Age effects on auditory sensory memory:

a cognitive neuroscience perspective

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Statements by the candidate

Statement of originality

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying subject to the provisions of the Copyright Act 1968.

Declarations

I hereby certify that the work embodied in this thesis has been done in collaboration with other researchers. I have here included as part of the thesis a statement clearly outlining the extent of collaboration, with whom and under what auspices.

The second study presented in this thesis was completed in collaboration with two researchers, Ms Rosemary Clark and Ms Rebbekah Atkinson. Approximately one third of the participants tested for study 2 were tested by Ms Clark. Ms Clark submitted her honours thesis in psychology based on the data she collected from this subset of participants. Ms Atkinson was also responsible for testing approximately one third of participants for study 2 as a research assistant.

Candidates signature: ……..

Date: ……

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Dedication

Thank you to my dear husband, Rusty. I have saved my greatest cliché for you: I could not have done this without you (at least not with my sanity quite so intact). You believed in me throughout. You cooked me delicious dinners, listened to the dramas, remained calm, kept me laughing, and generally helped me through. For these reasons and many more, I would like to dedicate this work to you.

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Abstract

It is well established that there are changes in cognition and in peripheral sensory mechanisms that occur with age. However, there is much less known about the cause of either change or indeed the relationship between age-related change in sensory processing and age-associated cognitive decline. Understanding these mechanisms could improve our capacity to devise strategies which could assist older adults in aging successfully. In this thesis, I aim to bridge a gap in our knowledge concerning the relationship between age-related change in sensory processing and age-associated cognitive decline by studying the effect of age on what can be considered an intermediary process, sensory memory (in the auditory modality). I continue this line of research by examining the relationship between auditory sensory memory and other types of memory for auditory information in young and older adults. To address these goals, I adopted a cognitive neuroscience approach, relating electrophysiological data to data derived from behavioural memory assessments.

In the following thesis, I present a literature review, four studies, and a general discussion of results. Several waveforms of the auditory event-related potential (ERP), including N1, P2, repetition positivity (RP), and mismatch negativity (MMN) were studied. More specifically, in study 1, we looked at the effect of age on N1 and P2 amplitude. In study 2, we examined the conditions eliciting two repetition effects, RP and the MMN memory trace effect, in the auditory ERP of young adults. Studies 3 and 4 concerned the effect of age on RP and the relationship between RP and implicit memory for contextual information as well as explicit memory for auditory information.

We concluded that i) age affects auditory sensory memory, ii) the potential relationship between auditory sensory memory and implicit memory for auditory information requires re-investigation, and iii) there is a relationship between auditory

sensory memory and explicit memory for auditory information that is altered with age. That is, we concluded that RP occurring in the N1/P2 and MMN latency period indicates memory trace formation and that age affects RP amplitude (restricted to an anterior RP generator). In addition, we showed that RP may be related to implicit memory (priming) in both young and older adults. Across two studies, we found a positive correlation between the response to repetition in the ERP (due to RP activity) and explicit auditory verbal memory in young adults but a negative correlation in older adults.

Therefore, although age-related change in RP could reflect the capacity of older adults to encode the context of auditory stimulation, this is potentially due to compensatory activity. We argue it is possible that implicit memory changes with age as a result of age-related change in explicit episodic memory. As a result of well established changes that occur in episodic memory with age, older adults may begin to rely on implicit memory as a source of memory more so than young adults. Our data shows that the implicit memory system may, as a result, favour content over contextual information. An important theme outlined in the discussion of results involves the idea that age-related changes in cognition that are commonly interpreted as cognitive deficits may in fact be beneficial in certain circumstances.

We review our results in relation to cognitive theories of aging and find that several theories are applicable to the data, including the frontal hypothesis (incorporating the inhibitory deficit hypothesis), the information degradation hypothesis, and the speed of processing hypothesis. Future research in this area could focus on exploring whether top-down or bottom-up or influences primarily contribute to the age effect on auditory sensory memory and RP, as well as evaluating our hypothesis that the age-related change in RP may be beneficial for explicit item memory but detrimental for implicit contextual memory

in older adults (i.e. compensatory mechanisms). While the studies presented in this thesis have provided the foundations guiding our understanding of these issues, researchers in the field of cognitive neuroscience are well equipped to resolve such questions in the future.