



Evaluation of Sound and Working Memory Intervention in Autism Spectrum Disorder (ASD) Children using Auditory Brainstem Response (ABR) with Psychological Task

Shahrudin F.A., Dzulkarnain A.A.A., Jamal F.N., Rahmat S., Ramli M., Basri N.A., Jusoh M., Sidek S.N., and Yusof H.M.

International Islamic University Malaysia (IIUM), Kuantan Campus, Malaysia

INTRODUCTION

- Sound therapy has been used as an alternative intervention to improve ASD symptoms. Many have reported its positive findings in improving cognitive, social, communication and behavioural aspects of ASD (1, 2).
- Despite this, several studies had questioned its effectiveness and highlighted few of the limitations. Past studies agreed that sound therapy's effectiveness could not be proven due to the lack of evidence, especially as a treatment for ASD (3, 4).

Issue 1: Use of objective outcome measures

- Previous literature mostly utilized parental-reported questionnaires as an outcome measure for determining the effectiveness of post-intervention (5). To our knowledge, no studies have investigated the use of objective measure such as auditory-evoked potential (AEP) to evaluate the effectiveness of sound therapy in ASD children.
- Whilst the perceptual questionnaire is still considered a valid tool, it could not measure the physiological changes that occur in the neural level following any intervention. Thus, for this study we would like to address this issue by using Auditory Brainstem Response (ABR) to measure changes after the intervention.

Issue 2: Sound Therapy and Working Memory Training

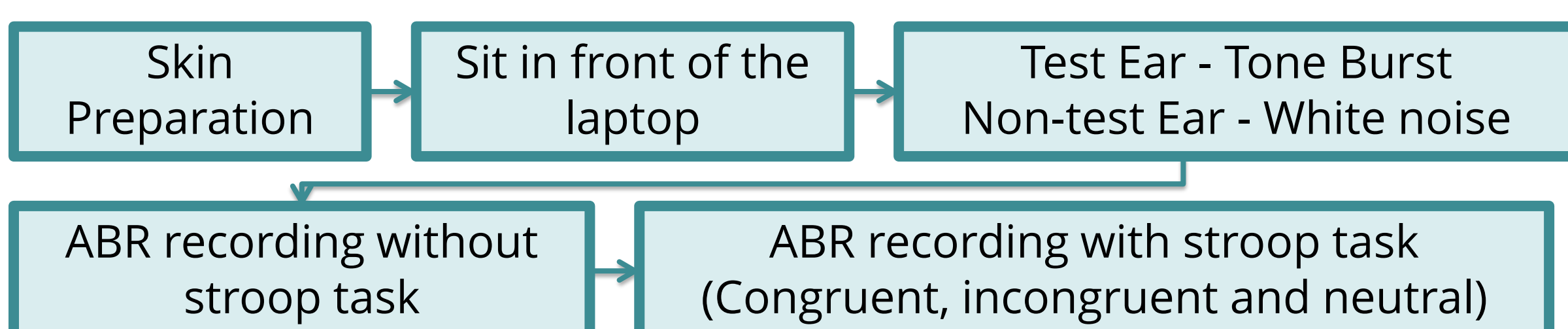
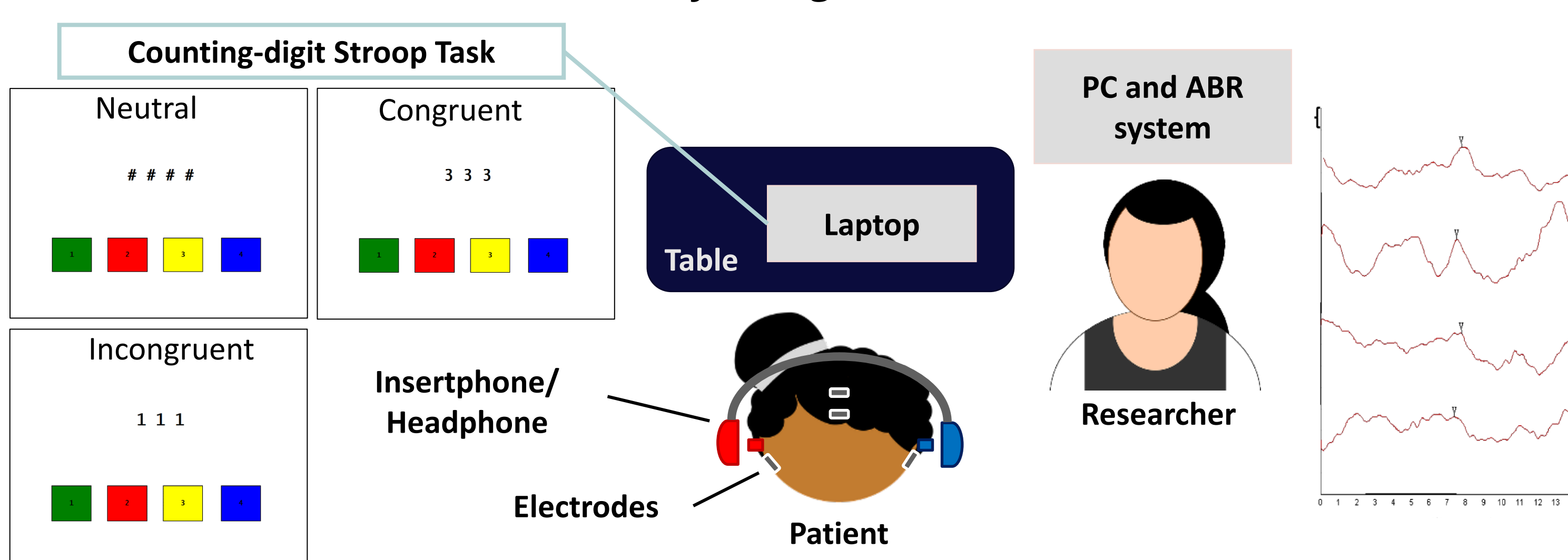
- To our knowledge, no studies had combined sound therapy with working memory (WM) training among ASD population. WM training and sound therapy individually has been shown to provide positive results in improving attentional skills which is a part of sensory gating mechanism (6, 7). By combining these methods, it is hypothesized that it can further enhance the effect of intervention to ASD symptoms.
- WM load comprises of attention control (important for information selection and filtering) will be increased via WM training, while sound presented as background will act as a distraction; training the brain to focus its attention on the WM task while ignoring the sound.
- A habituation effect is expected after repeated exposure to the sound as an effect of training to non-important stimulus.

Aim: To investigate the effectiveness of sound-working memory therapy to improve sensory gating of ASD children using Auditory Brainstem Response (ABR) with psychological (Stroop task).

METHODS

- Twenty-three mild to moderate ASD children randomly divided into 4 groups.

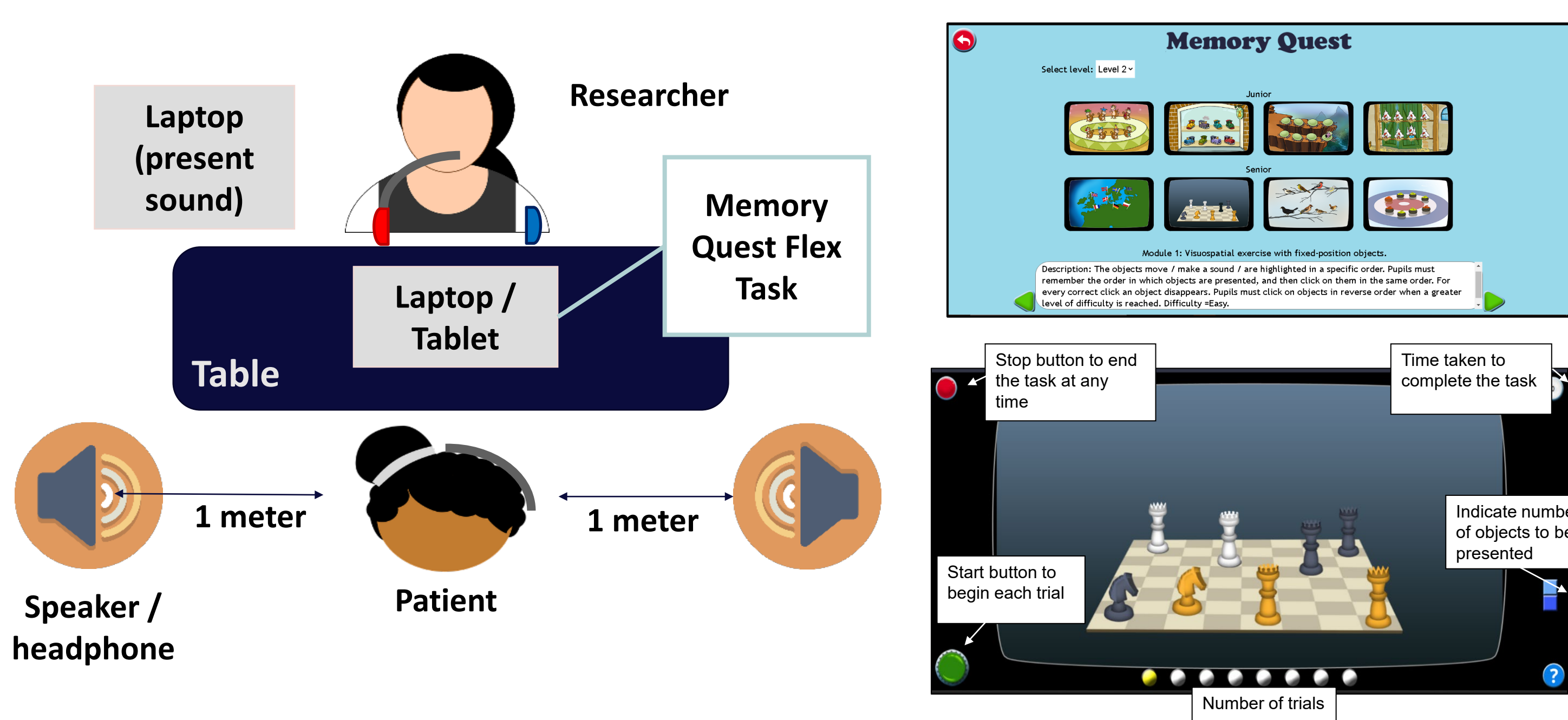
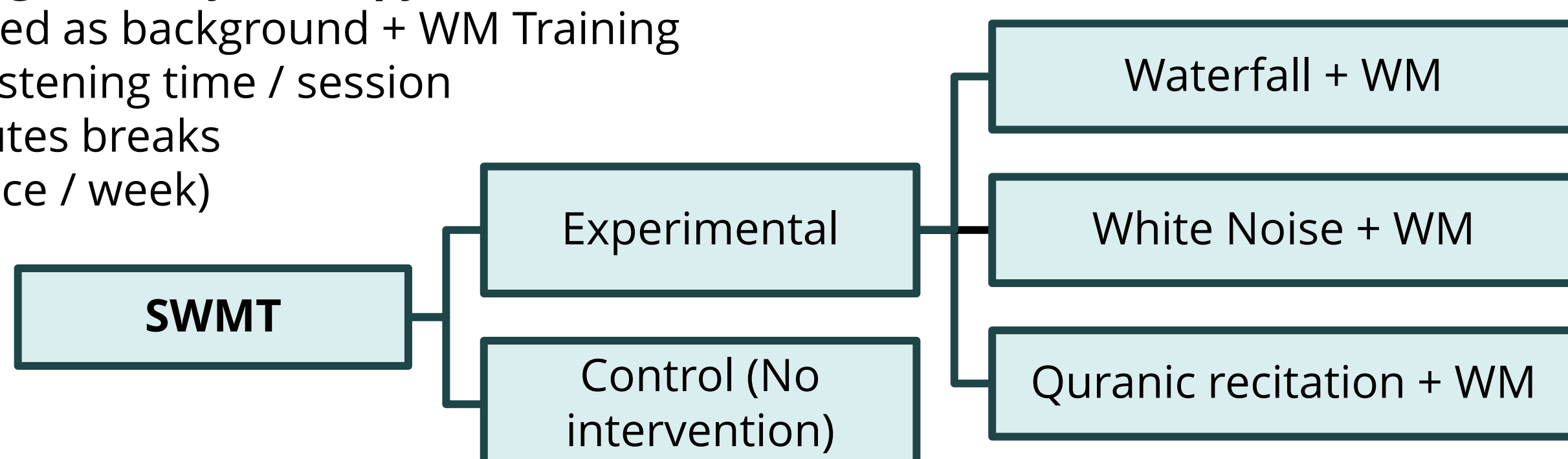
Pre- & Post-Intervention (ABR with Psychological Task)



- Calculate Stroop Interference (SI) and ABR Sensory gating (ABR SG):
 $SI/ABR\ SG = \text{Incongruent condition (percentage score/response time/amplitude/latency)} - \text{neutral condition (percentage score/response time/amplitude/latency)}$

Sound-Working Memory Therapy (SWMT)

- Sound presented as background + WM Training
- 45 minutes listening time / session
- Three 5 minutes breaks
- 4 session (once / week)



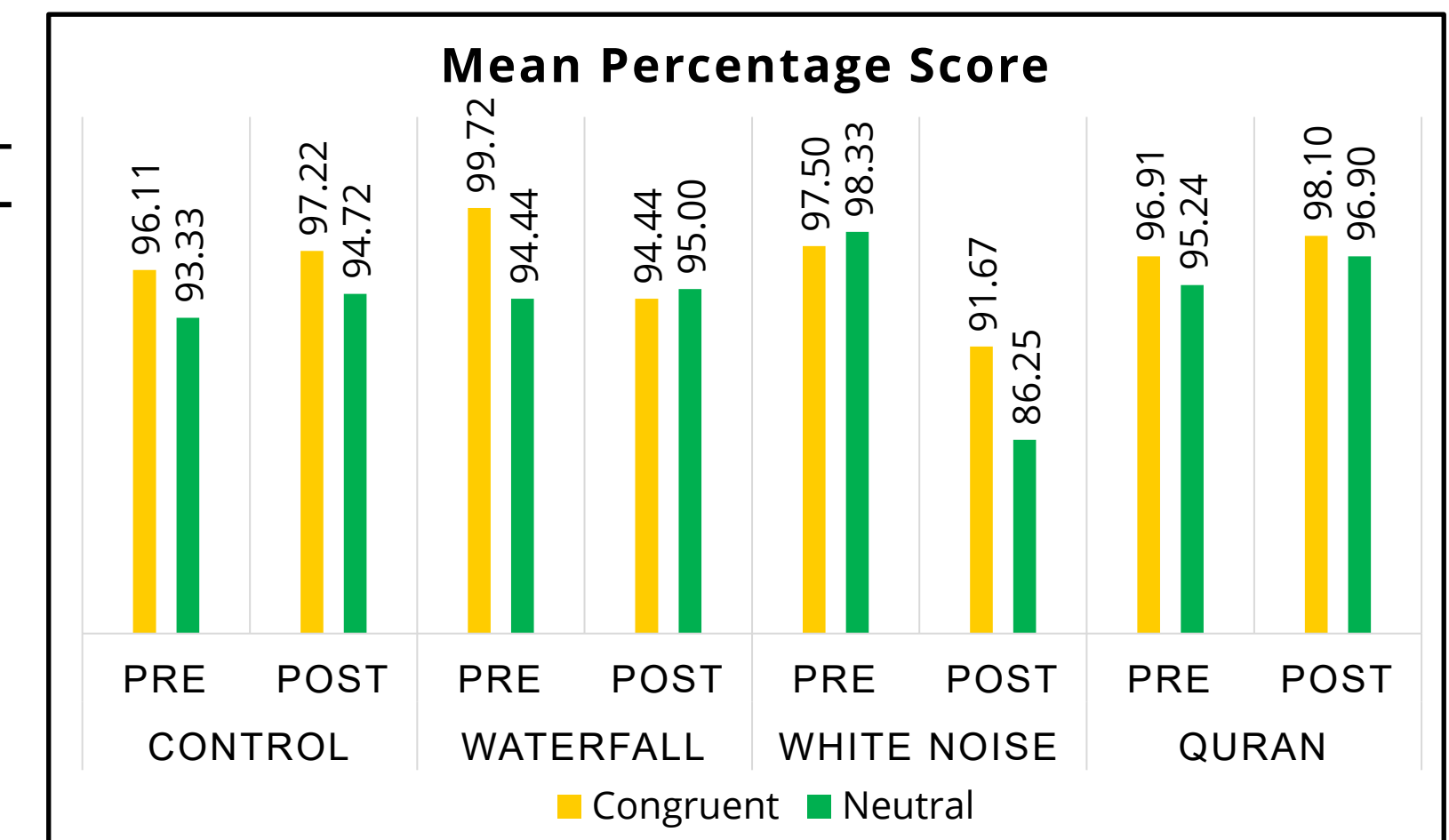
RESULTS

Stroop Task: RM ANOVA - Post vs Pre intervention

- RM ANOVA found significant main effect of trainings with medium to large effect size.
- Post-Hoc - white noise, waterfall and Quran SWMT shows significant changes after intervention for percentage score, SI percentage score and response time ($0.01 < p > 0.05$, medium to large effect size).
- Percentage Score
 - Congruent: Only Quran group shows significant increase in percentage score.
 - Incongruent: No significant findings for any groups after intervention.
 - Neutral: No group shows increase in percentage score
- SI Percentage Score: Participants in white noise and waterfall SWMT show increase and decrease of SI respectively after intervention in comparison with other groups.
- SI Response Time: Only waterfall groups show significant decrease in SI after intervention.

Table shows summary of p-value and effect size for both RM ANOVA and Gain Score + ANOVA

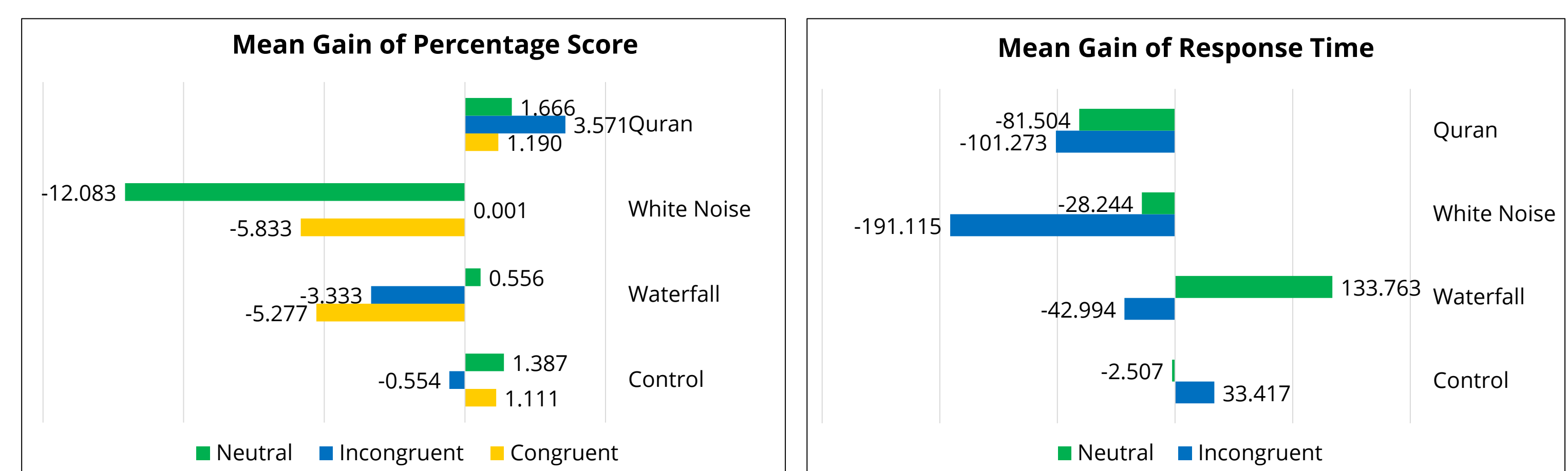
	p-value	Effect size
Percentage Score		
Congruent		Large
Incongruent	> 0.05	Medium
Neutral		Large
Response Time		
Congruent		Small
Incongruent	> 0.05	Medium
Neutral		Medium
Stroop Interference		
Percentage Score	0.003	Large
Response Time	> 0.05	Large



Stroop Task: Gain Score + ANOVA - Between groups (Control vs waterfall vs white noise vs Quran)

- RM ANOVA found significant different in between group analysis with medium to large effect size
- Post-Hoc - All group suggest significant effect of interventions ($0.01 < p > 0.05$, medium to large effect size).
- Percentage Score
 - Congruent: Those in waterfall and white noise SWMT have significantly highest intervention effect for percentage score in congruent condition compared to control and Quran SWMT.
 - Incongruent: Only Quran SWMT shows significant increase in percentage score
 - Neutral: No groups shows improvement in percentage score.
- Response Time
 - Congruent: No significant intervention effect was found
 - Incongruent: Only White noise SWMT and waterfall SMWT shows reduction in response time
 - Only those in waterfall SWMT shows significant effect (positive gain) when compared to other groups SI percentage score.
- SI Percentage Score: The highest intervention improvement was from waterfall followed by the Quran SMWT
- SI Response Time: The highest significant effect of intervention (negative gain) can be seen in white noise followed by waterfall, Quran, and control group.

ABR: RM ANOVA and Gain Score + ANOVA - None of the wave V ABR (amplitude and latency) in each Stroop task condition and ABR sensory gating (amplitude and latency) results were significant.



CONCLUSIONS

Overall, this finding suggests an improvement in the sensory gating abilities among ASD children following some of the SWMT training. It can be observed that white noise and waterfall is effective in combination with working memory intervention therapy to address the auditory sensory gating issues among ASD children as found in this study. In addition, the Stroop task tool has the potential to measure the changes that occur from the SWMT and provide useful information on the status of the cognitive function in ASD children. Whilst ABR as a measuring tool for sensory gating requires more in-depth research as results obtain from this study provide inadequate evidence to prove its reliability and validity.

ACKNOWLEDGEMENT

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