the number of tests performed. Additional methodological issues are raised that need to be addressed. For example the choice of neurocognitive measures needs more detailed justification. In addition, the title and the abstract need to be modified to reflect the preliminary nature of the study, and larger better resolution figures are needed.

Obviously, a resubmission of your manuscript could only be considered on the basis of extensive revisions, requiring the description of new evidence and/or additional analyses of your data. When you prepare your re-submission, please consult the Author's Checklist provided at the bottom on this email, notably with regard to characterization of reagents and reporting of statistical analyzes in the Results section and Figure legends.

Thank you for submitting your work to EJN.

Kind regards,

John Foxe & Paul Bolam
co-Editors in Chief, EJN

Reviews:

Reviewer: 1 (Kristen Morie, Yale University)

Comments to the Author
The paper “Stimulus processing and error monitoring in more-able kindergarteners with Autism Spectrum Disorder (ASD): An ERP study” is an interesting exploration of the ERP correlates of cognitive control and

executive function capabilities in ASD kindergartners and healthy controls. The authors found that ASD youth demonstrated larger ERN/Pe amplitudes and smaller P3 amplitudes compared to controls. In addition, scores on executive function tests were associated positively with amplitude of the P3 and negatively with the CRN, and autism symptoms were correlated positively with the PE and negatively with the N2. The study is well-done and the methods are sound, though more detail could be added to the discussion. However, the major weakness of the paper is the extremely low sample size.

Major comments: While the authors acknowledge this in their limitations section, only having 9 ASD individuals is a major weakness. While effect sizes for the group comparisons seem large, I am not convinced that the correlations found are legitimate, especially as the authors mention that some analyses did not survive multiple comparisons. Including scatter plots of the correlations would be helpful, as without them it is difficult to determine if these correlations are real or being driven by one or two individuals.

The authors mention not having access to ADOS scores. This should be reiterated in the limitations. Was there a way to tell the general capability of the ASD individuals? The authors mention they are “more able,” but how was this determined exactly? Was the diagnosis based upon the SCID-IV or SCID-V?

Minor comments:

The authors should consider reporting waveform means in the text as well as in the table.

The authors mention calculating difference waves, but these difference waves don’t appear to be used in any of the analyses.

More detail could be added to the discussion, further grounding the findings in previous literature.

Final thoughts: The work is intriguing and deserves report, but the small sample size severely limits the impact. I would suggest that the authors reframe the report, either as a brief report or perhaps as a review of executive functions in ASD children with the ERP study included as preliminary data.

Reviewer: 2 (Peter Mundy, University of California at Davis)

Comments to the Author
This paper provides a very well written report of a study that demonstrates that it is possible to examine ERP indexes of error monitoring and stimulus information processing in “more-able” five-year-old children. Moreover, the data provided on ERN are consistent with previous findings that some children with ASD may be characterized by higher amplitude ERN in conjunction with repaid cortical self-monitoring of errors on a behavioral task. The data also suggest that individual some ERP components may be related to individual differences in behavioral measures of executive functions, academic development and symptom presentation in young children with ASD. These data certainly have the potential to make a significant contribution to the literature. Nevertheless, aspects of the methods, data analyses and presentation of the goals of the study were less than clear, and raised significant issues to be considered further by the authors.

1) The sample selection and description was not clear. Did the authors only recruit 9 children with ASD for the study, if so why? Or was it the case that more children were recruited but only some children were able to complete the Go/no-go task. If the latter that would require clear discussion and if possible data on the characteristics of the children not included in the study. Alternatively, Heterogeneity of presentation ASD is well understood to challenge the replication and interpretation of research from small sample studies of ASD. So if it’s the former the authors would need to address the issue of why they only recruited 9 participants with ASD.

2) The goals of the study were not completely clear, at least to this reader. The discussion contains a moderate lengthy section that asserts that this study provided proof of principle of the valid use of a child friendly Go\no-go task in ERP studies of young children with ASD. Was that major goal of the study? If so that might explain why such a small sample was recruited. However, that goal was not emphasized in the introduction.

3) After stating that, "ERP patterns may be mediated by … cognitive levels (average vs. below average IQ) in their introduction (p. 7) it was surprising to find that the authors did not include an IQ (or any general cognitive index) in the sample description assessment in this study. Rather they described the Diagnostic Groups as comparable on the Applied Problems subtest, but not the Letter Word Identification test of Woodcock-Johnson achievement text (p. 9). No explanation of why they provide data on these measures but no data on an IQ measure was provided (or language development). Word level reading may be elevated versus other aspects of language and cognitive development in some children with ASD. I've never seen this type of "matching on achievement" method before, so I don't understand its merits. Why were these specific measures chosen from all those available on the WCJ? I think these need to be explained. The lack of IQ data may make it very difficult for anyone to compare future samples (and results) in related research to this one. I'm also not sure if the achievement data is the basis for describing the sample as "more-able kindergarteners with ASD" in the title of paper or whether that designation comes from the school program that was the source or recruitment. At any rate, this description appears to lack the typical degree of precision wanted in sample descriptions.

4) I may misunderstand the measure but it was not clear to me why the % error trials and % correct trials in the data for the Zoo Task in Table 1 summed to 118% in the ASD sample and 103% in the TD sample.

5) Why are EF data only presented for the ASD sample? (e.g. Table 3)

6) Eighty-four 84 correlations are presented in Table 4 from data on the 9 children in the ASD sample. Nine of the correlations were significant (alpha .05). However, that alpha accepts 4 'significant' correlations as chance observations. In addition, because of the very small sample size, nonlinear distributions characterized by one or two extreme outliers accounting for the parametric correlation coefficients reported in that table. A useful control for these issues might be to report non-parametric (distribution free) correlations and only report observations where both the parametric and non-parametric correlations are significant.

Minor Issue

It could be useful to report some data on the reliability and validity of the EF measures used in this study. Given the limits of this study I wonder if the paper would be better served with a more concise and goal oriented introduction and circumspect discussion.

Authors' Response 24 February 2017

Dear. Drs. Foxe & Bolam,

Thank you for the opportunity to revise our manuscript, EJN-2016-12-24243(ASD), Stimulus processing and error monitoring in more-able kindergarteners with Autism Spectrum Disorder (ASD): A short review and a preliminary ERP study. All change are tracked in the manuscript using bold typeface and blue text to facilitate the reviewers' subsequent reviews.

We appreciate the thoughtful comments provided in the reviewers, and we feel that this revised version of the manuscript has greatly benefited from the suggestions made. First, as you requested, we now present the paper as a short review with preliminary data based on a highly focused sample of children with a narrow range of age (4-5 years) and cognitive skills (those without any reported cognitive delays by parents and teachers as well as based on standardized testing – Stanford Binet Intelligence Scale). The title, abstract, and text were all modified to reflect the preliminary nature of the study. Given that there are rapid developmental changes occurring between the ages of 4 and 7 years in skills related to executive functions and related

ERP patterns (e.g., Grammer et al., 2014), it was important for us to focus our investigation to a narrow age group. Furthermore, the ERP correlates of executive functions for children with ASD at this age have never been explored in previous studies. Even based on a small sample size, we were pleased to be able to detect significant patterns of differences between the ASD and matched typical controls in ERP patterns as well as moderate associations between the ERP patters and other behavior profiles in ASD. Therefore, we wanted to present the data given the growing interest in the field in examining early biomarkers of ASD and their associations with various behavioral and clinical features.

We have also incorporated all suggestions including the nonparametric correlation analyses given a small sample size (per Reviewer 1's suggestion) and present the data based on scatter plots (per Reviewer 2's suggestion) only for the correlations significant based on both nonparametric and parametric analyses. With these new analyses and the inclusion of additional representations of the data, we now feel even more confident about our findings, and hope that our results will be clearer to the readers as well.

In addition, we agree with the reviewers that our sample descriptions and rationales for the selection of the measures should have been more clearly outlined. Thus, we have made changes to the text to increase clarity for each of these important components of the work. For example, we now include a more extensive discussion on the justification of the measures to describe the samples. Furthermore, we clarified that given that our goal was to examine the differences in the ERP patterns between the ASD and TD groups in the areas of stimulus control and response monitoring, we aimed to match children based on the variables that are most likely to directly affect these cognitive domains: age, gender and error rates on Go/No-go task. More importantly, we emphasized that all children with ASD in our sample were considered "more-able" based on two factors: 1) Children were recruited from integrated, general education classrooms; 2) Parents and teachers did not report current delays with language and cognitive skills and the children had average to above average scores on the Stanford Binet Intelligent Scale (with full-scale IQ scores of at least 85). Because the original goal of the study was to examine the ERP correlates of executive functions in a focused sample of children with ASD recruited from a general education classroom whose academic achievement levels were comparable to TD peers, our battery of assessments for this preliminary study included achievement testing, computerized tasks of executive functions and parent questionnaires of autism symptom severity, in conjunction with the ERP task.

We have also made minor editorial changes for clarify.

Finally, larger figures with better resolution are provided now.

We hope that our changes have sufficiently addressed the reviewers' concerns. We look forward to any further feedback you may have with regard to this manuscript.

Best Wishes,

Sophy

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Response to reviewers' comments

Reviewer: 1

1. The paper “Stimulus processing and error monitoring in more-able kindergarteners with Autism Spectrum Disorder (ASD): An ERP study” is an interesting exploration of the ERP correlates of cognitive control and executive function capabilities in ASD kindergartners and healthy controls. The authors found that ASD youth demonstrated larger ERN/Pe amplitudes and smaller P3 amplitudes compared to controls. In addition, scores on executive function tests were associated positively with amplitude of the P3 and negatively with the CRN, and autism symptoms were correlated positively with the PE and negatively with the N2. The study is well-done and the methods are sound, though more detail could be added to the discussion. However, the major weakness of the paper is the extremely low sample size.

Our study was focused on a selected sample of children with ASD who were more-able (defined as the children who were integrated into a general education classroom, without current language and cognitive delays reported by the parents and teachers and based on the standardized testing [e.g., Stanford Binet Intelligence Scale]) recruited from Kindergarten classrooms. Thus, the participants all were within a restricted age range (5-6 years). Our goal of focusing on this particular period in development is due to evidence for the rapid developmental changes occurring between the age of 4 and 7 years in skills related to executive functions and related ERP patterns (e.g., Grammer et al., 2014). To begin examining these phenomena in young children with ASD, we felt it was important for us to focus our investigation to a narrow age group. We also felt that it was particularly important to focus on this age-range as the ERP correlates of executive functions in this area for children with ASD at this age have never been explored in previous studies, with prior research focusing on older children and children with a wider range of ages.

Even though the sample size in this investigation was small, we were pleased to be able to detect significant patterns of differences between the ASD and matched typical controls in ERP patterns as well as moderate associations between the ERP patterns and other behavior profiles in ASD. Therefore, we felt compelled to present the data now given the growing interest in the field in examining early biomarkers of ASD and their associations with various behavioral and clinical features. However, we do agree that the data based on the small sample size should be presented as preliminary, and this is now emphasized in the title as well as throughout the text.

2. Major comments: While the authors acknowledge this in their limitations section, only having 9 ASD individuals is a major weakness. While effect sizes for the group comparisons seem large, I am not convinced that the correlations found are legitimate, especially as the authors mention that some analyses did not survive multiple comparisons. Including scatter plots of the correlations would be helpful, as without them it is difficult to determine if these correlations are real or being driven by one or two individuals.

Reviewer 2 also made a similar comment and suggested that we conduct nonparametric correlation analyses. We now present scatter plots reflecting these associations (Figure 3). We have chosen to only present the correlations that were significant for both parametric (Pearson) and non-paramedic (Spearman) correlation analyses for parsimony in Figure 3.

3. The authors mention not having access to ADOS scores. This should be reiterated in the limitations. Was there a way to tell the general capability of the ASD individuals? The authors mention they are “more able,” but how was this determined exactly? Was the diagnosis based upon the SCID-IV or SCID-V?

All children with ASD in our sample were recruited from Kindergarten classrooms and considered “more-able” based on these factors: 1) Children were integrated into a general education classroom; 2) Parents and teachers did not report current delays with language and cognitive skills and all children received at least average cognitive score on the measure of Stanford Binet Intelligence Scale. Given the strong correlation between IQ and achievement in both typically developing children(Deary, Strand, Smith, & Fernandes, 2007) and children with ASD (Mayes, Calhoun, Bixler, & Zimmerman, 2009), children with ASD in our sample showed average to above average Letter-Word Identification (word decoding) and Applied Problems (math) based on Woodcock-Johnson achievement testing. These are clarified in Page 9:

Although children were not statistically matched on achievement scores, we compared scores on the Woodcock-Johnson (Woodcock, McGrew, Mather, & Schrank, 2001) for the ASD and TD groups. Children with ASD performed significantly higher on the Letter-Word Identification test ($t(27)=2.255$, $p<0.05$), but the two groups obtained comparable scores on Applied Problems.

All of the children with ASD were from a public school integrated program (general education classrooms) for more-able children with ASD. Criteria for this program included average to above average IQ scores based on Stanford Binet Intelligence Scale (Thorndike, Hagan, & Sattler, 1986; with full-scale IQ scores of at least 85) and a community diagnosis of ASD as well as a confirmed classification on the gold-standard diagnostic measure, the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) although the scores and the protocols were not available to the research team. Parents and teachers of these children did not report any current concerns for language or cognitive delays.

We also made the changes to the limitation section:

Our preliminary data is based on a small sample size, especially for children with ASD. Therefore, given the heterogeneous behavioral presentations of the population under investigation, the results cannot be generalized into other children without further replications in larger, independent samples. Although the children were confirmed to exceed the ASD cutoff scores on the ADOS and to have average to above average scores on the Stanford Binet Intelligence Scale, we did not have an access to the protocols and scores for this study.

Minor comments:

4. The authors should consider reporting waveform means in the text as well as in the table.

Given that we already have many comparisons for the 3-way RM ANOVAs (by trials, electrodes and diagnosis), we are concerned about overwhelming the readers with too many numbers in the text. However, for the comparison of ASD vs. TD, we have included some means and SDs as examples to make those more readily available for the readers (Page 19).

5. The authors mention calculating difference waves, but these difference waves don't appear to be used in any of the analyses.

The difference waves (Δ N2, Δ P3, ΔERN, ΔPe) were included in the correlation analyses.

6. More detail could be added to the discussion, further grounding the findings in previous literature.

We made various changes to the discussion now to fit our data results based on the new correlation analyses, also connecting those with previous findings. We have also taken a more circumspect approach in the interpretation of these findings given the preliminary nature of the study.

7. Final thoughts: The work is intriguing and deserves report, but the small sample size severely limits the impact. I would suggest that the authors reframe the report, either as a brief report or perhaps as a review of executive functions in ASD children with the ERP study included as preliminary data.

As explained in the response to the comment 1 above, we do agree that the data based on the small sample size should be presented as preliminary, and this is now emphasized in the title and abstract as well as throughout the text.

Reviewer 2.

This paper provides a very well written report of a study that demonstrates that it is possible to examine

ERP indexes of error monitoring and stimulus information processing in "more-able" five-year-old children. Moreover, the data provided on ERN are consistent with previous findings that some children with ASD may be characterized by higher amplitude ERN in conjunction with repaid cortical self- monitoring of errors on a behavioral task. The data also suggest that some ERP components may be related to individual differences in behavioral measures of executive functions, academic development and symptom presentation in young children with ASD. These data certainly have the potential to make a significant contribution to the literature. Nevertheless, aspects of the methods, data analyses and presentation of the goals of the study were less than clear, and raised significant issues to be considered further by the authors.

1. The sample selection and description was not clear. Did the authors only recruit 9 children with ASD for the study, if so why? Or was it the case that more children were recruited but only some children were able to complete the Go/no-go task. If the latter that would require clear discussion and if possible data on the characteristics of the children not included in the study. Alternatively, Heterogeneity of presentation ASD is well understood to challenge the replication and interpretation of research from small sample studies of ASD. So if it's the former the authors would need to address the issue of why they only recruited 9 participants with ASD.

This preliminary study was initially prompted to examine if the newly developed and validated child friendly Go/No-go task can elicit the ERP components related to stimulus processing (N2 and P3) and response monitoring (ERN/CRN and Pe) in kindergarteners with ASD (Aim 1). All children who participated in the study were able to complete the ERP task. Once we confirmed the presence of the ERP components in our sample of children with ASD which had never been observed in previous studies, we then pursued further investigations on: differences in the ERP patterns between ASD and TD groups (Aim 2) and associations between ERP patterns and other behavioral profiles in ASD (Aim 3) based on the literature of typically developing children and older, school age children with ASD. Even based on a small sample size, we were pleased to be able to detect significant patterns of differences between the ASD and matched typical controls in ERP patterns as well as moderate associations between the ERP patterns and other behavior profiles in ASD. Therefore, we felt compelled to present the data given the growing interest in the field in examining early biomarkers of ASD and their associations with various behavioral and clinical features. However, we do agree that the data based on the small sample size should be presented as preliminary, and this is now emphasized in the title as well as throughout the text. Therefore, we now present this paper as a short review with preliminary data (e.g., Title, Abstract and Discussion):

> ***(Title) Stimulus processing and error monitoring in more-able kindergarteners with Autism Spectrum Disorder (ASD): A short review and a preliminary ERP study***
>
> ***(Abstract) In this study, we provide a focused review of EF-related Event-Related Potentials (ERP) studies in children with ASD, accompanied by preliminary data for neurophysiological correlates of EF on a child-friendly Go/No-go task.***
>
> ***(Discussion - Page 20-21) The purpose of the present study was to provide a short review focused on EF-related ERPs in children with ASD and to present initial evidence for the neurophysiological correlates of cognitive control based on a preliminary sample of 5-year-old kindergarteners with ASD and matched controls based on age, gender, and error rates using a child friendly visual Go/No-go task. To our knowledge, our preliminary study is the first investigation to identify EF-related components in children with ASD who are younger than 8-10 years and to examine the associations between ERP patterns with other behavioral and clinical domains.***

We also made it clear in the introduction that the first aim was to examine whether the ERP patterns can be elicited based on the child friendly Go/No-Go task (Page 7-8):

> ***Given the limited and inconsistent findings in previous research, we focused our efforts on three aims in this preliminary study: 1) to examine whether a recently developed and***

validated Go/No-go task (Grammer et al., 2014) can validly elicit N2, P3, ERN/CRN and Pe in kindergartens with ASD and typically developing (TD) children matched on age, gender, and task accuracy, 2) to compare the ERP patterns between the ASD and TD groups, and 3) to examine the relations between the neurocognitive correlates of cognitive control and error processing and patterns of behavioral functioning in the ASD group.

We also made some changes to the limitation section to emphasize that given the heterogeneous nature of the population, replications are necessary before we generalize the findings into other children (page 27):

Our preliminary data is based on a small sample size, especially for children with ASD. Therefore, given the heterogeneous behavioral presentations of the population under investigation, the results cannot be generalized into other children without further replications in larger, independent samples.

2. The goals of the study were not completely clear, at least to this reader. The discussion contains a moderate lengthy section that asserts that this study provided proof of principle of the valid use of a child friendly Go\no-go task in ERP studies of young children with ASD. Was that major goal of the study? If so that might explain why such a small sample was recruited. However, that goal was not emphasized in the introduction.

See the comments above. Based on our rationale, we made changes to the introduction to clarify the points (Page 7-8):

Given the limited and inconsistent findings in previous research, we focused our efforts on three aims in this preliminary study: 1) to examine whether a recently developed and validated Go/No-go task (Grammer et al., 2014) can validly elicit N2, P3, ERN/CRN and Pe in kindergartens with ASD and typically developing (TD) children matched on age, gender, and task accuracy, 2) to compare the ERP patterns between the ASD and TD groups, and 3) to examine the relations between the neurocognitive correlates of cognitive control and error processing and patterns of behavioral functioning in the ASD group.

3. After stating that, "ERP patterns may be mediated by … cognitive levels (average vs. below average IQ) in their introduction (p. 7) it was surprising to find that the authors did not include an IQ (or any general cognitive index) in the sample description assessment in this study. Rather they described the Diagnostic Groups as comparable on the Applied Problems subtest, but not the Letter Word Identification test of Woodcock-Johnson achievement text (p. 9). No explanation of why they provide data on these measures but no data on an IQ measure was provided (or language development). Word level reading may be elevated versus other aspects of language and cognitive development in some children with ASD. I've never seen this type of "matching on achievement" method before, so I don't understand its merits. Why were these specific measures chosen from all those available on the WCJ? I think these need to be explained. The lack of IQ data may make it very difficult for anyone to compare future samples (and results) in related research to this one. I'm also not sure if the achievement data is the basis for describing the sample as "more-able kindergarteners with ASD" in the title of paper or whether that designation comes from the school program that was the source or recruitment. At any rate, this description appears to lack the typical degree of precision wanted in sample descriptions.

To clarify, given that our goal was to examine the differences in the ERP patterns between the ASD and TD groups in the areas of stimulus control and response monitoring, we aimed to match children based on the variables that are most likely to directly affect these cognitive domains: age, gender and error rates on Go/No-go task (See page 8), instead of IQ scores. We used a propensity matching method to select a subset of typically developing children from a larger dataset (95 children). We had the confirmation from the recruitment site for ASD that the children had average to above average IQ scores (see comments below). However, IQ scores

were not available for both ASD and typically developing groups. The typically developing children were within the age range that matched with the ASD group initially, but we used gender and error rates on the Go/No-go task as variables to make a selection of 18 children from the TD dataset that will be matched at the 2 to 1 ratio to the 9 children with ASD. The resulting sample of 9 ASD and 18 TD children were then compared on all the other variables listed on Table 1. Although these children were not matched by the achievement test, children with ASD showed comparable or more advanced achievement scores compared to TD children. To minimize the confusion, we clarified this point in the participants section (page 9):

> ***Although children were not statistically matched on the level of achievement test, we compared the scores on the Woodcock-Johnson achievement testing (Woodcock, McGrew, Mather, & Schrank, 2001) between the ASD and TD groups.***

As mentioned above for the comments of Reviewer 1, all children with ASD in our sample were considered "more-able" based on these factors: 1) Children were recruited from integrated, general education classrooms; 2) Parents and teachers did not report current delays with language and cognitive skills and the children had average to above average scores on the Stanford Binet Intelligent Scale (with full-scale IQ scores of at least 85). The original goal of the study was to examine the ERP correlates of executive functions in a focused sample of children with ASD recruited from a general education classroom whose academic achievement levels were comparable to TD peers. Therefore, our battery of assessments for this preliminary study included achievement testing, computerized tasks of executive functions and parent questionnaires in conjunction with the ERP task. The children in our sample did not have any reported concerns of language or cognitive delays and the programs that the children were enrolled in required the children to have at least average cognitive scores based on the standardized measure, Stanford Binet Intelligence Scale. We agree with Reviewer 2 that this needs to be more clearly outlined for future studies. These are now clarified in Page 9:

> ***All of the children with ASD were from a public school integrated program (general education classrooms) for more-able children with ASD. Criteria for this program included average to above average IQ scores based on Stanford Binet Intelligence Scale (Thorndike, Hagan, & Sattler, 1986; with full-scale IQ scores of at least 85) and a community diagnosis of ASD as well as a confirmed classification on the gold-standard diagnostic measure, the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) although the scores and the protocols were not available to the research team. Parents and teachers of these children did not report any current concerns for language or cognitive delays.***

Furthermore, we acknowledge that the result cannot be generalized into other children without further replications, so we made following changes to the limitation section (Page 27):

> ***Our preliminary data is based on a small sample size, especially for children with ASD. Therefore, given the heterogeneous behavioral presentations of the population under investigation, the results cannot be generalized into other children without further replications in larger, independent samples. Although the children were confirmed to exceed the ASD cutoff scores on the ADOS and to have average to above average scores on the Stanford Binet Intelligence Scale, we did not have an access to the protocols and scores for this study.***

4. I may misunderstand the measure but it was not clear to me why the % error trials and % correct trials in the data for the Zoo Task in Table 1 summed to 118% in the ASD sample and 103% in the TD sample.

The values reflecting percent error and percent correct are calculated as a function of the number of accurate or inaccurate responses for each of the go and to no-go trials separately. In the go/no-go task it is possible to respond accurately and err via omission *or* commission.

However, we are only able to look at ERPs linked to responses of commission, and we calculate the performance on error trials of commission and accurate responses separately out of the total possible given the number of trials within the task there are for each. Thus, for example, it is possible to respond to 98% of the 240 go trials correctly, and also respond incorrectly on 22% of the 80 possible no go trials. This is now clarified on Page 10-11:

> ***The values reflecting percent error and percent correct on the ERP task were calculated as a function of the number of accurate or inaccurate responses for each of the go and no-go trials separately. Because we were only able to examine ERPs linked to responses of commission, we calculated performance on error trials of commission and accurate responses separately out of the total possible given the number of trials within the task.***

5. Why are EF data only presented for the ASD sample? (e.g. Table 3)

Because our main goal was to examine the association between ERP patterns during the Go/No-go task and other behavior features in children with ASD (because previous studies in this area have been mainly focused on investigations with TD children), the computerized EF tasks were only given to children with ASD (also mentioned on Page 12). The sample of TD children were recruited for a larger-scale study which also involved the same ERP task and a similar battery of assessments without the computerized EF tasks.

6. Eighty-four correlations are presented in Table 4 from data on the 9 children in the ASD sample. Nine of the correlations were significant (alpha .05). However, that alpha accepts 4 'significant' correlations as chance observations. In addition, because of the very small sample size, nonlinear distributions characterized by one or two extreme outliers accounting for the parametric correlation coefficients reported in that table. A useful control for these issues might be to report non-parametric (distribution free) correlations and only report observations where both the parametric and non-parametric correlations are significant.

Per Reviewer 2's suggestions, we now report the correlation results based on both parametric and non-parametric methods in the text, and emphasize that we believe the strongest associations are found between the ERP task and CRN as well as between autism symptom severity (on SCQ and CBCL) and P3 (for which both the non-parametric and parametric correlations were significant). We also made changes to the abstract so that we only highlight these associations. We have also made changes to the methods, results and discussion to mention that we conducted both Pearson and Spearman correlation analyses and that correlations that are significant for only one of the analyses require more cautious interpretations. In addition, per Reviewer 1's suggestion, we present scatter plots and emphasize the exploratory nature of the results based on the preliminary data. The changes are made to these sections:

> ***(Methods, Page 15)***
> ***The relations between behavioral performance on the task as well as other behavioral and symptom measures and ERP amplitudes were explored through both parametric (Pearson [r]) and non-parametric (Spearman [rs]) correlations. Given the small sample size, we present results based on both correlation analyses and point out the data that are significant by both analyses.***
>
> ***(Results Page 19-20) Executive functions***
> ***Both parametric and non-parametric correlations were significant for the association between higher accuracy (lower error rates) on the zoo task and larger Cz CRN ($r=.73$; $r_s=.77$) in children with ASD. The other correlations were only significant for one of the methods. Higher accuracy (a lower error rate) on the zoo task was correlated with a larger difference between error and correct trials for posterior Pe amplitudes ($r_s=.77$) and a larger difference in P3 between go and no-go trials ($r_s=-.73$). Higher accuracy rates on the computerized EF tasks were also correlated with lower posterior P3 amplitudes during go trials ($r=-.68$ for Spatial Conflict Arrows), larger N2 for the go trials ($r_s=.78$) and a larger difference between go and no-go trials for N2 ($r_s=.71$). All p's were less than***

0.05. These support our prediction that higher CRN and Pe are associated with higher performance on EF-related tasks.

(Results Page 20) Academic achievement
ERP amplitudes were not correlated with academic achievement.

(Results Page 20) Autism symptom severity
Both parametric and non-parametric correlations were significant for the association between higher symptom severity and higher P3 for no-go ($r=.73$, $r_s=.71$ for SCQ, $r=.77$, $r_s=.76$ for CBCL Pervasive problems) and go trials ($r=.82$, $r_s=.76$ for CBCL Pervasive problems). These confirm our prediction that higher P3 is associated with higher autism symptom severity. Larger differences in N2 amplitudes between go and no-go trials were also associated with lower levels of repetitive behaviors ($r=-.68$ for RBS-R), but not for the non-parametric correlation. All p's were less than 0.05.

(Discussion Page 24-25) Associations between ERP and other behavioral and clinical characteristics In ASD
As we hypothesized, larger CRN reflective of heightened response monitoring in children with ASD were associated with higher performance on a Go/No-Go task tapping into EF, specifically inhibitory control. The results also show that there may be potential associations between larger Pe and the computerized EF tasks.

(Discussion Page 25)
In contrast, ERP amplitudes that were targeted by our task were not correlated with achievement. A recent paper based on typically developing children examining associations between Pe and achievement in math and reading revealed that the links between Pe and achievement may be rather specific for children having academic difficulty because these associations were not observed in children performing above grade level (Kim et al., 2016b). This may be why we did not find any significant association between achievement and Pe in our more-able ASD group. However, because our study is preliminary, replications are needed before further inferences are made.

(Discussion Page 26)
Furthermore, our preliminary findings indicate that atypical brain activity reflected by the larger amplitudes in these EF-related ERP components may be associated with compensatory mechanisms for cognitive and other behavioral functioning. For instance, higher CRN and Pe amplitudes were associated with higher accuracy during the ERP and computerized EF tasks, suggesting that heightened response monitoring and motivational processes reflected by CRN and Pe may facilitate performance on EF-related tasks. Furthermore, children with higher autism symptom severity showed higher P3 amplitudes, which may suggest that these children need more effort to sustain performance on a cognitive task compared to those with milder symptom presentations.

Table 4 is now deleted and replaced by the scatter plots of correlations significant for both parametric and non-parametric correlation analyses.

Minor Issue
7. It could be useful to report some data on the reliability and validity of the EF measures used in this study.

The psychometric properties on the EF tasks based on 1000 children were strong with moderate to high reliability and criterion validity (Willoughby et al., 2012). The detailed results on the Test Information Curves for reliability and factor analyses for criterion validity are not reported in the present paper for due to lack of space, but we made the following change on the manuscript:

The psychometric properties on the EF tasks based on a large sample of preschool children (n=1,292) were strong with moderate to high reliability and criterion validity (Willoughby et al., 2012).

8. Given the limits of this study I wonder if the paper would be better served with a more concise and goal oriented introduction and circumspect discussion.

EJN European Journal of Neuroscience FENS Federation of European Neuroscience Societies

We made various changes for more circumspect discussion (see response for comment 6). Also, per discussion with editors, we decided to present the data as a short review with a preliminary ERP study focused on stimulus processing and response control in kindergarteners with ASD.

2nd Editorial Decision 24 March 2017

Dear Dr. Kim,

Your resubmitted manuscript was reviewed by external reviewers as well as by the Section Editor, Dr. Sophie Molholm, and ourselves. We are pleased to say that it will be accepted for publication in EJN after you have dealt with a couple of minor points.

Both reviewers find the revised manuscript to be much improved, and that the majority of their concerns have been addressed. They each have suggestions for strengthening the manuscript. These are minor and should be easy to address in your revision.

Please also:
-supply a graphical abstract
-ensure that the reporting of statistical data adheres to EJN guidelines, notably please report precise P values.

If you are able to respond fully to the points raised, we would be pleased to receive a revision of your paper within 30 days.

Thank you for submitting your work to EJN.

Kind regards,

Paul Bolam & John Foxe
co-Editors in Chief, EJN

Reviews:

Reviewer: 1 (Kristen Morie, Yale University)

Comments to the Author
I am satisfied with the steps the authors have taken to improve the paper.

Minor comments:

As the paper is now a review, authors should consider adding more background into the review portion.

The sentence "children are asked to press a button as quickly when they see an animal" should be edited.

Reviewer: 2 (Peter Mundy, University of California at Davis)

Comments to the Author

EJN European Journal of Neuroscience FENS Federation of European Neuroscience Societies

I think the authors have done an excellent job of responding clearly and effectively to earlier review comments. With this revision report more clearly makes a significant contribution to the literature. The authors' demonstration of the feasibility of the valid measurement of ERN in a sample of young children with ASD advances the neuroscience of ASD.

One minor suggestion that is entirely up to the authors. It may be useful to revise their limitation statement to explicitly note the need for more specific (quantitative) control or examination of IQ effects in future studies that examine diagnostic group differences or relation if ERN variables to symptoms in studies of ASD. The may not be an issue for Go-No-Go tasks. Rather it is an issue because previous findings have observed relations between IQ and amplitude or latency of various ERP wave forms in ASD research (e.g. P3; Salmond, Vargha-Khadem et al. 2007; Hileman, Henderson et al. 2011). Consequently, best practice is to use quantitative measures of IQ in order to examine IQ effects (e.g. Vlamings, Jonkman et al. 2008 this journal).

Authors' Response 03 April 2017

Dear. Drs. Foxe & Bolam,

Thank you for the acceptance of this manuscript titled "Stimulus processing and error monitoring in more-able kindergarteners with Autism Spectrum Disorder (ASD): A short review and a preliminary ERP study." We are excited that our manuscript will be a part of the special issue.

We made further changes suggested by the editors as well as the reviewers:

1. We attached the graphical abstract.

2. We reported precise P values in the text.

3. We did not add a lot more background to the review portion as Reviewer 1 suggested because we felt that the review was already extensive as a short review paper and also due to concerns about the space (as our manuscript is almost at 9687 words); however we had added a few lines related our findings to CRN in the introduction as well as discussion.

4. Reviewer 1 suggested editing the sentence, "children are asked to press a button as quickly when they see an animal" which is edited in the text now.

5. Reviewer 1 suggested that we suggest future studies to stratify the sample better with quantitative measures of IQ, which now is added to the limitation and future direction.

6. We also made more editorial changes to clarify our results (e.g., the interpretation of our results on CRN has been modified and expanded more).

Best Wishes,

Sophy