

Qualifying Report

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1 Overview of Problem

Dementia has been identified as one of those fast growing difficulties facing the world. A recent report suggests that in 2015 there were 46 million people with a diagnosis of dementia and that number is expected to hit 131.5 million by 2050(CITE). The report also states that the worldwide cost of dementia in 2018 is estimated to be in the region of one trillion US dollars.

In 2009, the Department of Health in it's National Dementia strategy made 'early diagnosis and support' one of it's key themes as part of this strategy. A lot of work, therefore, has gone into trying to find ways of improving the early diagnosis of Alzheimer's Disease (AD) and Mild Cognitive Impairment (MCI). As described above, the numbers of those suffering from AD and MCI are going to increase as the population ages and thus it is important that we utilise technology wherever possible to aid clinicians. At the present time diagnosis is typically conducted at memory clinics by trained clinicians. I theorise that we might be able to use diagnose patients in their own homes utilising smart-home technology.

Language analysis is an important part of assessing those suspected of suffering with AD or MCI and this language analysis in part informs an official clinical diagnosis. This analysis often takes the form of tasks such as Free Cued Selective Recall Task, the Boston Cognitive Assessment, and the Mini Mental State Examination which are all quite targeted in the language required of the person being assessed.

A step towards the ambient detection of AD and/or MCI in population requires that we look for similar features in language used naturally as part of every day conversation. Part of this work therefore is to see whether spontaneous discourse, such a semi-structured interview is a task that has the ability to put pressure both the cognitive and linguistic systems as it requires the ability to understand speech, formulating a coherent answer and then responding in an appropriate way. Berisha et al [?], has shown through language analysis in this area that there are marked differences in this process between those who have a diagnosis of AD and healthy controls. The next part of this work looks at how technology, particularly the use of smart home devices such as the Amazon Echo and Google Home families of devices can be used to capture data that can then be analysed.

The potential impact of this research is immense. Research has shown that early diagnosis of people with AD or MCI improves sufferers quality of life and can slow the progress of the disease. Equally, early diagnosis can increase the number of research opportunities for understanding the early stages of dementia and how the disease progresses so that more research can be conducted which may, in the future, lead to new treatments and other interventions.

2 Literature Review

3 Work already carried out

3.1 Literature Review - April 2018 to July 2018

A literature review was carried out from several perspectives in order to understand both an applied and theoretical perspective. Thus a search for papers was conducted in both the psychology and computer science domains, as well as papers which intersected these areas and were relevant to this particular problem. SEARCH - ProQuest (PsychArticles) - Search Terms (Language AND Decline AND DEMENTIA) - 1484 Results

SEARCH - ProQuest (PsychArticles) - Search Terms (Language AND Decline AND DEMENTIA AND Speech) - 486 Results

SEARCH - Web Of Science - Search Terms (Language AND Decline AND DEMENTIA AND Speech) - 151 Results

SEARCH - Web of Science - Search Terms (Language AND Decline AND DEMENTIA) - 1207 Results

SEARCH - Scopus - Search Terms (Language AND Decline AND DEMENTIA AND Speech) - 91 Results

SEARCH - Scopus - Search Terms (Language AND DEMENTIA AND Decline) - 791 Results

Studies that met the following criteria were included: articles that addressed the association between language and all forms of dementia. Studies with one or more of the following characteristics were not included in this literature review: articles and dissertations that did not meet the selected inclusion in different databases and those that were not available in its original form.

3.2 Skills development - April 2018 to March 2019

IS-4001 Research Skills and Professional Development Module - Aston University - 3rd May, 10th May, 16th May - 45 Hours

Day 1 consisted of an introduction to the module (IS4001), a rough guide to how to start a PhD and a look at how to conduct and write a literature review. This looked at the concept of a PhD and the meaning of original research. This also talked about the supervisor relationship and understanding the role of the supervisor in the PhD. In addition, we explored the idea of our expectations around supervision. We then went on to look at what skills, qualities and attitudes are necessary to be a good researcher including the idea of what constitutes ethical research and finally we looked at the obstacles to progress on a PhD and what we can do as students. In the afternoon, we looked at how a way of conducting a literature review. This talked about what a literature review is, along with the different types of literature review (Narrative, Systematic and Meta-Analysis). We talked about the function of a literature review, and how this fits in with the writing up of a thesis. We then explored the stages that the

literature review process contains, from defining the scope of the research, to coming up with a plan on how to collect sources of information to synthesising and reporting the findings of the review. This part of the lecture looked in detail at each of these areas and included some examples to put the theory of the literature into context. Finally, we talked about the the process of a literature review in the context of the written assignment.

Day 2 consisted of a presentation on Effective Presentation skills, what constitutes a perfect poster presentation, research project planning and management and how to work effectively in research teams. In the presentation on effective presentation skills we talked about different ways in which we could plan a presentation and some of the key concepts in terms of communication and engaging the audience. We also talked about different presentation styles. This was with a view to thinking about our presentation assessment. We then went on to talk about what constitutes a poster presentation, and what the general features and conventions of poster presentations were. We then went through some examples of what made poster presentations good and bad. In the afternoon we went through how to plan and manage a research project effectively. Our goals were to see our research projects as a series of tasks which needed to be completed in a sequence, and to be able to plan this in a way that makes good use of time and energy as well as a mechanism for keeping track of progress. We used the Association of Project Managers (APM) protocol for managing a project and we looked at the notion of having a Gantt chart to have a graphical representation of research project. We then talked about these processes in relation to the research plan which needs to be produced for assessment. Finally we talked about how to work and communicate effectively in teams. We talked about how to work effectively within a team, and specified the difference between groups and teams. We talked about the different roles that people have within teams, and the idea that all teams have individuals that take on these distinct roles. We talked about how to identify our own-strengths within and how we might facilitate good teamwork withing a research team using our strengths. Finally we talked about some of the the results of poor communication within a team.

The assessments for this module were a 3,000 word literature review with a focus on process rather than content (See Appendix A), a ten minute presentation based on my research project (See Appendix B) and the submission of a project plan spanning the first year of my research(See Appendix C).

Alexa Skills Training Day - Amazon - May 9th 2018 - 7 Hours

Test

Deep Learning Online Course - deeplearning.ai - Dates - 70 Hours
Summary Here

3.3 Lab Book

3.4 Publication plan

Year One Year Two Year Three

4 Project Proposal

4.1 Part A: Core study information

4.1.1 1. Administrative Details

A1 - Full Title of the Research: Title here A2 - Educational

5 Provisional Table of Contents

5.1 Aims and Rationale

The aim of my research is to find less burdensome ways of detecting dementia without the use of invasive procedures (taking bloods, or using medical equipment such as MRI's and EEG's) and without resorting to time-consuming and expensive psychological tests. There is a lot of research into the analysis of language as a bio-marker for MCI and Early Dementia. Given that sampling a person's language is relatively effortless, my research looks at whether we can find bio-markers of MCI and Early Dementia in natural language.

Concerns: Language and Memory are quite naturally intertwined and it would be difficult to test one without some reliance on the other. I'm not going to control for memory problems as a potential confound, but does this weaken the research? How do I defend this?

5.2 Chapter 1: Introduction

Introduction to the problem of dementia in the context of the wider world including quality of life and financial implications. Exploration of dementia as a syndrome rather than a disease, and a look at the different variants of dementia. A look at the rationale behind research into the early diagnosis of dementia as well as a brief look at what has been done in the area (wide context, so pharmacological and psychological).

5.3 Chapter 2: Background

Literature Review which looks at the background of what has been done in the area of early diagnosis of dementia, from a purely psychological perspective as well as the work done in machine learning in this topic. Look at the different

attributes that researchers have explored. Look at the difference between traditional machine learning methods and deep learning and discuss the pros and cons of each perspective.

5.4 Chapter 3: Experiment: Presidential Debates revisited

Aim: To replicate and extend the work by Berisha and Liss. To use traditional machine learning techniques to test whether they can differentiate between Reagan, Bush and Trump using similar features. To test to see whether Deep Learning can also differentiate between the three.

Dataset: the presidential press conferences given by Presidents Ronald Reagan, George H.W. Bush and Donald Trump.

Paper: This experiment replicates work done by Berisha and Liss and extends this by adding Donald Trump as an alternative comparison to Ronald Reagan. This experiment will look at the features originally recommended by Berisha and Liss, as well as any others that have potential as discussed in the literature review above.

5.5 Chapter 4: Experiment: Three Authors - Murdoch, Christie and James

Aim: To replicate the work by Le et al. To use traditional machine learning techniques to see if it can differentiate between the three authors using similar features. To test to see whether deep learning can also differentiate between the three. To add 'pre-trained' layers from Presidential Debates experiment to see if this improves accuracy.

Dataset is the literary novels of Iris Murdoch, Agatha Christie and P.D. James.

Paper:

5.6 Chapter 5: Experiment: Using the DementiaBank Corpus

Aim: To replicate and extend the work of Orimaye et al. To use traditional machine learning techniques to see if it can categorise people into dementia or healthy categories using the samples given. To see whether can use pre-trained layer from presidential debates to improve accuracy. It doesn't seem relevant to use pretrained layer from Experiment four, but it might be worth looking at the results of this.

Dataset: The DementiaBank Corpus.

Paper: To replicate and extend the work of Orimaye et al. To compare traditional machine learning techniques (already completed by Orimaye) and deep learning.

5.7 Chapter 6: Experiment: Longitudinal Data - Current Cohort

Aim:

Dataset: To be created.

5.7.1 Dataset creation

The aim is to recruit a set of 50 participants with MCI / Early Dementia (diagnosed or undiagnosed) and a set of 50 controls with a similar age and broadly similar educational background (a known potential confound in assessing cognitive decline). The rationale for recruiting this number is that there will be an expected drop out rate and so

5.7.2 Patient Health Questionnaire (PHQ-9)

5.7.3 Free Cued Selective Reminding Test (FCSRT)

5.7.4 Mini Mental State Examination(MMSE)

5.7.5 Written Description (Cookie Theft Picture)

5.7.6 Semi-Structured Interview

Paper:

5.7.7 Ethics

Need to discuss confidentiality right at the start of each conversation and to reiterate at every meeting. I will also provide an information sheet which details the confidentiality statement. The spoken confidentiality statement will be as follows. "Anything you say to me today will be confidential unless I feel that there is a risk to you, or someone else. If this is the case, I may need to speak to or write to third parties such as your GP. Is this ok?"

5.7.8 What if someone reveals suicidal ideation or other risks?

As part of the battery of tests for this experiment, there is an opportunity for a participant to reveal that he or she has had suicidal ideation in the past two weeks (Patient Health Questionnaire, Question 9). This is something to explore further. As I have been trained in psychological risk assessments, it seems appropriate to carry out a further risk assessment. Optionally with the tape recorder turned on, or off as requested. Any text recorded during the risk assessment will not be included in the language analysis. Following this, some information about local services such as Improving Access to Psychological Therapies (IAPT), Samaritans and other appropriate services will be provided. A discussion will then be made about whether it is appropriate to notify the GP of the disclosure. In the event that there is imminent risk to self or others,

a discussion will be made about who I need to contact. (Crisis Team and GP). In the event that the participant scores 0 on Q9 of the PHQ, no risk assessment will be undertaken.

5.7.9 What happens at the end of the data collection phase if there is a suspected decline in a participant's cognitive function

5.8 Chapter 7: Overall results and Discussion

5.9 Chapter 8: Conclusions and Future work

6 Reflection on my experience so far

References

A Title of Appendix A

Text of Appendix A is Here

B Title of Appendix B

Text of Appendix B is Here

C Title of Appendix C

Text of Appendix C is Here.