

THE POTENTIAL USE OF AUDITORY BRAINSTEM
RESPONSE (ABR) WITH SENSORY GATING
FUNCTION TO IDENTIFY AUDITORY PROCESSING
DISORDER (APD) IN CHILDREN

BY

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ABSTRACT

Auditory Processing Disorder (APD) is characterized by a difficulty to perceive sound due to inability to accurately process the auditory information. Several issues have been debated about APD including; (i) the conceptualization on the origin of APD, especially on the involvement of top-down processing of cognitive function in APD, (ii) the absence of gold standard assessment for APD, and (iii) the limitations in the existing APD assessments to assess younger children. To address the above-mentioned issues, this study aimed; (i) to examine the influence of attention on auditory processing performance in children with and without APD, including those with co-existing attention deficit, and (ii) to explore the potential use of Auditory Brainstem Response (ABR) test with Stroop Task to objectively identify APD. The ABR test with Stroop task in this study integrates the role of top-down processing through sensory gating pathway that possibly related to auditory processing. This thesis was divided into three main studies. In Study 1, 94 children (8 to 11 years old) with normal hearing, intelligent quotient and working memory were recruited. These children were divided into two main groups, normal and APD group, based on their performance on five APD assessments; (i) Dichotic Digit Test, (ii) Gap-in-noise Test, (iii) Pitch Pattern Sequence Test, (iv) Masking Level Difference Test and (v) Digit Triplet Test. The children in each group were further categorized into three sub-groups based on their attention status - normal attention, suspected with Attention Deficit Disorder (ADD), and suspected with Attention Deficit Hyperactivity Disorder (ADHD), by using the Swanson, Nolan and Pelham, Fourth Edition (SNAP-IV) questionnaire. In Study 2 and 3, a counting Stroop Task with three Stroop conditions (congruent, incongruent and neutral) was used. ABRs were recorded in two general conditions - with and without cognitive task. For ABRs with cognitive task, the ABR test was conducted whilst the participant performing Stroop Task in three conditions - congruent, incongruent, and neutral. The Stroop Task was conducted to generate cognitive interference, which would then activate sensory gating process. The ABR waveforms hypothetically would be affected from the effect of neural suppression as a result of sensory gating. In Study 1, the results indicate that, patient with attention problems (suspected with ADD or ADHD) may also has problem with their auditory processing skills that include significantly poor performance in binaural integration, temporal resolution and temporal ordering skill. In Study 2, two patterns of ABR with Stroop Task results were observed. Among children without APD and no attention problem, a reduction in wave V amplitude during ABR recording with cognitive interference in comparison with those without cognitive interference (a negative downward pattern) was observed. This is consistent with neural suppression as a result of normal sensory gating abilities. For children without APD but with attention deficit (ADD or ADHD), minimal reduction in wave V amplitude was observed suggesting a decline in sensory gating abilities. On the contrary, no reduction in the ABR wave V amplitude (positive upward pattern) was observed among children with APD especially those with attention problem (ADD or ADHD) suggesting absence of neural suppression that could be due to poor sensory gating abilities. In Study 3, a significant relationship were found between sensory gating and majority of auditory processing skills including; (i) binaural integration, (ii) binaural interaction, (iii) temporal resolution, and (iv) temporal sequencing. In summary, attention deficit may influence the auditory processing abilities and the ABR conducted with Stroop task has the potential to be used as a tool to identify children with APD.

الملخص

يتميز اضطراب المعالجة السمعية بصعوبة في إدراك الصوت بسبب عدم القدرة على معالجة المعلومات السمعية بدقة. وقد نوقشت عدة مسائل بشأن اضطراب المعالجة السمعية، بما في ذلك: (1) وضع تصور بشأن منشأ اضطراب المعالجة السمعية، ولا سيما بشأن إشراك المعالجة من أعلى إلى أسفل للوظيفة المعرفية في اضطراب المعالجة السمعية، (2) عدم وجود تقييم لمعيار الذهب لاضطراب المعالجة السمعية، و(3) القيود في تقييمات اضطرابات المعالجة السمعية القائمة لتقييم الأطفال الأصغر. ولمعالجة المسائل المذكورة أعلاه، استهدفت هذه الدراسة: (1) دراسة تأثير الاهتمام على أداء المعالجة السمعية لدى الأطفال المصابين باضطراب المعالجة السمعية وغير المصابين به، بما في ذلك الأطفال الذين يعانون من نقص في الاهتمام، و(2) استكشاف إمكانية استخدام اختبار استجابة الدماغ السمعي مع مهمة ستروب لتحديد اضطراب المعالجة السمعية بشكل موضوعي. يدمج اختبار استجابة الدماغ السمعي مع مهمة ستروب في هذه الدراسة دور المعالجة من أعلى إلى أسفل من خلال مسارات التحسس الحسية التي قد تتصل بالمعالجة السمعية. وقد قسمت هذه الأطروحة إلى ثلاث دراسات رئيسية. في الدراسة 1، 94 تم توظيف الأطفال (الذين تتراوح أعمارهم بين 8 و 11 عاماً) مع السمع العادي، والذكاء والذاكرة العاملة. وقسم هؤلاء الأطفال إلى مجموعتين رئيسيتين، هما مجموعة اضطرابات المعالجة السمعية العادية، استناداً إلى أدائهم على أساس خمس تقييمات لاضطرابات المعالجة السمعية: (1) اختبار ديشوتيك ديفيت، (2) اختبار الفجوة في الضوضاء، (3) اختبار تسلسل نمط بيتش، (4) اختبار الفرق في مستوى الحجب، و (5) اختبار ثلاثي الحجب. وتم تصنيف الأطفال في كل مجموعة إلى ثلاث مجموعات فرعية على أساس مركز اهتمامهم. الاهتمام الطبيعي، الاشتباه باضطراب نقص الانتباه، و الاشتباه باضطراب فرط النشاط الناجم عن نقص الانتباه، باستخدام استبيان سوانسون ونولان وبيلهام، الطبعة الرابعة (SNAP-IV). في الدراستين 2 و 3، تم استخدام مهمة ستروب للعد مع ثلاثة شروط ستروب (متطابقة وغير متحيزة ومحايدة). تم تسجيل استجابة الدماغ السمعية في شرطين عامين مع المهمة الإدراكية وغير الإدراكية. بالنسبة لاستجابة الدماغ السمعية ذات المهمة الإدراكية، أجري اختبار استجابة العقل السمعي بينما قام المشاركون بأداء مهمة ستروب في ثلاثة ظروف: التطابق، عدم الاتساق، و الحياض. وقد أجريت مهمة ستروب لتوليد التداخل الإدراكي، الذي من شأنه بعد ذلك تنشيط عملية التحسس الحسي. يمكن أن تتأثر أشكال استجابة الدماغ السمعية افتراضياً من تأثير القمع العصبي نتيجة التحسس الحسي. وفي الدراسة 1، تشير النتائج إلى أن المرضى الذين يعانون من مشاكل في الانتباه (يشته في إصابتهم باضطراب نقص الانتباه أو اضطراب فرط النشاط الناجم عن نقص الانتباه) قد يواجهون أيضاً مشكلة فيما يتصل بمهاراتهم في المعالجة السمعية والتي تتضمن أداء ضعيفاً إلى حد كبير في التكامل بين الأطراف، والاستبانة الزمنية، ومهارة الترتيب الزمني. وفي الدراسة 2، لوحظ نمطان من استجابة الدماغ السمعي مع نتائج مهمة ستروب. بين الأطفال الذين لا يعانون من اضطراب المعالجة السمعية ولا توجد مشكلة في الانتباه، لوحظ انخفاض في سرعة الموجة الخامسة أثناء تسجيل استجابة الدماغ السمعية مع التدخل الإدراكي مقارنة مع أولئك الذين لا يتداخل الإدراكي (نمط هبوط سلبي). وهذا يتسق مع القمع العصبي نتيجة لقدرات التحسس الحسية العادية. وبالنسبة للأطفال الذين يعانون من اضطراب المعالجة السمعية ولكن مع نقص الانتباه (اضطراب نقص الانتباه أو اضطراب فرط النشاط الناجم عن نقص الانتباه)، لوحظ انخفاض ضئيل في سرعة الموجة الخامسة مما يشير إلى انخفاض في قدرات التحسس الحسي. على النقيض من ذلك، لم يلاحظ أي انخفاض في موجة الاستجابة الذهنية السمعية الخامسة (النمط التصاعدي الإيجابي) بين الأطفال المصابين باضطراب المعالجة السمعية وخاصة أولئك الذين

يعانون من مشكلة الانتباه (اضطراب نقص الانتباه أو اضطراب فرط نشاط نقص الانتباه) مما يشير إلى غياب القمع العصبي الذي قد يكون راجعا إلى ضعف قدرات التحسس الحسي. وفي الدراسة 3، وجدت علاقة هامة بين التحسس الحسي وأغلبية مهارات المعالجة السمعية بما في ذلك: (1) التكامل البيئي، (2) التفاعل البيئي، (3) الاستبانة الزمنية، و (4) التسلسل الزمني. وخلاصة القول، قد يؤثر العجز في الانتباه على قدرات المعالجة السمعية، كما أن استجابة الدماغ السمعية التي تُجرى بمهمة ستروب يمكن استخدامها كأداة لتحديد الأطفال المصابين باضطراب المعالجة السمعية.



APPROVAL PAGE

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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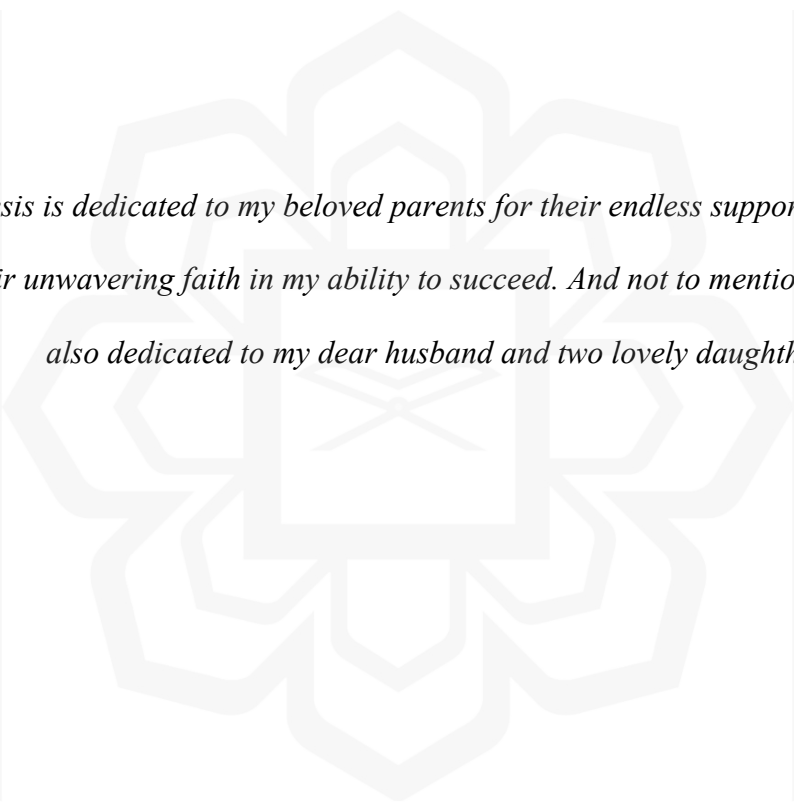
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This thesis is dedicated to my beloved parents for their endless support and du'a, and for their unwavering faith in my ability to succeed. And not to mention, this thesis is also dedicated to my dear husband and two lovely daughters.

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