

**OUR FUTURES IN MIND UPLOADING: PUBLIC PERCEPTIONS AND  
NARRATIVES**

**Angela Claire Thornton**

**Thesis submitted to the University of Nottingham**

**For the degree of Doctor of Philosophy**

**November 2023**

## **Abstract**

Advances in neurotechnology, have immense potential but also pose significant ethical challenges since they implicate fundamental human capacities such as identity, agency, and autonomy. Hence the development of neurotechnology is being prioritised by intergovernmental organisations such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) and The Organisation for Economic Cooperation and Development (OECD). The aim is to ensure neurotechnology development is grounded in principles of Responsible Research and Innovation (RRI) and is responsive to all stakeholders.

While the public is a key stakeholder, research, and engagement with this audience is understudied. To address this gap, I implemented a multistage, multi-method, research programme which was informed by an e-Delphi study with multidisciplinary experts. My research used mind uploading as an exemplar for hypothetical future neurotechnology and contributes new data to an understudied field.

To encourage participants to connect with mind uploading, I designed a novel data collection tool and method - a website that told the stories of two fictional mind uploaded characters. This method was effective in facilitating narrative transportation, engagement and character identification and illustrated important ethical themes such as personal identity, subjective experience, immortality, and embodiment. My results showed that while awareness of mind uploading has remained relatively static over the last few years, favourability towards the concept has significantly increased, reflected in an increasing number of people who would

upload if their physical body was dying and search for meaning in this new afterlife. However, despite the increasing use of Virtual Reality (VR) an afterlife as an avatar was unappealing and participants wanted a physical body the form of which was important. Reactions to the concepts of life extension and immortality indicated that an extended life span, which is potentially becoming more feasible, would be positively received, immortality less so.

However, while the public could identify several benefits for mind uploading, primarily a continued connection to loved ones, they were clearly concerned how neurotechnology, particularly that which would augment our existing capabilities, might develop. Public concerns reflected those of policymakers and scientists including data protection, privacy, and security although public priorities sometimes differed. Participants confirmed the need for regulation to ensure neurotechnology is not discriminatory and does not create an even greater divide between the privileged and disadvantaged. There were clear indications of the public's interest in mind uploading as an example of future neurotechnology which signposts future opportunities in public research and public science.

## **Acknowledgements**

First and foremost, I must thank my supervisors – Alexandra Lang, Dimitris Papadopoulos, and Elvira Perez Vallejos. I couldn't have started this journey without them let alone finished it. I was fortunate to have a team with such a wide range of academic expertise who was always supportive, inspiring, and interesting.

I'd also like to thank my industry partner – The Carboncopies Foundation - and specifically Dr Randal Koene, who taught me about whole brain emulation and mind uploading. I was fortunate to have such a productive collaboration.

I'm also extremely grateful to everyone at Horizon CDT – the management team who took a chance on a distinctly mature student - and the 2019 cohort who are an amazing crowd.

Special thanks to my amazing family and friends without their support I would not have been able to do this. Mum and Dad for always being there and believing in me and my partner in crime – Emma – who made soothing noises when required, fed me, kept daily life running and still managed to laugh and socialise with me. Finally, a special mention to the pets - B, Sox, Max and my two sadly departed house rabbits Ballyturk and Misterman (aka Ears/Chester/Bun Bun) – my office helpers and personal shredders.

## Academic and Public Engagement

### Academic:

***East Midlands Doctoral Network*** on Interdisciplinarity and Collaboration 21<sup>st</sup> September 2022. A webinar on Mind Uploading: An Interdisciplinary and Collaborative Approach to Exploring Future Worlds.

***Festival of Ideas*** on 22<sup>nd</sup> and 23<sup>rd</sup> September 2022. Poster displayed throughout the event.

***National Centre for Research Methods (NCRM) e-Festival*** on 9<sup>th</sup> November 2023. A webinar on Our Futures in Mind Uploading: Public Perceptions & Narratives.

### Awards & Recognition:

One of seven Award Lecturers (Digital Innovation) at The British Science Festival 2023 on the 7<sup>th</sup> of September 2023.

### Press:

***Article in magazine for Nottingham Festival of Science and Curiosity (FOSAC)*** in February 2021.

***Article in The Conversation*** published in June 2023

<https://theconversation.com/how-uploading-our-minds-to-a-computer-might-become-possible-206804>

***Article in Dazed Digital (Life and Culture)*** published July 2023.

<https://www.dazeddigital.com/life-culture/article/60341/1/mind-uploading-key-to-eternal-life-or-terrifying-dystopia-neuralink-elon-musk>

**Public Science Lecture at the University of Nottingham** on 15<sup>th</sup> December 2022.

**Public Science Lecture at Pint of Science** on 23<sup>rd</sup> May 2023.

**Demonstration with electronic music composers at Creative Reactions** on 19<sup>th</sup> May 2023

**Segment on Notts TV** on 6th June 2023

**Further Funding:**

Engineering and Physical Sciences Research Council (EPSRC). Grant 2279195.

Awarded Small and Large Impact Grants 2022-2023.

## **Background**

I am a PhD candidate from the Horizon Centre for Doctoral Training (CDT) at the University of Nottingham and am currently based in the Human Factors Research Group alongside my Lead Supervisor. A key requirement of Horizon is a multidisciplinary theme and team. Hence, I have three supervisors. These are Professor Alexandra Lang who leads and specialises in Human Factors but also has expertise in Computer Science and Medicine, Professor Elvira Perez Vallejos who specialises in citizen-centric approaches to social media, cybersecurity, and digital humanism and Professor Dimitris Papadopoulos, whose research is in the intersection of science and technology studies, social theory, cultural, and visual studies, and the environmental humanities. My theme of mind uploading spans many of these themes.

Horizon stipulates that PhD candidates must have an industry partner and mine is The Carboncopies Foundation (CCF), a not-for-profit organisation with headquarters in the USA and a global membership of volunteers. CCF was founded by a computational neuroscientist, Dr Randal Koene, who pioneered the field of whole brain emulation (WBE) and CCF's vision is an "expedited future where whole brain emulation benefits humanity and individuals." (The Carboncopies Foundation, 2023, About, para 2.) I am on the Board of Directors and lead the Ethics Department with the aim that we contribute to efforts to ensure neuroscience and neurotechnology are developed ethically and responsibly.

## **Research Expertise**

Many years working as an industry researcher as well as my academic experience mean I appreciate the importance of using both quantitative and qualitative methods to answer the research question and to ensure that the solution is both insightful and practical (Bryman, 1988; Gibson, 2017; Plano, Clark & Badiie, 2010). I follow Feltzer (2010, p.3) in believing that “a pragmatic approach to problem-solving in the social world offers an alternative, flexible, and more reflexive guide to research design and grounded research.” This approach reflects my belief that one traditional philosophy, one way of viewing the world, and one truth does not reflect the infinite meaning of human experience, where attitudes and experiences change over time. As one of the pioneers of pragmatism stated, “We live in a world in process. The future, although continuous with the past is not its bare repetition” (Dewey, 1929, p.40).

## **Reflexivity**

All research is dependent on and influenced by the researcher (Anderson, 2010). However, in qualitative research, which makes a substantial contribution to my thesis, this influence is inherent and is often discussed as “bias.” Bias, as defined by Simundić (2013), is “any trend or deviation from the truth in data collection, data analysis, interpretation, and publication which can cause false conclusions.” However, this term comes from quantitative research and there is some contention about how to apply it to qualitative research or indeed if it even should be. As Galdas observed, in qualitative work the researcher is an “integral part of the process and final product, and separation from this is neither possible



nor desirable” Galdas (2017, p.2) claims that we should not try to convince that qualitative work reflects objective, opinion-free neutrality but recognise the interpretative value that it brings to the table.

However, that is not to diminish the importance of reflecting on our influence on research and our practice. This “reflexivity” is generally understood as “awareness of the influence a researcher has on the people or topic being studied, while simultaneously recognizing how the research experience is affecting the researcher” (Gilgun, 2008, p.1). Reflexivity is often seen as necessary to “enhance the credibility of the findings by accounting for researcher values, beliefs, knowledge, and biases” or to put it another way “*accounting for oneself in the research*” (Cutcliffe, 2003, p.11).

However, achieving and demonstrating true reflexivity is a challenge and potentially even impossible. We can only reflect on what we are consciously aware of and as a qualitative researcher you draw on your tacit knowledge. Hence it is often beyond your ability to fully articulate how you reached this conclusion or knew it to be the case (Cutcliffe & McKenna, 1999; Glaser, 1978, 1998).

Hence, rather than trying and failing to fully account for my role in the research perhaps by writing a detailed reflexive essay I followed the approach advocated by (Glaser, 1978, 1992, 1998). This approach meant I took spontaneous notes and recorded “insights” as they came to me at all times. This included interviewing or moderating, collecting, and analysing data. This allowed me to focus my attention on the process rather than try and simultaneously reflect on my position.

Hence as Cutcliffe (2003) and Probst (2015) suggest I have included a statement that outlines my background and interest in the research. However, I also acknowledge that there are some processes of which I am unaware and some influences on me as an individual that I cannot explicitly state.

### **My Statement**

I obtained my BSc in Psychology in 1988 but in 2018 I returned to higher education to complete my master's in Psychological Research and subsequently my PhD. Before that, I was an industry researcher for over 30 years. My research was predominantly qualitative, and I specialised in healthcare. I have always been fascinated by science and psychology specifically but until my PhD, my only exposure to mind uploading was through science fiction. However, the programme of public research described in this document made me reflect on how privileged I have been to have had a fulfilling industry career and an opportunity later in life to complement this academically.

## Table of Contents

Abstract .....	i
Acknowledgements .....	iii
Academic and Public Engagement.....	iv
Background .....	vi
Table of Contents .....	x
List of Tables .....	xxi
List of Figures .....	xxiii
Chapter 1 Introduction .....	1
1.1 Why Mind Uploading? .....	1
1.2 Research Questions .....	3
1.3 Overview of Research .....	4
1.4 The Current State of Science .....	6
1.5 The Impact .....	7
1.6 Definition of Mind Uploading.....	9
1.7 One Potential Path to Mind Uploading.....	10
1.8 Theoretical Framework.....	13
1.9 Metaphysical Challenges and Assumptions .....	15
1.9.1 Consciousness .....	15
1.9.2 Personal Identity.....	17
1.10 Assumptions for Mind Uploading.....	18
1.11 Existing Research on Public Response.....	19
1.12 The Research Gap .....	22
1.13 Conclusion .....	22
Note regarding Appendices. ....	23

Chapter 2 Expert Consensus on Key Concepts .....	24
2.1 Key Concepts and Expert Opinion.....	24
2.2 Method – Qualitative e-Delphi Study .....	25
2.2.1 Research Questions .....	27
2.2.2 Ethical Considerations.....	29
2.2.3 Recruitment .....	29
2.2.4 Response .....	33
2.2.5 Participants.....	34
2.2.6 Controlled Feedback .....	35
2.3 Thematic Analysis .....	36
2.4 Results .....	38
2.4.1 Definition of Memory.....	39
2.4.2 Definition of Mind.....	42
2.4.3 Relationship between Mind and Body .....	43
2.4.4 Relationship between Memory and Mind.....	43
2.4.4.1 Case Studies.....	45
2.5 Central Themes.....	46
2.5.1 Time and Memory.....	46
2.5.2 Persistence of Memory .....	48
2.5.3 Time and Technology .....	50
2.5.4 Personal Identity and Sense of Self.....	54
2.5.5 Collective Memories .....	57
2.5.6 Accuracy of Memory .....	59
2.5.7 Forgetting .....	60
2.5.8 Neurorights .....	62

2.5.9	An Individual Vision of a Far, Far Future .....	65
2.6	Limitations .....	66
2.7	Discussion .....	67
2.8	Conclusion.....	68
Chapter 3 Public Research Methodology .....		70
3.1	Introduction.....	70
3.2	Research Questions .....	70
3.3	Overview of Approach .....	71
3.4	Ethics.....	73
3.4.1	Informed Consent.....	74
3.4.2	Confidentiality and Anonymity .....	74
3.4.3	Personal and Sensitive Information .....	76
3.5	Pilot - Online Survey (QUANT + qual) .....	78
3.5.1	Objectives.....	78
3.5.2	Method .....	78
3.5.3	Materials.....	78
3.5.4	Recruitment .....	80
3.5.5	Participants.....	80
3.5.6	Analysis .....	81
3.5.7	Results .....	82
3.6	Study 1 - Online Qualitative Interviews and Focus Groups (QUAL) ...	82
3.6.1	Objectives.....	82
3.6.2	Method .....	82
3.6.3	Materials.....	84
3.6.4	Recruitment .....	86

3.6.5	Participants.....	87
3.6.6	Analysis .....	88
3.6.7	Results .....	88
3.7	Framing a Solution .....	89
3.7.1	Mental Models .....	89
3.7.2	Pathways to Mind Uploading .....	90
3.8	Study 2 - Longitudinal Qualitative Interviews (QUAL).....	92
3.8.1	Objectives.....	92
3.8.2	Method .....	92
3.8.3	Materials.....	93
3.8.4	Recruitment .....	94
3.8.4.1	Prolific .....	95
3.8.5	Participants.....	96
3.8.6	Analysis .....	97
3.9	Optional Engagement Tasks .....	97
3.9.1	Objectives .....	97
3.9.2	Method and Materials .....	97
3.9.3	Recruitment.....	102
3.9.4	Participants.....	102
3.9.5	Analysis .....	102
3.10	Researching Future Worlds.....	103
3.10.1	Objective .....	103
3.10.2	Evaluation of Potential Methods .....	103
3.10.3	Games as a Method .....	105
3.10.4	Website .....	107

3.11	Study 3 – Storytelling Website (quant+ qual).....	112
3.11.1	Objectives.....	112
3.11.2	Materials.....	112
3.11.3	Method .....	114
3.11.3.1	Website Survey and Story Flow .....	116
3.11.4	Copyright Law.....	119
3.11.5	Recruitment .....	120
3.11.6	Participants.....	120
3.11.7	Analysis .....	121
3.12	Secondary Themes .....	122
3.13	Discussion .....	125
3.14	Conclusions.....	126
Chapter 4 Public Awareness and Attitudes to Mind Uploading.....		129
4.1	Introduction to Data Sets .....	129
4.2	Pilot Online Survey.....	131
4.2.1	Attitudes towards Science Fiction (Sci-Fi) .....	131
4.2.2	Awareness of Mind Uploading.....	136
4.2.3	Favourability towards Mind Uploading (Prompted).....	137
4.2.4	Willingness to Mind Upload (Prompted) .....	139
4.2.5	Limitations .....	141
4.2.6	Discussion .....	142
4.3	Study 1 and Study 2 Online Qualitative Groups & Interviews.....	143
4.3.1	Brain, Mind, and Body .....	143
4.3.2	Awareness of and Attitudes towards Mind Uploading.....	145
4.3.3	Limitations .....	149

4.3.4	Discussion .....	150
4.4	Optional Engagement With AI Apps and BCIs .....	151
4.4.1	AI Apps.....	151
4.4.1.1	Alter Ego .....	153
4.4.1.2	I Meet Myself.....	153
4.4.1.3	Replika .....	154
4.4.1.4	Karen.....	155
4.4.2	BCIs.....	155
4.4.3	Uploading Memories.....	161
4.4.4	Results .....	162
4.4.5	Discussion .....	163
4.5	Public Response to Mind Uploading via Storytelling Website.....	164
4.5.1	Pre-Website Awareness of Mind Uploading .....	166
4.5.2	Pre-Website Favourability towards Mind Uploading .....	167
4.5.3	Introduction to Mind Uploading .....	168
4.5.4	Reactions to Mind Uploading Stories (of Nathan and Simon)..	169
4.5.5	Response to the Scanning Process.....	170
4.5.6	Reactions to Uploading .....	172
4.5.7	Response to Nathan’s Upload and Initial Experience.....	173
4.5.8	Level of Appeal of Unlimited vs. Limited Resources.....	175
4.5.9	Advancing or Changing what it means to be Human.....	177
4.5.10	Uniqueness and Survival.....	181
4.5.11	Subjective Experience .....	183
4.5.12	Immortality vs. Life Extension .....	192
4.5.13	Key Positive and Negative Attributes of Mind Uploading.....	197



4.5.14	Willingness to Mind Upload when Physical Body is Dying.....	200
4.5.15	Change in Awareness .....	201
4.5.16	Comparative Awareness and Favourability .....	203
4.5.17	Pre-Experience Exposure to Media .....	205
4.5.18	Limitations .....	205
4.6	Discussion .....	207
4.7	Conclusions .....	212
Chapter 5 Memories and Life Stories .....		213
5.1	Introduction.....	213
5.2	Data Set .....	213
5.3	Chapter Structure .....	214
5.4	Expert vs. Public Opinion .....	214
5.4.1	Time and Memory .....	215
5.4.2	Self/Individual vs. Group/Collective Memories .....	217
5.4.3	Accuracy of Memories .....	217
5.4.4	Forgetting.....	218
5.5	Retention, Recall, and Retrieving Memories .....	220
5.6	Recording, Revisiting Memories, and the role of Technology.....	222
5.7	Past Memories .....	224
5.7.1	Interview Method .....	224
5.7.1.1	Example 1 – Panellist ‘R’ (3) .....	225
5.7.1.2	Example 2 – Panellist ‘S’ (10) .....	228
5.8	Categorisation and Contribution of Memories .....	232
5.8.1	Summary of Memory Boards .....	232
5.8.2	Method .....	232

5.8.3 Life Story Analysis .....	235
5.9 Planning for the Future .....	236
5.10 Predicting the Future .....	237
5.10.1 Example 1 – Panellist ‘R’ (3).....	237
5.10.2 Example 2 – Panellist ‘S’ (10) .....	239
5.11 Using the Past to Predict the Future .....	241
5.12 Reflection on the Interviews .....	242
5.13 Discussion .....	244
5.14 Conclusions.....	245
Chapter 6 Science and Stories .....	246
6.1 Introduction.....	246
6.2 Role of Storytelling .....	246
6.3 Definition of a Story or Narrative .....	247
6.4 Composition and Analysis of Media (Upload and Soma).....	248
6.5 Analysis of Narrative Structure in Upload and Soma.....	251
6.5.1 Act 1 Set-up.....	254
6.5.2 Analysis of Website Story vs. Three-Act Story Arc.....	255
6.6 Narrative in Different Media.....	258
6.7 Evaluation of Storytelling Website .....	260
6.8 The Concept of Narrative Experience.....	260
6.9 Methods of Measurement.....	261
6.10 Transportation .....	264
6.10.1 Attentional Focus.....	267
6.10.2 Emotional Components .....	268
6.10.3 Imagination .....	270

6.11	Narrative Engagement.....	271
6.11.1	Narrative Understanding.....	273
6.11.2	Narrative Presence.....	273
6.12	Character Identification.....	274
6.13	Rating Scales used on the Website .....	274
6.14	Evaluation of Storytelling Website on Key Dimensions .....	276
6.14.1	Analyses.....	276
6.14.2	Data Sets for Public Research.....	277
6.14.3	Transportation .....	278
6.14.4	Discrete Emotions .....	279
6.14.5	Imagination.....	280
6.14.6	Scores for Engagement.....	284
6.14.7	Summary of Emotional Effect .....	286
6.14.8	Character Identification .....	287
6.15	Overall Reaction to the Narrative.....	290
6.16	Reaction to the Website Design .....	291
6.17	Future Developments .....	291
6.18	Participant’s Final Comments.....	292
6.19	Quality Assessment.....	292
6.20	Limitations .....	293
6.21	Discussion .....	294
6.21.1	Narrative Experience Assessment.....	295
6.21.2	Mind Uploading Stimulus Material.....	295
6.22	Conclusions.....	297
	Chapter 7 Discussion .....	299

7.1	Potential Impact of Neurotechnology.....	299
7.2	Research Considerations .....	300
7.3	Scope of My Research .....	300
7.4	Key Results .....	301
7.4.1	Expert Consensus on Key Concepts (e-Delphi study).....	301
7.4.2	How Public Perceptions compare with Experts .....	303
7.4.3	Public Awareness and Response to Mind Uploading .....	304
7.4.3.1	Theology .....	305
7.4.3.2	Embodiment .....	305
7.4.3.3	Age.....	307
7.4.3.4	Sex.....	308
7.4.4	Public Recall of their Past, and Imagining Their Future.....	308
7.4.5	Public Response to Future Stories of Mind Uploading .....	308
7.5	Limitations .....	309
7.6	Future Research .....	311
7.6.1	Physiological Measures of Narrative Experience.....	311
7.6.2	Design Fiction & Science Fiction .....	311
7.7	Personal Reflection .....	312
7.8	Concluding Statements .....	313
	REFERENCES.....	315
	Appendix A: Pilot Questionnaire .....	355
	Appendix B: Study 1 Discussion Guide .....	368
	Appendix C: Study 2 Discussion Guide – Stage 1.....	372
	Appendix D: Study 2 Discussion Guide – Stage 2.....	374
	Appendix E: Questionnaire for AI Apps .....	377

Appendix F: BCI Questionnaire .....	380
Appendix G: AfterLives Questionnaire.....	388
Appendix H: Science Fiction Hobby-ism Scale.....	427
Appendix I: Memory Boards .....	428
Appendix J: Narrative Changes .....	456

## List of Tables

Table 1.1 <i>Overview of Research</i> .....	5
Table 1.2 <i>Neurorights</i> .....	8
Table 2.1 <i>Strengths and Weaknesses of Delphi Technique</i> .....	27
Table 2.2 <i>e-Delphi Research Questions for Experts</i> .....	28
Table 2.3 <i>Expert Research Specialty</i> .....	32
Table 2.4 <i>The Functions of Forgetting</i> .....	61
Table 3.1 <i>Data Set for Power Analysis</i> .....	121
Table 3.2 <i>Power Analysis (from SPSS)</i> .....	122
Table 4.1 <i>Comparative Mean Scores for Sci-Fi Hobby-ism</i> .....	136
Table 4.2 <i>BCI Engagement Videos</i> .....	156
Table 4.3 <i>Scan and Upload</i> .....	169
Table 4.4 <i>Nathan's First Day</i> .....	174
Table 4.5 <i>Nathan Scenario 2</i> .....	175
Table 4.6 <i>Simon's Embodiment</i> .....	179
Table 4.7 <i>Simon's Ending</i> .....	181
Table 4.8 <i>Evaluation of Soma's Questions and Responses</i> .....	186
Table 4.9 <i>Most Appealing Attributes of Mind Uploading</i> .....	198
Table 4.10 <i>Most Worrying Attributes of Mind Uploading</i> .....	199
Table 4.11 <i>Comparative Awareness of &amp; Favourability Towards Mind Uploading</i> .....	204
Table 4.12 <i>Comparative Favourability Towards Mind Uploading (Means)</i> .....	205
Table 5.1 <i>Life Story Coding</i> .....	234
Table 6.1 <i>Summary of Rating Scales</i> .....	275
Table 6.2 <i>Scores for Transportation</i> .....	278

Table 6.3 <i>Discrete Emotions</i> .....	280
Table 6.4 <i>Imagination</i> .....	281
Table 6.5 <i>Engagement</i> .....	284
Table 6.6 <i>Website Back Story for Nathan and Simon</i> .....	286
Table 6.7 <i>Character Identification – Nathan and Simon</i> .....	288
Table 6.8 <i>Narrative Arc</i> .....	295

## List of Figures

Figure 1.1 <i>Simplified Process for Whole Brain Emulation</i> .....	11
Figure 2.1 <i>Key Questions for SQEP</i> .....	31
Figure 2.2 <i>Central Themes From e-Delphi Study</i> .....	38
Figure 3.1 <i>Multi-staged Public Research Methodology</i> .....	72
Figure 3.2 <i>Structure of Focus Group Discussion</i> .....	84
Figure 3.3 <i>Potential Pathways to Mind Uploading</i> .....	91
Figure 3.4 <i>Stage 1 Interviews - Discussion Flow</i> .....	93
Figure 3.5 <i>Stage 2 Interviews - Discussion Flow</i> .....	94
Figure 3.6 <i>Interactive Apps for Engagement</i> .....	99
Figure 3.7 <i>BCI Engagement Videos</i> .....	101
Figure 3.8 <i>Potential Tools &amp; Techniques to Research Hypothetical Futures</i> ....	104
Figure 3.9 <i>NASA</i> .....	109
Figure 3.10 <i>Opera North</i> .....	109
Figure 3.11 <i>Robert Space Industries</i> .....	110
Figure 3.12 <i>Afterlives Website</i> .....	116
Figure 3.13 <i>Website Structure</i> .....	117
Figure 3.14 <i>Sci-fi Hobby-ism Items</i> .....	124
Figure 3.15 <i>Multi-staged Public Research Methodology</i> .....	127
Figure 4.1 <i>Data Sets for the Programme of Public Research</i> .....	131
Figure 4.2 <i>I Think Science Fiction (Sci Fi) is an Interesting Topic</i> .....	133
Figure 4.3 <i>I Try to Actively Follow the Latest Developments in Natural Sciences or Technology</i> .....	134
Figure 4.4 <i>I Often Contemplate Matters Dealing With Artificial Intelligence (AI)</i> 134	
Figure 4.5 <i>I am Familiar With Transhumanism</i> .....	135



Figure 4.6 <i>Awareness of Mind Uploading</i> .....	137
Figure 4.7 <i>Favourability Towards Mind Uploading</i> .....	138
Figure 4.8 <i>Willingness to Mind Upload</i> .....	140
Figure 4.9 <i>Apps</i> .....	152
Figure 4.10 <i>Muse</i> .....	157
Figure 4.11 <i>BrainBit</i> .....	158
Figure 4.12 <i>NextMind</i> .....	159
Figure 4.13 <i>Neurable</i> .....	160
Figure 4.14 <i>Neurable VR</i> .....	160
Figure 4.15 <i>Uploading Memories</i> .....	161
Figure 4.16 <i>Pre-Website Awareness of Mind Uploading</i> .....	167
Figure 4.17 <i>Pre-Website Favourability to Mind Uploading</i> .....	168
Figure 4.18 <i>Extent Comfortable With Scanning Process for Nathan</i> .....	171
Figure 4.19 <i>Extent Comfortable With Scanning Process for Simon</i> .....	172
Figure 4.20 <i>Extent Comfortable With Simon’s Scan &amp; Upload</i> .....	172
Figure 4.21 <i>Appeal of Nathan’s Upload</i> .....	174
Figure 4.22 <i>Appeal of 2GB Upload</i> .....	176
Figure 4.23 <i>Belief in Using Science &amp; Technology to Develop Both Physically and Mentally</i> .....	178
Figure 4.24 <i>Willingness to Exist in a Robot Body</i> .....	179
Figure 4.25 <i>Preferred Form</i> .....	180
Figure 4.26 <i>Willingness to Exist as a Copy vs. an Original</i> .....	182
Figure 4.27 <i>Extent Concerned “Not Truly You”</i> .....	183
Figure 4.28 <i>“If I was an upload, I would feel ...” Positive Associations</i> .....	184
Figure 4.29 <i>“If I was an upload, I would feel ...” Negative Associations</i> .....	185
Figure 4.30 <i>I would be troubled by the fact that I am no longer strictly human?</i> .....	188

Figure 4.31 <i>How would you perceive your new existence?</i> .....	188
Figure 4.32 <i>Do you think this new existence would be a life worth living?</i> .....	189
Figure 4.33 <i>Appeal of Immortality</i> .....	192
Figure 4.34 <i>Appeal of Life Extension</i> .....	193
Figure 4.35 <i>Life Extension vs. Immortality</i> .....	193
Figure 4.36 <i>Willingness to Mind Upload</i> .....	201
Figure 4.37 <i>Change in Awareness of Mind Uploading</i> .....	202
Figure 4.38 <i>Favourability towards Mind Uploading</i> .....	203
Figure 4.39 <i>Branching Identity</i> .....	210
Figure 6.1 <i>Three-Act Story Arc</i> .....	253
Figure 6.2 <i>Narrative Flow</i> .....	256
Figure 6.3 <i>Narrative Structure of Website</i> .....	257
<i>Fig 6.4 Components of Narrative Experience</i> .....	261
Figure 6.5 <i>Elements of Transportation</i> .....	264
Figure 6.6 <i>Elements of Engagement</i> .....	271
Figure 6.7 <i>Preference for Storytelling Website vs. Game</i> .....	292
Figure 7.1 <i>Research Questions and Chapters</i> .....	301
Figure 7.2 <i>Definition of Generations</i> .....	307

## Chapter 1 Introduction

### 1.1 Why Mind Uploading?

The concept of Mind Uploading has been around since the 1950s and although the initial author is debated, I attribute it to Arthur C. Clarke's novel *The City and the Stars* (1955) where individual's minds are uploaded and stored in a computer at the end of their life and can then be downloaded to artificial bodies.

In the intervening years many books, films, and dramas have revisited the topic with mind uploading featured in TV programmes like *Black Mirror* (Jones & Brooker, 2011–present) and *Years and Years* (Cellan Jones & Shindler, 2019) as well as Netflix's *Altered Carbon* (Lenic, 2018-2020) and Amazon's *Upload* (Daniels & Klein, 2020–present). Today, science fiction or sci-fi is one of the most popular genres in literature (Harari, 2018).

Mind uploading can be conceptualised as the ultimate expression of neurotechnology, transforming the human brain and mind and allowing us to exist in a non-biological form. The definition and theoretical framework for this concept are discussed in Section 1.6.

Current neurotechnology restores normal function to patients and offers vast potential for the treatment of disease and neurological or cognitive disorders. However, when coupled with Artificial Intelligence (AI), the implications go far beyond medical/clinical applications. A recent *Financial Times* article (Cookson, 2023) cites Mariagrazia Squicciarini, a UNESCO economist, describing the combination of neurotechnology and Artificial Intelligence (AI) as “like putting neurotechnology on steroids,” and it is feasible that in the future we will be able to

augment or enhance human cognition beyond what is considered “normal.” As a recent UNESCO report stated, “The developments that many thought were science fiction only a few years ago are here with us already” (Hain et al., 2023, p.7).

Mind uploading has attracted considerable attention in both popular and academic/scientific media. Since I started my PhD in 2019, there has been an explosion in the number of academic publications as well as articles for public consumption. A literature search on Google Scholar using “mind uploading” as keywords revealed over 17,000 published works since 2019 alone. However, public response to neurotechnology and mind uploading is understudied (Burwell et al., 2017; MacDuffie et al., 2022) and I review the small body of available literature in Section 1.11. This lack of public research and engagement falls short of the principles of responsible research and innovation (RRI), which implies “societal participation at the early stage of envisioning research questions, technologies, and futures” (Sovacool et al., 2020).

At this point, I note my use of the term “public” throughout. I follow Mohr (2013), by using this to denote the “static views of forms of behaviour that can be accurately captured by research.” which in this case represents the participants in my studies. I do not use the term “public” to necessarily denote a majority perspective and I acknowledge “plurality and differences in public opinion” (Raman, 2019). When I refer to “public research” I refer to research among the public rather than publicly available research.

## 1.2 Research Questions

The overarching Research Question (RQ) underpinning this programme of research was “How does the public feel about neurotechnology that may transform memory and mind and ultimately allow us to mind upload?”

This RQ focuses on mind uploading in the context of future neurotechnology and is underpinned by the principles of responsible research and innovation (RRI). The RRI Consortium which developed the RRI toolkit states that “public engagement can help bring policies on RRI closer to society making them more robust and legitimate” (RRI Tools, n.d.) and my research reflects this aim.

My research was highly iterative and adaptive; each stage was analysed and reflected upon before the next stage was designed. Full details of the multistage methodology are discussed in Chapter 3. This methodology looked to answer the main RQ via the following constituent RQs.

- What consensus, if any, is there among experts on key concepts such as memory and mind?
- How aware of these technologies is the public and how does it respond?
- How does public perception compare with an expert perspective?
- How does the public describe and recall their past and imagine their future?
- How does the public respond to and experience future stories of mind uploading?

I was mindful of the topics identified in existing research so that I could explore these when appropriate. These included data privacy, security, and

consent as well as the abuse or misuse of neural data and the risks of discrimination and inequitable access.

### **1.3 Overview of Research**

The first study I conducted was an e-Delphi study with multidisciplinary experts working in whole brain emulation and related fields. This provided a valuable understanding of key concepts such as memory and mind and the potential implications of neurotechnology and is reported in Chapter 2.

Thereafter I focused on the public's understanding of and response to mind uploading. The study design (detailed in Chapter 3) is significant because of its complexity and novelty. The methodology was multistage and comprised both qualitative and quantitative methods. Two of these, namely longitudinal qualitative interviews and a storytelling website are novel methods and contributed methodological knowledge as well as attitudinal data.

The study details, question areas, and the relevant chapter for reporting are summarised in Table 1.1.

**Table 1.1***Overview of Research*

Study	Chapter	Question Areas
<b>Expert e-Delphi Study</b>	2: Expert Perspective on Key Concepts	Consensus among experts on key concepts such as memory and mind.
<b>N/A</b>	3: Public Research Methodology	Frames and discusses the multi-staged methodology for the core research with the public.
<b>Pilot - Online Survey</b>	4: Public Response to Mind Uploading	Public awareness of and favourability towards mind uploading and propensity to upload.
<b>Study 1 – Online Qualitative Focus Groups &amp; Interviews</b>	4: Public Response to Mind Uploading	Public awareness of and attitudes to mind uploading. Public response to ethical considerations, self-identity, and subjective experience. How public perceptions compare with experts.
<b>Study 2 - Online Longitudinal Qualitative Interviews (2 stages)</b>	5: Memories and Life Stories	Public recall of their memories and life story and their imagined futures.
<b>Optional Engagement</b>	4: Public Response to Mind Uploading	Public response to examples of BCIs and AI-driven apps.

---

<b>Tasks</b>		
<b>Study 3 – Storytelling Website</b>	6: Digital Stories of the Future	Public response to stories of two characters who have uploaded their minds.
<b>N/A</b>	7: Discussion	Discusses key themes and provides a high-level summary of results. Concludes and identifies potential avenues for future research.

---

#### **1.4 The Current State of Science**

As I write this in 2023, the scientific and popular press have recently reported on a groundbreaking brain-computer interface (BCI) that allowed a paralyzed woman to communicate through a digital avatar. This advancement marks the first-ever synthesis of speech or facial expressions directly from brain signals. The system can convert these signals to text at an impressive rate of nearly 80 words per minute, significantly surpassing existing technologies. The study “reading the brain” presents a significant leap toward restoring comprehensive communication for paralyzed individuals (Metzger et al., 2023).

While writing to the brain is less advanced, we already have a hippocampal neural prosthetic that has demonstrated a significant improvement (35%) in both short-term and long-term retention of visual information and an implantable neural prosthetic to improve human memory is being constructed (Hampson et al., 2018).



Future developments may allow us to record experiences as they happen and read/write these memories externally, allowing easy and accurate recall and retrieval (Teeuwen et al., 2018). A novel theory of memory MeshCODE (Goult, 2021) proposes a physical mechanism of memory storage in binary code, and if we can unlock it, could facilitate such advances.

These innovations are underpinned by substantial global investment both from governments and private investors. In the last 10 years, governments invested more than six billion dollars in neuroscience with private funds of over seven billion dollars. The neurotechnology market alone is projected to be worth over 24 billion dollars by 2027 (UNESCO, 2023). Coupled with investments in AI totalling approximately 92 billion dollars in 2022 and with a projection of 200 billion by 2025 (Goldman Sachs, 2023), technologies such as brain/mind augmentation and mind uploading cannot be definitively discounted.

### **1.5 The Impact**

The following statement from UNESCO (2023) indicates the extent to which neurotechnology is already on the agenda of governmental and intergovernmental organisations.

“The fast-developing field of neurotechnology is promising but we need a solid governance framework for non-invasive methods. Combined with artificial intelligence, these techniques can enable developers, public or private, to abuse cognitive biases and trigger reactions and emotions without consent. Consequently, this is not a technological debate, but a societal one. We need to react and tackle this together, now!”

The risks neurotechnology poses to “human rights and fundamental freedoms” (UNESCO, 2023), have come to be termed “Neurorights.” Neurorights can be defined as “the ethical, legal, social, or natural principles of freedom or entitlement

related to a person’s cerebral and mental domain; that is, the fundamental normative rules for the protection and preservation of the human brain and mind” (Ienca, 2021). There is a debate about the number and precise definition of items, but I am using those created by The Neurorights Foundation (Yuste, 2021) and cited by UNESCO in their 2023 Neurotechnology report. The five key rights are as follows:

**Table 1.2**

*Neurorights*

<b>Neurorights</b>	<b>Definition</b>
Mental Privacy	The ability to keep thoughts protected from disclosure
Personal Identity	The ability to control both one’s physical and mental integrity
Agency	The freedom of thought and free will to choose one’s actions
Fair Access to Mental Augmentation	The ability to ensure that the benefits of improvements to sensory and mental capacity through neurotechnology are distributed justly in the population
Protection from Algorithmic Bias	The ability to ensure that technologies do not insert prejudices

Data privacy and protection is a global concern although the robustness of these policies varies by country (Databasix, 2024). In the European Union (EU) personal data is currently processed following the General Data Protection Regulation (GDPR)—articles 13 and 14 and - in the UK - the Data Protection Act (2018). Sensitive personal data currently includes racial or ethnic origin, health-related data, and genetic or biometric data and is additionally protected. Discussions on how to process neural data are ongoing across the world and

indicate that policies like GDPR may be sufficient to mitigate risks but that solely assessing the category of data rather than its characteristics may be insufficient (Ienca & Malgieri, 2022).

## **1.6 Definition of Mind Uploading**

Having referred to mind uploading at the outset, I describe the concept in more depth and consider how it might be possible. Although we lack a clear and consensual definition, the mind is regarded as the seat of many human characteristics and abilities and is inextricably linked to the brain although the relationship between them is the subject of much debate. Being able to upload the mind or mind uploading has many different definitions depending both on the context and discipline.

However, for the remainder of this document, I will define mind uploading as follows:

The process of copying all functional details of a person's (or animal's) brain from their original, biological brain into an artificial system that can carry out all of the normal cognitive functions of that person, retaining memories and personality traits (Koene, 2023).

This definition clearly illustrates the aim of emulating or reproducing our biological brain on an artificial platform or substrate. Theoretical discussions of mind uploading often use examples of the brain and mind being replicated on a digital platform, such as a supercomputer. Uploaded minds are also referred to as emulations as in Robert Hanson's 2016 novel "The Age of Em".

The definition of mind uploading I am using includes several important criteria or "success criteria" (Bostrom & Sandberg, 2008), which would need to be achieved for an individual emulation to be successful. These include reproducing

a person's normal cognitive function. Cognitive function can be defined as "mental processes involved in the acquisition of knowledge, manipulation of information, and reasoning. Cognitive functions include the "domains of perception, memory, learning, attention, decision making, and language abilities" (Kiely, 2014, p.974). A successful emulation would also retain the person's memories and personality. In the broadest sense, the emulation would be you, although how that would be assessed is a complex and contentious area and worthy of its own thesis. My research assumes that the emulated you feels like the "real" or "original" you: namely, that your subjective experience is convincing both to you and others.

### **1.7 One Potential Path to Mind Uploading**

While it is outside the scope and expertise of this thesis to provide a detailed analysis of the science and technology necessary to achieve mind uploading, it is important to contextualise the concept.

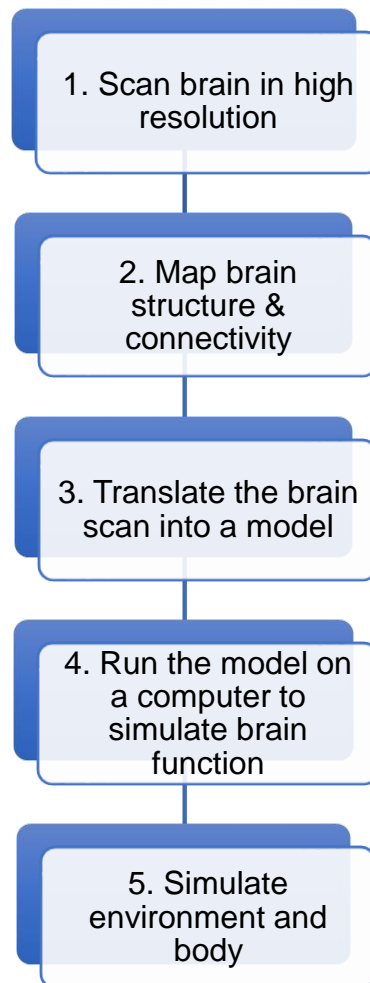
One possible route to mind uploading is whole brain emulation. This is a technical solution to reverse engineer a biological brain. This would hypothetically allow a biological brain to be reproduced or emulated on a different platform or substrate. This area has attracted billions of pounds in funding and several international multidisciplinary research groups are working in this area, including the Human Connectome Project, The Human Brain Project, the BRAIN Initiative, The Blue Brain Project, and the Allen Institute for Brain Science.

While the goal is to understand the human brain, the pathway to understanding requires us to map the brains of other, less complex invertebrates and vertebrates. Regardless of the organism, the theoretical process is the same—

it just varies by size and complexity. A simplified representation of whole brain emulation is shown in Figure 1.1

**Figure 1.1**

*Simplified Process for Whole Brain Emulation*



As shown in Figure 1.1, the first step involves scanning the brain and creating “connectomes.” A connectome is “the comprehensive structural description of the network of elements and connections in a nervous system” (Sporns et al., 2005, p.1). Studying connectomes or “connectomics” is a multidisciplinary field spanning neuroscience, neurobiology, engineering,

computing, and artificial intelligence, and it is benefitting from new high-speed, high-resolution electron microscopy and machine learning techniques to visualise and interpret the data.

Earlier this year, researchers (Winding et al., 2023) published a three-dimensional microscopy-based reconstruction of the larval fruit fly brain (*Drosophila melanogaster*). This is the largest synaptic-level connectome reconstructed and analysed to date, comprising 3016 neurons and 548,000 synapses and will provide a valuable reference for future work mapping the connectome of more complex animals. While not undervaluing this achievement, the human brain has approximately 86 billion neurons which we would need to scan and map as the first step in human whole brain emulation. This gives an idea of the scope of the challenge.

In addition, once we have scanned and mapped the connectome, the next step is to translate it into a model we could run on a computer. If successful, then we would have emulated a human brain. Having achieved this in one subject, we would need to recreate an individualised emulation for each upload.

Even this extremely simplified summary of the theoretical steps shows that whole brain emulation in humans is an ambitious task. However, assuming science and technology continue to advance rapidly, whole brain emulation in humans is theoretically a possibility, albeit several decades away. Current estimates of the timeframe vary but even the more ambitious forecasts regard whole brain emulation as at least 60 years and maybe a century hence. However, to place this into context, it has only been 50 years since the first functional magnetic resonance

imaging scan (fMRI), and we have advanced and refined this technology so we can now capture an image that is 64 million times sharper (Johnson et al., 2023).

## **1.8 Theoretical Framework**

Multiple efforts to understand, model, and emulate the brain are forging a path in neuroscience and other related disciplines. However, those looking to create an artificial brain outside the body and those striving for mind uploading make several key assumptions that are much debated.

I summarise the main assumptions and explain which stance I have adopted in my research. An extensive review of the scientific and metaphysical debates is beyond scope and would be a thesis in its own right, but it is important to acknowledge the contention and controversy surrounding mind uploading.

The first assumption is that the mind is what the brain does, a statement generally attributed to Minsky (1987). There are broadly two schools of thought concerning the relationship between the different elements: dualism and monism. Dualists believe that there are two kinds of substance and a human embodies two parts, mind and matter; these parts are separate and each has a different nature (Mehta, 2011). In dualism, the mind is more than just our organic/biological brain, it has a non-material, spiritual dimension that includes consciousness. In contrast, monism assumes only one type of element and hence makes no distinction between mind and matter believing in unity of being (Berecz, 1976). Regardless of discipline, experts hold differing views about the relationship between material and non-material elements. However, those who believe in whole brain emulation and mind emulation/uploading typify the physicalist/materialist/functional stances, as

espoused by Minsky (1987): namely, that the mind is a function of the brain. I am conscious that distinctions can be made between the three stances listed above, but they all believe that everything that exists is material (Robinson, 1998).

The second premise is that the brain and mind could function effectively if separated from the body. This is also contentious since most believe that the brain is embodied, embedded, enacted, or extended, often referred to as the “4E approach to cognition” (Rowlands, 2010). While there are multiple stances on the extent of this embodiment, the basic tenet is that the body is host to the brain and that it is embedded in terms of both its relationship to other functions and systems of the body (Cappuccio, 2017; Papadopoulos, 2011; Rupert, 2009) and the environment that we can sense and interact with (Cappuccio, 2017; O’regan et al., 2005). In contrast, those who believe in mind uploading believe in “brain-centeredness”: namely, that “to produce accurate behaviour only the brain and some parts of the body need to be simulated, not the entire body” (Sandberg, 2008, p.15). Although which “parts” we might need is a question that we haven’t even started to answer on the path to whole brain emulation.

While an emulated existence as an avatar in a virtual world is one option, the weight of opinion (Eth et al., 2013; Linssen & Lemmens, 2016; Sandberg, 2013) is that an emulated brain and mind would require some kind of body. This body - be it simulated in virtual reality (VR) or a physical form of some type such as a robot - would interact with the environment as well as “maintain a model of body state as it affects the emulation” (Sandberg, 2008, p.75). There are theoretical distinctions drawn between the simulation being “adequate” or



“convincing.” An adequate body simulation would allow the emulation to function while a convincing one would feel like the original body and/or actual reality even if the environment was virtual. Given the advances in Immersive Virtual Reality (IVR), it seems feasible that we would be able to synthesise an “interaction with the environment and the simulation activity of our mind” (Cantone, 2022, p.1015). Advances in robotics may enable this route to embodiment since while the use of humanoid robots is still limited, the sector is expected to grow substantially over the next five years with some estimates predicting a value of over 11 billion pounds (Marketsandmarkets.com, 2023). My research explores these themes of embodiment and form.

## **1.9 Metaphysical Challenges and Assumptions**

Mind uploading has provoked much theoretical debate on the implications for personal identity and consciousness (Agar, 2016; Cerullo, 2015; Chalmers, 2014; Goldwater, 2021), to cite but a few. These are large, complex topics and hence the following sections focus on the metaphysics of mind uploading.

### **1.9.1 Consciousness**

While there are many different aspects and definitions of consciousness, I focus on “phenomenal consciousness” which is also referred to as “subjective experience”, “subjective awareness,” “qualia,” or simply the “feeling of being” (Butlin et al., 2023). I chose subjective experience since it features in the stimulus material that participants were exposed to and is a concept that they could understand and relate to.

As Lewis states in an article in *Psychology Today* (2023) “There are a great many theories of consciousness proliferating and competing with each other” but I will follow Ruan (2023) who divides them into two types, namely philosophical vs. scientific. This classification reflects how theories of consciousness have moved from philosophical to theoretical and to the search for empirical evidence aided by the rapid development of neuroscience and cognitive science (Kirkeby-Hinrup & Fazekas, 2021).

Some philosophies of mind believe that some aspects of consciousness cannot be produced by the material brain and no matter how complete a physical explanation is, it would not explain certain aspects such as subjective consciousness (Levine, 1983). This is the “hard problem” of consciousness, as described by Chalmers (1995). Panpsychism is another explanation for consciousness but takes it a step further by stating that consciousness “pervades the universe and is a fundamental feature of it” (Goff, 2019). The hard problem does not allow for an upload to be conscious and those who support panpsychism do not seem to have reached a conclusion on mind uploading. However, I theorise that panpsychism would not support mind uploading since this assumes consciousness is derived from the brain and mind alone.

In this thesis I follow theories based on cognitive neuroscience that assume consciousness occurs because of how we process input or information, and that consciousness is a result of neural function. Recent fields of endeavour include searching for the neural correlates of consciousness (Koch, 2012; Tononi & Koch, 2015), which are the neural mechanisms that result in conscious experience (Crick

& Koch, 1990). Many contemporary neuroscientific theories claim that consciousness is related to a dynamic process of neural signals that is self-sustaining coordinated and responsive to an equally dynamic environment (Dehaene & Changeux, 2011; Northoff & Huang, 2017) Thus the overall conscious experience would be generated by synchronized neural networks that work in parallel (Nani et al., 2019). In theory, if we could emulate these neural connections and dynamics, an upload would be subjectively conscious.

Interestingly Chalmers (2014) observed that we do not know if or how either biological or artificial systems are conscious, and in the absence of what he described as “principled differences” we should assume both systems can be. The possibility that artificial systems could be conscious is attracting considerable attention currently. A group of 19 scientists—spanning neuroscience, computer science, and philosophy—have collaborated to create an initial checklist of criteria to demonstrate consciousness in an artificial system or intelligence (Butlin et al., 2023). In theory, these principles could also be used to assess the subjective consciousness of an upload or emulation.

### ***1.9.2 Personal Identity***

Personal identity is another complex area and as with consciousness, I am discussing this specifically with regard to mind uploading. In my work, the definition of personal identity was contingent on the continuity or connectedness of subjective experience. This follows many other theorists such as Parfit (1971) although the sort of (psychological) continuity or connectedness stated as a requirement differs.

So, what about neuroscientific evidence relating to personal identity? One component of identity involves both reflecting on how we were in the past using memories and predicting and imagining how we will be in the future (Stendardi et al., 2021). This continuity or connectedness links to the definition of personal identity I am using in my work. Several studies have shown that imagining or simulating future events relies on many of the same cognitive and neural processes as remembering past events (Klein, 2013; Schacter et al., 2007; 2012; Schacter & Madore, 2016; Stendardi et al., 2021; Szpunar & McDermott, 2008; Thakral et al., 2021). This relationship between recalling autobiographical memories, for example, and imagining a personal future is an important component of my research with the public.

### **1.10 Assumptions for Mind Uploading**

In “Mind Uploading: A Philosophical Analysis” Chalmers (2014), summarises the big questions that need answers as follows:

“The key question is: will I survive? This question itself is divided into two parts, each corresponding to one of the hardest questions in philosophy: the questions of consciousness and personal identity. First, will an uploaded version of me be conscious? Second, will it be me?” (Chalmers, 2014, p.2)

My assumptions when conducting this research were as follows:

- As an upload, we would want to be conscious (defined as subjective experience) as the alternative is a “zombified existence ... a life of greatly diminished meaning and value” (Chalmers, 2014, p.2).
- We would want to feel that we are the same person/and retain the same connectedness of personal identity (Cerullo, 2015; Chalmers, 2014). This

assumption would be tested by the perceptions of the individual who has been uploaded and the response of others who know them.

### **1.11 Existing Research on Public Response**

A search using the keywords of “public,” “mind uploading” and “neurotechnology” demonstrated the limited research in these areas. An overview of published research among the public is presented here.

In an early study, Arras and Cerqui (2005) surveyed over 2,000 attendees to a robotics exhibit and evaluated the concept of participants having their mobile phone implanted directly into their brain. In 2005, this futuristic concept provoked a largely negative response although a greater proportion of participants aged under 18 years accepted the brain-to-phone fusion. Limitations included a non-representative sample biased towards better-educated, younger individuals and men with an interest in robotics. The effect of age on attitudes to conceptual neurotechnology has been briefly considered in my research and additional data will be collected in the next study in 2024.

More recently, a Pew Research Center poll (Funk et al., 2016) surveyed a nationally representative sample of Americans to establish public attitudes to computer chips implanted in the brains of healthy people that may help improve their concentration and ability to process information. This quantitative data was supplemented by six focus groups. Approximately two-thirds of people were worried about the impact of such brain implants and would not want them. Participants were particularly wary of such advancements being used to boost the

capacities of healthy people to create “superhumans” which is relevant for the theme of mind uploading.

Limitations are not easily identifiable—the design of the questionnaire was informed by focus groups, additional pretests, and external advisers and piloted before the main study.

Another study by Sattler and Pietralla (2022) also demonstrated that using neurotechnology to restore “normal” function was more likely to be accepted than “superior” functioning even if there is a potential bias towards internet users who may have more positive views towards technologies. As mentioned above, mind uploading is discussed in the context of brain enhancement rather than on restoring lost abilities to a “normal” level. Neurotechnology that potentially augments human cognition beyond “normal” occupies a different perceptual space and one relevant to mind uploading (Castelo et al., 2019; Erden & Brey; Funk et al., 2016).

The public’s widespread fears of increased inequality between the “haves” and “have nots” are not restricted to this audience. The implications are considered in current literature such as the ICO Neurotechnology report (Information Commissioner's Office, 2023), as well as concerns of hackers gaining access to the brain implants and being able to control or manipulate them (Funk et al., 2016; Sattler & Pietralla, 2022). My research explores these themes in detail.

Sample et al. (2020) and MacDuffie et al. (2022) both investigated public attitudes to ethical issues associated with neural devices such as brain-to-computer interfaces (BCIs). Both studies also used academic literature to identify

ethical issues, and MacDuffie's research also included a sample of industry experts. Both Sample et al. (2020) and MacDuffie et al. (2022) found that the vast majority of both audiences "endorsed the need for ethical principles/guidelines," (as cited by Pham et al., 2018). However, the public prioritized data privacy and consent more than industry and such differences of opinion between experts and the public are explored in my work. Both Sample et al. (2020) and MacDuffie et al. (2022) recorded limitations: namely, that ethical issues were preselected without the option for participants to add to or comment on. Both studies also used scientific or "advanced" language which may have limited participant understanding. I endeavoured to avoid this when researching the public by exploring their understanding of complex concepts.

There are two published studies on mind uploading and both were quantitative with the first paper (Laakasuo et al., 2018), investigating cognitive factors which may influence how people react to the concept of mind uploading. Results included an indication that people who were anxious about death and condemned suicidal acts were more accepting of mind upload. The research also found that higher science fiction literacy and/or hobby-ism strongly predicted approval of mind uploading. I also explored associations with science fiction hobby-ism in the pilot study and replicated Laakasuo et al.'s (2018) result.

The second paper by the same research group (Laakasuo et al., 2021), investigated if there was a link between people's acceptance of mind uploading and personality traits, specifically the Dark Triad of Machiavellianism, Psychopathy, and Narcissism. Results revealed that Machiavellianism was

associated with favourable views about mind uploading although additional research is required. Samples in the 2018 and 2021 studies were biased towards well-educated participants who were likely to be more curious and open-minded than the average population and focused on “destructive” mind uploading where the brain is destroyed as a consequence. While I did not investigate the same factors, I too chose to use destructive mind uploading in my research because currently, this is the most likely scenario (Koene, 2013).

### **1.12 The Research Gap**

My overarching RQ (Section 1.2) was to explore “how the public feels about neurotechnology that may transform memory and mind and ultimately allow us to mind upload.” This objective was comprised of constituent RQs which speak to gaps in the current literature including:

- What consensus, if any, is there among experts on key concepts?
- How does public perception compare with an expert perspective?
- How aware of these technologies is the public and how does it respond?

Given the speed of neurotechnology development, these topics should be embedded in research and development. There is also an argument that they should be “confronted sooner rather than later because they affect essential notions about who humans are and what they can do” (Funk et al., 2016).

### **1.13 Conclusion**

Comparative data on mind uploading is limited so a detailed literature review was not possible. Therefore, I have read widely about the topics and engaged with experts both through my partnership with The Carboncopies



Foundation and the e-Delphi study reported in Chapter 2. Much of this expert dialogue has focused on the scientific and technological challenges associated with whole brain emulation and mind uploading. I have familiarised myself with the philosophical questions around personal identity and consciousness as they relate to mind uploading although I readily acknowledge the complexity of these topics. My research intersects with many other disciplines including neuroscience, narrative, and HCI. I read widely to investigate existing theories and practices and this literature is embedded in the relevant chapters.

The limited reference framework also has advantages. First, it means my research topic is novel as defined by Kumar et al, (2023, p.1) namely that “one or more elements of research that are unique, such as a new methodology or a new observation that leads to the acquisition of new knowledge.” My research provides new data on mind uploading as future neurotechnology and demonstrates a programme of public research and engagement that embodies the principles of RRI and contributes to the goal of “forging a new social contract between society and technoscience.” (Flink & Kaldewey, 2018, p.7).

***Note regarding Appendices.***

My use of traditional thematic analysis using Word and pen and paper rather than Computer Assisted Qualitative Data Analysis Software such as NVivo added considerable length to the Appendices. This factor, when combined with the number of studies and detailed study information provided in each case, would have exceeded the word limit. I have therefore taken the decision to streamline the Appendices and prioritised the study questionnaires. However, the thematic analyses and information sheets for each study are available on request.

## Chapter 2 Expert Consensus on Key Concepts

### 2.1 Key Concepts and Expert Opinion

My research primarily explores the public response to a conceptual journey. It begins with human memory and mind, explores the implications of augmenting these faculties, and culminates with mind uploading. However, before exploring this narrative with the public, I needed to understand how experts defined these concepts so that I could frame them appropriately for the public. A hypothetical scenario where memories could be stored externally from our biological brain was used to elicit the potential benefits and risks of neurotechnology and mind uploading.

The definition of a human mind is integral to discussing mind uploading as a potential future output of whole brain emulation. However, exactly what constitutes a mind and what therefore might theoretically be uploaded to another platform is a question for which we do not yet have an answer. Nevertheless, we know that human memory is a central component of the mind (Jonides et al., 2008), and hence, I decided to use it to facilitate discussions. Although our knowledge is incomplete, there is a substantial body of active research on memory (Boccia et al., 2019), and it is a concept that experts and non-experts alike are familiar with.

Furthermore, memory isn't limited to the way we perceive our past, it also informs episodic future thinking and neuroscientific evidence shows that many of the same brain structures are involved in both remembering and forecasting (Schacter et al., 2012, 2007; Schacter & Madore, 2016). This narrative bridge between the past, present, and future was integral to my research.

## **2.2 Method – Qualitative e-Delphi Study**

The vast literature on memory and mind reveals the complexity of the topics so to clarify definitions, I solicited expert opinions using the Delphi technique. The Delphi technique involves recruiting experts and asking a series of iterative questions or rounds. In between each round, the researcher analyses responses and sends controlled feedback to the experts. On receipt of this, each expert is allowed to revise their original opinion in light of group trends if they so wish (Donohoe et al., 2012).

The Delphi technique is a widely used and well-accepted consensus method for gathering data from respondents within their domain of expertise (Day & Bobeva, 2005) and is well suited to a complex field such as memory and mind where knowledge is incomplete (Donohoe et al., 2012; Matar et al., 2018). The rationale for surveying experts is that a number of these, with different but related perspectives on a topic, will provide a more informed and accurate result than a single expert even if the latter is a key opinion leader in their field (Niederberger & Spranger, 2020).

The Delphi technique has been used globally to investigate multiple topics across many disciplines. I was unable to find examples of the Delphi technique being used specifically to investigate memory, mind, and neurotechnology, but it has been used to define and describe key concepts and distinctions in motor learning (Kleynen et al., 2014). This latter study shares similar aims to my study albeit in a different field.

Delphi techniques have also been used in the health and social sciences to explore future developments such as artificial photosynthesis and new food systems (Cuhls et al., 2015; Jorm, 2015; Niederberger & Spranger, 2020). Using the Delphi technique for predictive purposes—in this case, a far future scenario—speaks to its initial objective: namely, to forecast future events albeit in warfare rather than neurotechnology (Dalkey & Helmer, 1963).

Before deciding to use the Delphi technique, I considered a range of qualitative methods such as interviews, focus groups, workshops, and nominal groups/expert panels. I focused on qualitative approaches since in the early stages of my PhD it was important to understand how experts described key concepts. I sought a shared language or consensus that would inform and frame subsequent research with the public. Of the possible methods, only a few are designed specifically to elicit consensus. These include the Delphi method and the expert panel. I decided on the Delphi method and specifically an online or e-Delphi study since it offered a cost-effective and practical route without geographical limitations (Jones & Hunter, 1995). It also allowed me to conduct research despite the constraints imposed by a global COVID—19 pandemic.

Having researched and evaluated potential methods I decided to proceed with an e-Delphi study as described in Section 2.2.1 onwards. Table 2.1 below summarises the commonly cited positive and negative attributes of the Delphi technique as drawn from various sources (Donohoe et al., 2012; Niederberger, & Spranger., 2020; Hasson & McKenna, 2000; Barrett & Heale, 2020).

**Table 2.1**

*Strengths and Weaknesses of Delphi Technique*

Strengths	Weaknesses
Flexible, adaptable method	Low response rates Attrition/dropout over time/across rounds
Avoids peer pressure/" group think" thus allowing independent thought	Can be time/resource intensive for the researcher
Can survey a range of experts	No set criteria for what defines an expert
Relatively low cost	No standard definition of consensus
Enables anonymity	No standardised quality criteria
Allows experts to reconsider and revisit their initial opinions	Expert judgments can vary between different groups
Can utilise both quantitative and qualitative methods	Not associated with any particular paradigm

**2.2.1 Research Questions**

Typically, Delphi studies involve two to three rounds of questions (Niederberger & Spranger, 2020). Given the complexity of the topics, I conducted three rounds focussing on memory and mind as shown in Table 2.2. The questions were open-ended to facilitate exploration (Custer et al., 1999).

**Table 2.2**

*e-Delphi Research Questions for Experts*

How would you define and describe human memory?	What relationship, if any, do you think memory has to mind?	To what extent, if at all, do you agree that “we are who we are in great measure because of what we learn, and what we remember.” Kandel (2007, p.10)
Round 1		
What impact, if any, do you think it would have if technology could change the capabilities of human memory?	What developments, if any, are you aware of that might change the capabilities of human memory?	What potential advantages and disadvantages can you foresee for memory augmentation?
Round 2		
Imagine a hypothetical scenario far in the future where we could store our memories externally to our biological brain – not just capture or record them but export formed memories to another substrate for storage. This wouldn't necessarily make our memories any more accurate, but it would prevent them from degrading or being lost over time. What would the implications be if we could retain all our memories? What purpose does forgetting serve?		
Round 3		

I chose these questions to reflect key themes of my research and to inform subsequent research with the public. Mind is a requirement for mind uploading, and memory is a key component of mind, so the research questions focused on how experts defined these terms and the relationship between them. Thereafter,

the questions became more conceptual and considered how future advances in neurotechnology might augment memory and mind. This reflected my research aims of engaging with mind uploading as a far-future example of neurotechnology.

In my research, I concluded the study as planned—after the third round—since I judged that I had gained sufficient knowledge of key definitions, identified where consensus existed and honoured the agreement I had initially made with the participants. Using closing criteria that rely on a prefixed number of rounds, in this case three, follows majority practice (Diamond et al., 2014; Jünger et al., 2017; Nasa et al., 2021).

### **2.2.2 Ethical Considerations**

The Faculty of Engineering's Ethics Committee approved the e-Delphi study. I obtained email addresses for the experts from publicly available records and resources as well as referencing the Carboncopies Foundation's expert network. I used a purposive sampling method (Gray, 2004), using my University of Nottingham email and noting my affiliation with the Carboncopies Foundation. Since data was collected via email, it was associated with each participant's email address and name. Hence, all data captured during this study was stored separately from personal data. An individual's field of expertise was used for analysis and given the small sample size; this was the only identifier for verbatim quotations.

### **2.2.3 Recruitment**

Participant selection is crucial in all research, and in an expert Delphi study it directly impacts on the consensus reached and the quality of the results (Taylor &

Judd, 1989). However, the identification and definition of an “expert” is both contentious and complex.

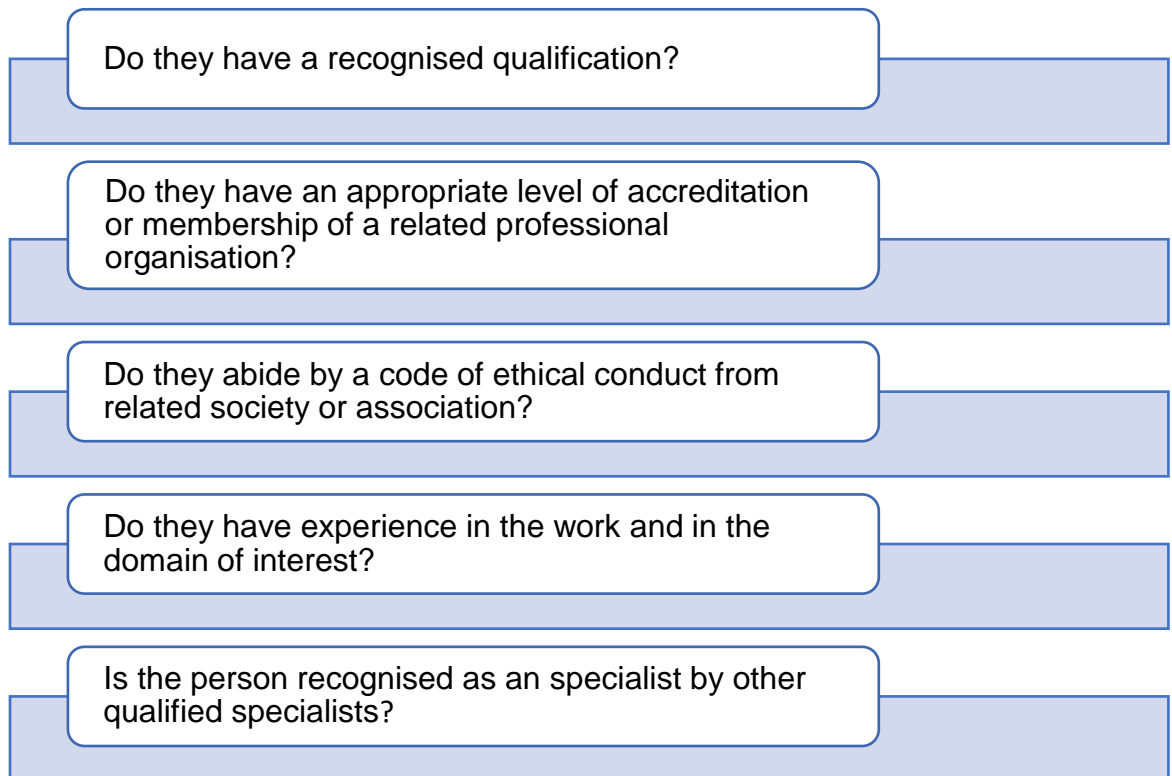
Several studies have judged that one can consider someone an expert if they know about the topic under investigation (Ashton, 1986; Bolger & Wright, 1994; Parente et al., 1984), but this does not specify the level of knowledge required. Another potential way of identifying and quantifying expertise is using the h-index or Hirsch factor (Hirsch, 2005), which gives the combined publication and citation counts (Gasparyan et al., 2018). In this study, h-indices as given on the Web of Science were collected. However, while the h-index is a useful measure, it is not without its flaws. For example, it does not necessarily consider the impact of the research or researcher's career stage and age (Kreiner, 2016). Hence, I used the index to contribute to selection rather than control it.

I also considered how other organisations and disciplines assess expertise. In military and defence, aerospace, and nuclear power engineering, the acronym for Suitably Qualified & Experienced Personnel (SQEP) is widely used. This terminology has also expanded to manufacturing, support, and service sectors in industry. Shorrocks (2018) proposes five questions (Figure 2.1) as a means of assessing if an individual can be classed as SQEP, albeit as a consultancy provider. I applied this definition when reviewing the sample of experts in the e-Delphi study.



## Figure 2.1

### *Key Questions for SQEP*



This is a truly multidisciplinary field, and I identified experts in all the specialisms shown in Table 2.3 recognising that research activity is heavily weighted towards researchers/academics rather than industry and recruitment.

**Table 2.3**

*Expert Research Specialty*

---

Specialty
Brain/Cognitive Sciences/ Psychology
Neuroscience/Computational Neuroscience
BCI/BMI/Neuro-computer Interfaces/Neuro-prosthetics
Neuro-informatics
Computer Science
AI/Machine Learning
Engineering – Electrical/Biomedical/Neural/Synthetic Biology
Biological Sciences/Physiology/Biophysics
Radiology/Imaging/Neuroimaging/MRI
Ethics/Neuro-ethics/Bioethics
Medicine) Neurosurgery/Psychiatrist
Philosophy/Theology

---

The feasibility of human whole brain emulation and the assumption that the mind is an emergent function of the mind is divisive. As recorded in Chapter 1, “protagonists” of whole brain emulation assume “brain centeredness” and that emulating a human brain will result in a human mind. In contrast, “antagonists” claim the brain is embodied or embedded and that emulating a brain will not produce a mind (Dirckx, 2019).

Hence, I endeavoured to recruit individuals who represented both “protagonists” and “antagonists” of whole brain emulation. Without predefined criteria, classifying an expert was a matter of subjective opinion, but I used a combination of methods to guide me. These included a search for commonly cited authors as well as expertise from my industry partner who knows many of the

individuals in the diverse global community. In total, I approached 93 experts of which 37 could be broadly classified as “protagonists” and 34 as “antagonists” of whole brain emulation.

#### **2.2.4 Response**

Of the 93 individuals initially approached, 15 consented and completed Round 1. Response rates vary widely with Gargon et al. (2019) citing 45%–100%. However, most of the 31 Delphi studies in Gargon’s review (predominantly conducted online) achieved response rates of 80% or higher. Hence the response rate of 16% for the first round is low and may have impacted the validity of the responses.

The 15 experts who consented were invited to take part in Round 2, and those who replied in Round 2 ( $n = 12$ ) were sent Round 3, which nine completed. I had expected attrition, and the dropout rate of 20%–25% between rounds aligns with the literature (Bardecki, 1984; Murphy et al., 1998). Reminders are part of the Delphi process, albeit without specific guidance (Veugelers et al., 2020), but I was cognisant of the participant burden. Hence, I sent a maximum of three personalised email reminders after the initial approach.

There does not appear to be consensus on the ideal sample size in a Delphi study, and published studies cite anywhere from three to 80 or more participants (Ogbeifun et al., 2017). However, a minimum of eight to 12 respondents is generally considered sufficient (Ogbeifun et al., 2017; Vogel et al., 2019). I achieved a maximum of 15 and a minimum of nine responses, but this was a

qualitative study that typically involves smaller samples than quantitative studies. Furthermore, the expertise of participants is apparent in their responses.

### **2.2.5 Participants**

Willingness to participate is often related to the individual's interest and involvement with the topic (Hasson et al., 2000). While whole brain emulation "protagonists" were willing to discuss and debate the issues, "antagonists" were more reluctant to engage. This was reflected in the response rate with approximately three times as many "protagonists" participating compared with "antagonists." As a result, responses were likely to be biased towards those who believe that whole brain emulation "represents a formidable engineering and research problem" but is technologically achievable (Sandberg, 2008, p.6).

All participants were sent an Equality Monitoring form that requested information relating to sex, age, ethnicity, and religion or belief. Completion was optional and only five participants responded. However, I was able to ascertain biological sex and age from literature even if other demographics such as ethnicity or gender were not readily available. All participants were male, typically aged 45 years or older, the youngest being in their 30s and the oldest in their 60s. There does not appear to be UK data, but the age of my sample, typically 45 and above, is comparable to existing data for tenure-track staff in higher education in the US (McChesney & Bichsel, 2020). I also compared my participant's sex with data on academic neuroscientists, which was the closest comparator. In this field, women typically only account for around a third of graduates, and this proportion declines with career progression (Metitieri & Mele, 2020). My participants were all doctors

or professors, well established in their field, and it is at these higher levels that women may be even more under-represented. Hence it is likely that the all-male sample reflects reality.

### **2.2.6 *Controlled Feedback***

An essential component of Delphi studies is controlled feedback. However, as reported by Meijering and Tobi (2016), there are no guidelines for how to provide feedback to participants, with some studies providing summary statistics, others sharing more descriptive feedback, and some providing both (Boulkedid et al., 2011).

After each round, I sent a summary of the results to each participant. Since this was a qualitative study, I provided an overview that indicated areas of consensus as well as areas where there was more divergence of opinion. Informing Delphi participants of the commonality of opinion can allow individuals to change their opinion in light of the views of their peers (Couper, 1984; McKenna, 1994; Ogbeifun et al., 2017); although Makkonen et al. (2016) observed that some experts may be more entrenched in their position. The latter was the case with my study since feedback did not result in any substantial change of opinion. This may have been because the sample comprised experts from a wide range of disciplines.

The Delphi technique is a consensus method, but the definition of consensus is rarely specified (Barrett & Heale, 2020) and lacks evidence-based guidelines (Meijering & Tobi, 2016). The definition is typically quantitative, using measures like percentage agreement (Adnan & Daud, 2010; Day & Bobeva, 2005;

Hasson et al., 2000), and across studies, consensus is defined as anywhere from 51% to 100% (Hasson et al., 2000; Keeney et al., 2011). My study was qualitative and in the absence of guidelines, I defined consensus as major or widely held beliefs and themes albeit that these relied on my subjective assessment.

### **2.3 Thematic Analysis**

Expert responses were captured via email and thematically analysed. There is some debate over content analysis vs. thematic analysis, but I followed the distinctions made by Vaismoradi et al. (2013), who evaluated both approaches. Thematic analysis can be described as “a method for identifying, analysing, and reporting patterns (themes) within data” (Braun & Clarke, 2006). My thematic analysis is inductive since there are no other published studies that qualitatively explore public perceptions of mind uploading; hence, my themes are derived directly from the data rather than using a preexisting framework (Hsieh & Shannon, 2005). The objective was to integrate the data so that it meets the criteria set by Braun and Clarke (2006, p11.): namely, to capture “something important about data in relation to the research question” and give context and meaning to the data. Unlike content analysis, the aim was not to allocate importance to themes based on quantitative assessments such as frequency counts or number of mentions (Braun & Clarke, 2006; Spencer et al., 2003)

There were several stages of iterative analysis. Immediately after each round, I conducted an interim analysis that formed the basis of the controlled feedback to participants. First, I familiarised myself with the data, reviewed each participant’s response, created codes and, where appropriate, categorised by

sentiment (e.g., positive, and negative). I considered each response in the context of other opinions and used this comparison to develop key themes and areas of consensus and divergence.

The full thematic analysis occurred after Round 3. I reviewed the data collected after each round and rechecked the themes I had previously identified. Areas of consensus as well as questions where responses diverged were clarified and grouped with relevant quotations. This produced a clear overview of the sample's responses to each question. In essence, I followed the stages of thematic data analysis as described by Braun and Clarke (2006).

Before these studies, I had not used Computer Assisted Qualitative Data Analysis Software such as NVivo. Since it is available at the university, I researched the advantages and disadvantages relative to manual analysis. In brief, software such as NVivo allows for the organisation and storage of large volumes of data and allows fast and efficient search and retrieval as well as the ability to easily recode. However, in the hands of an inexperienced researcher, it can enable excessive quantification of qualitative data. It may also distance the researcher from the data and, hence limit reflexivity. There is also the argument that data analysis software does not facilitate an overview of the data and its themes (Murphy et al., 2021).

In the early stages of my PhD, I trialled NVivo using the pilot study and study 1 and could see how it might be a useful tool. However, my experience led me to revert to more traditional tools, such as cutting, pasting, and colour coding in Word together with paper, coloured pens, and sticky notes. I found this the best way to

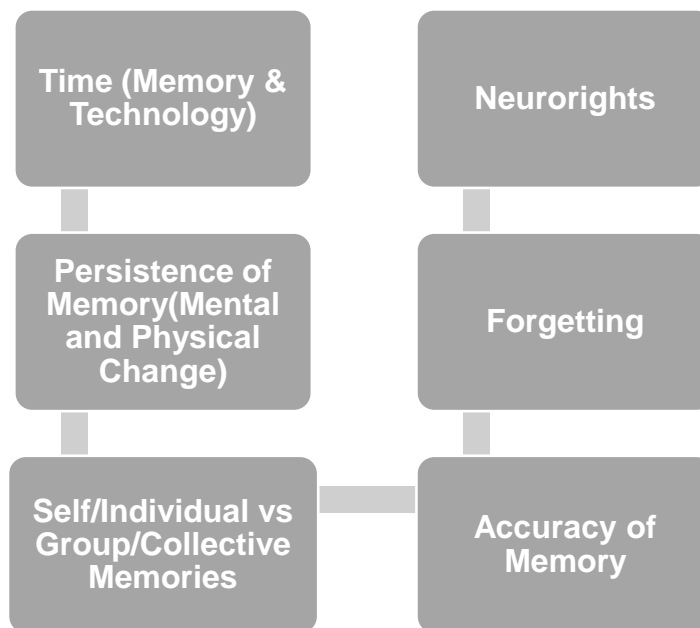
contextualise the data and generate interpretative and creative insights (Maher et al., 2018). This approach was used for the expert analysis described here and for analysis of the public research thereafter. Zamawe (2015) observes that the analysis method chosen, whether manual or computer-assisted, may depend on the size of the project, the funds, time available, and the inclination and expertise of the researcher and as Murphy et al. (2021) state, ultimately it is the personal choice of the researcher.

## 2.4 Results

Overall, I identified six central themes that form the basis of the subsequent discussion (see Figure 2.2).

**Figure 2.2**

*Central Themes From e-Delphi Study*



However, these themes were not always discrete, for example, time, persistence, and forgetting overlapped. Hence some commentary runs through



several sections in the same way, as an AI researcher stated our memories can “become fuzzier over time as they are accessed and blended into other memories”

Firstly, it is important to discuss how experts defined and described memory and mind and the relationship between them. Overall, there was no unified definition of memory or mind. This likely reflected both the diverse backgrounds of experts (who ranged from neuroscientists through engineers to philosophers) and the complexity of the concepts being discussed.

Since this was a multidisciplinary sample, a participant’s area of expertise was relevant, and quotations are identified by the speciality of the expert in brackets. However, given the relatively small size of the sample, particularly in the latter rounds, when representing each participant’s specialism, I have been careful not to identify them.

#### **2.4.1 Definition of Memory**

Human memory is the recording of the past events that tune the person to best respond to future events. (Bioscience)

The faculty by which a person's experiences and behaviours leave traces that can later be used to reconstruct aspects of the original experience or behaviour. (Computational Neuroscience)

Memory was described as a way of storing information, experience, and knowledge. However, experts took pains to stress that it involves multiple, active processes; memories must first be encoded, then stored, and finally retrieved. They noted that memories can change at any stage from encoding, retrieval, representation, and interpretation and that past recollections are vital to inform and shape our future thoughts and actions. The influence of the past on the present and future is discussed in more detail under the theme of Time (see Section 2.5.1).

Experts used several different memory classifications often drawn from psychology. Terms included semantic, episodic, procedural, short-term, long-term, working, autobiographical. Several also distinguished between conscious vs. unconscious, explicit vs. implicit, declarative vs. non-declarative, short-term vs. long-term, low-level vs. high-level, and working vs. long-term memory. Expert descriptions of the most commonly used memory types are shown below:

**Episodic** memory. According to a psychiatrist in the study, “memory as we usually talk about it is essentially episodic memory that is incorporated into a narrative of the person and an essential part of personal identity.” Individuals stated that Tulving (2002) compared episodic memory to “mental time travel” and noted Buzsáki’s connection between cognitive and physical navigation. A BCI expert quoted Buzsáki (2019) as saying that “brain mechanisms that evolved initially for navigation in physical space by dead reckoning [using head velocity cues] are the same as those used for navigation in “cognitive space” to create and recall episodic memory.”

**Semantic** memory was said to depend on self-referenced episodic experience and Buzsáki (2019, p7.) was also quoted in this context since he linked the use of maps to navigate with the way we deal with semantic knowledge: “neural algorithms evolved to support map-based navigation are largely the same as those needed to create, store and remember semantic knowledge.” (BCI)

**Working** memory was described as the ability to form and constantly update interpretations and representations of the immediate environment. Such features were said to change on a moment-to-moment basis: for example, keeping track of

conversations, navigating, creative thinking, and problem-solving. Individuals noted that “working memory is really short, so we can only take snapshots that have a few little pieces in it.” (Computational Neuroscience).

**Procedural** memory was said to be a capacity that humans share with other animals and “involves the ability to acquire and refine behaviours through practice.” (Computational Neuroscience). One example of this included learning to play the piano.

**Declarative** memory was sometimes divided into semantic memory (remembering names, facts, and other symbolically represented concepts) and episodic memory (remembering incidents in an autobiographical way). “If we look at cases of extreme memory loss like that of HM and Clive Wearing, they still only lost a fraction of one general type of memory: declarative memories. Complete loss of all the types of memories that Squire describes (declarative, procedural, perceptual, etc.) would leave little left—perhaps like a newborn baby.” (Computer Science).

**Long-term** memory was described as representations of experiences, knowledge, and skills accumulated over our lifetime. As one Human Cognitive Neuroscientist remarked, “Retrieval from long-term memory involves a process of reconstruction, particularly for details of events that were not originally encoded or have been forgotten. The reconstruction process uses accumulated knowledge to fill in the gaps in our memory for events.”

Expert commentary on memory demonstrated the complex, dynamic nature of this phenomenon and its significance in all aspects of our lives. These included

our sense of identity, our interactions and relationships with others, and our ability to respond to and learn from events in our world. Our memories anchor us to our past, inform the present, and help us navigate our future and I will develop these themes in subsequent chapters.

#### **2.4.2 Definition of Mind**

If memory is a vast field, the human mind is an even greater challenge and one that scientists and philosophers have debated for decades. As the experts in this study acknowledged defining a mind is incredibly difficult. As one observed “The problem with that question is that we don't have a sufficient definition of mind yet, so no two people are likely to perfectly agree on what traits or features qualify as a mind” and this lack of consensus was confirmed by the remaining experts. Words used by these participants included “virtual reality,” “psyche,” “consciousness and unconsciousness” “attention,” “planning,” “memory,” “personal experience” and our “subjective self,” which reflects the vastness of scope. As one Computational Neuroscientist remarked:

Well, I when I think of mind, I think of all of the parts. What we are and how we respond. So mind is attention. Mind is goals, mind is planning, mind is retrieving memory, making a new memory. But when we talk about mind, we think about the whole system when and how that system responds to everything. (Computational Neuroscience)

However, in the case of the human mind, one can say, “The whole is something besides the parts” (Aristotle, 335–323 BC/1908). Experts described the mind in a variety of ways from the model of the world that our brain generates and how we experience this to our sense of self and consciousness. Memory was identified as part of (or in one case the totality) of the mind—the information, knowledge, and experience that the mind processes. Overall, experts tended

towards physicalist/materialist/functional stances, but the following quotations show the scope of discussion.

A first pass definition would be “mind is what the brain does,” the “virtual reality” or “hallucinated model” of the world that the brain generates where our subjective selves feel as if they reside. (BCI)

Mind is our personal experience of what is currently activated and available from our stored accumulation of events and knowledge, and that is required for our current task. At any one moment, this is a tiny fraction of what has been stored in our memory from lifetime experiences, and only a limited sample of what is currently available within our working memory. (Human Cognitive Neuroscience)

#### **2.4.3 Relationship between Mind and Body**

The “mind-body problem” was not specifically explored but it is relevant, particularly when considering the final question about storing memories outside of the biological brain. Experts had some different opinions on the extent of embodiment but tended to agree that the brain is embodied, which reflects the growing body of evidence (Fei, 2020). In this context, embodiment refers to the fact that the body is host to the brain and that it is embedded in terms of both its relationship to other functions and systems of the body (Cappuccio, 2017; Papadopoulos, 2011; Rupert, 2009) and the environment that we can sense and interact with (Cappuccio, 2017; Noë, 2005).

#### **2.4.4 Relationship between Memory and Mind**

Memory was seen as an integral component of the mind but the relationship between the two was difficult to pin down. This likely reflects the finding that we do not have a universal definition for memory or mind. Most experts felt that you required a mind to have memory and vice versa with memory being defined as the “raw material” or “building block” of the mind. In this context, memories were seen

as the templates or filters enabling us to “compare the past with the present to predict the future and adapt behaviour accordingly” (Computational Neuroscience). Individual experts also commented that the mind requires memory not only to predict and action behaviours but also for introspective processes such as recalling language and concepts. The view, that memory is crucial to mind, is illustrated by the following quote from a Computational Neuroscientist.

Memory is central to how the mind works. Experience in the present is always filtered through memories of the past. Most of the time this filtering is unconscious. Memories are templates that are used to characterize the present in terms of the past and thereby infer ongoing processes in the external world or the body. So memories enable an agent to compare the past with the present to predict the future -- and adapt its behaviour accordingly. In this way, even basic perception relies on memory. Even introspective mental experience relies on memory. An inner monologue requires memory of language and concepts. And inner imagery requires memories of previously experienced objects and concepts.  
(Computational Neuroscience)

Other experts, albeit individuals, also compared the mind to a computer that processes or runs memories and updates or writes to files. As one expert said, “What are you processing if not memory?” This approach—sometimes called the Computational Theory of Mind—can be linked back to the Human Information Processing Model rooted in cognitive psychology. This sees the individual as a processor of information and similar to a computer taking in information (input) and producing an output via processing. Human information processing theory helps explain how we “acquire, process, store, and retrieve information from memory” (Eggen, 2020, summary). This model has limitations, such as an oversimplification of the processes, inadequate consideration of the role of social contexts, cultural and individual factors, and the assumption that we process in a logical, sequential fashion. Nevertheless, it does provide a basic structure of human memory which

is widely agreed upon namely a limited capacity working memory and a long-term memory store (Eggen, 2020).

In contrast, others thought it was possible to possess a mind without some elements of memory, such as declarative memories, and one expert cited the famous neuroscience patient Henry Molaison (H. M.) as well as another more recent example – a musician named Clive Wearing (C. M.) who contracted herpes encephalitis in 1985. (Case studies for H. M. and C. M. are summarised below for reference).

#### **2.4.4.1 Case Studies**

Following bilateral medial temporal lobe resection, carried out to relieve epilepsy, H. M. was described as exhibiting:

Profound forgetfulness but in the absence of any general intellectual loss or perceptual disorders. He could not form new memories (anterograde amnesia) and also could not access some memories acquired before his surgery (retrograde amnesia). His impairment extended to both verbal and nonverbal material, and it involved information acquired through all sensory modalities. (Squire & Wixted, 2011)

C. M. also exhibited retrograde and anterograde amnesia with his retrograde amnesia being particularly severe extending back for virtually the whole of his life. His episodic and semantic memory is impaired, yet his musical ability appears to be relatively unaffected (Wilson & Wearing, 1995).

These case studies were cited to support the view that you can have a mind even with severe memory deficits although the mind might be limited:

Memory and mind are closely linked. I would not say inextricably, but they might be. Memory seems easier to imagine, it's the writing of information, the mind is more complex, it's the operations of the brain/organism and we experience these operations as "mind." However, without memory, the mind would be vastly limited as the operations of the brain rely on life

experiences to calculate the best probabilities. So mind without memory would be incredibly limited. (AI)

If we look at cases of extreme memory loss like that of HM and Clive Wearing, they still only lost a fraction of one general type of memory - declarative memories. Complete loss of all the types of memories that Squire describes (declarative, procedural, perceptual, etc.) would leave little left -perhaps like a newborn baby. (Computer Science)

## **2.5 Central Themes**

Some themes are covered in less detail than others, which reflects the amount of commentary that experts gave to each.

### **2.5.1 Time and Memory**

Physicists define time as the progression of events from the past to the present into the future. This theme links and binds my expert and public research. Time passes as we age, and researching a span of chronological age was a consideration in my public research to both capture their differing recollections and consider influences of age on attitudes towards and usage of digital technology in capturing, storing, and sharing memories (Knowles & Hanson, 2018; Venkatesh et al., 2003). Due, in part, to their expertise, the experts in the e-Delphi study tended to be aged in their forties or older so chronological age was less well represented but time itself was an important theme.

Using expert commentary, I first discuss memory as a record of experience, one that persists over time, and I also cover the use of experience to predict future thoughts and actions. The first theme of persistence is covered in more depth in Section 2.5.2. One expert encapsulated this time travel thus:

Memory is a record of experience, when we say “memory” we refer to what has happened in the past, whereas imagination/prediction refers to the future. That is why some neuroscientists call memory a “past



prediction” or “post-diction” and why we can call a prediction a “memory of the future.” (BCI)

As noted in Section 2.4.3 (Relationship between Memory and Mind) many experts commented that memories are reengaged in the present to inform, shape, and predict future thoughts and actions. These views echoed an old but influential view from the 1950’s namely that “to respect the future, we must be aware of the past” (Wiener, 1951, p.68). Several experts talked about this ability in evolutionary terms, meaning memory allows us to adapt and produce the optimal response to environmental stimulation and scenarios thus contributing to our survival (Klein et al., 2010). As these experts observed:

Memories are templates which are used to characterize the present in terms of the past and thereby infer ongoing processes in the external world or the body. So memories enable an agent to compare the past with the present to predict the future and adapt its behaviour accordingly.  
(Computational Neuroscience)

We can imagine or daydream or think through past memories mixed with current thoughts and processes/ storing of information, again with a reasonable emphasis on its ability to influence future processing.  
(Computer Science)

Memory is the altering or storing of information, again with a reasonable emphasis on its ability to influence future processing, for else what use would such storage be? (Computer Science)

Next let us look at the dynamic nature of memory since as experts observed, memory is not a static snapshot of past events it changes with our retrieval, representation, and reconstruction of events. These processes mean our memories are not always complete, truthful, or accurate. The following quotations represent this view:

Human memory is the ability to take in information and store it until it is retrieved. It does not refer to an exact copy of past experiences but one

processed through the mind, and retrieval also can modify the content and form of the memories. (Philosophy/Psychology)

At this level, memory involves a representation of past experiences that is partial (both in terms of the senses involved and the detail that is represented) and not necessarily accurate. (Biology/Zoology)

These expert comments confirm evidence that memories are not always accurate representations of experience, can be altered long after acquisition, and are sensitive to changes over time (Kroes & Fernández, 2012; Scully et al., 2017). This dynamism allows us to adapt our thoughts and actions and may be linked to the predictive function that memory serves (Kroes & Fernández, 2012; Schacter et al., 2007) and one expert referred to imagination as - “a memory of the future.”

Some researchers theorise that “our ability to revisit the past may be only a design feature of our ability to conceive the future” (Suddendorf & Busby 2003 as cited in Suddendorf & Corballis, 2007, p5). This refers to the concept of mental time travel mentioned previously. Suddendorf and Corballis (2007) also note that episodic memory is the most flexible in this regard and as Corballis (2019, p2.) noted, “we can travel mentally into a personal future as well as a personal past which can be construed as our personal (autobiographical) history.”

### **2.5.2 Persistence of Memory**

As well as spanning the past, present, and future, memory endures and persists. Memory is not just a mental representation—for example of an experience—but a physical one, as a Computational Neuroscientist remarked “a person's experiences and behaviours leave traces.” Many experts commented that these traces physically impact on the brain: “memory is—in my opinion—any

persistent change in neurological state, period” (Computer Science). Another expert in Brain and Cognitive Science observed:

Every experience in the life of a human being leaves a bodily trace, and the traces in the brain are of particular interest since it contains a system to store them in a more meaningful and abstract way than a scratch on the skin. The physical changes in the brain during behaviour, and just thinking appears to be enough, change subsequent computations of this massive neuronal network, likely by modifying the synaptic weights in some brain areas. These changes are memory in its purest form/ So human memory really must be considered as encompassing essentially every long-term change to our brain that happens due to experience. (Brain and Cognitive Science)

It is widely accepted that engrams or memory traces are stored in the brain and can persist for prolonged periods. The search for the memory engram has been a long one and it is only relatively recently that it was identified by four defining features: (i) it must relate to a specific experience; (ii) it must engender an enduring change in the neural substrate; (iii) it can lie dormant for extended periods; and (iv) it must enable memory recall, thus having an impact on behaviour by Josselyn et al. (2015). The search for engrams in animals took on new momentum in the 1980s (McCormick et al., 1981) where evidence of engrams or similar in humans came from a combination of Functional Magnetic Resonance Imaging (fMRI) and Diffusion-Weighted MRI (Brodt & Gais, 2020).

How engrams are formed at a molecular and cellular level is an active area of research, and one widespread theory is that engrams are created by neurons undergoing biochemical and physical changes which enables the information to be stored and accessible during recall of the memory (Ortega-de San Luis & Ryan, 2022). However, as the authors observe, there are still many questions including the location where memory is stored long-term and whether there is there

a memory code similar to the genetic code allowing memories to be written and read.

Recent research offers a novel theory addressing these questions. MeshCODE (Barnett & Goult, 2022; Goult, 2021) describes the physical basis of engrams as complexes that form on binary patterns encoded in synaptic scaffolds. MeshCODE theory is of particular relevance to my research since as well as providing an advance in understanding it also references bioscience and neuroscience by providing a storage solution for dynamic and persistent information with the brain acting like a “organic supercomputer” (Goult, 2021, p1). MeshCODE also theorises that memories are organised in a hierarchical database with the hippocampus acting as a data manager where it retrieves and connects memories and orders them so we can make sense of them (Goult, 2021).

The final question of the e-Delphi study (round 3) explored the concept of being able to store our memories externally to our biological brain and export them to another substrate for storage. This scenario was devised as a stepping stone to a future where the mind (of which memory is a substantial component) could be read, written, and uploaded. There is also a clear synergy between the e-Delphi scenario and the implications that “cracking” MeshCODE will enable us to model and potentially replicate human memory and mind on a different operating system.

### ***2.5.3 Time and Technology***

The development of technology, most noticeably the fourth industrial revolution, is important both in terms of how technology has shaped the way we record our memories and how it has impacted the development of

neurotechnology. Hence, I asked experts to consider the role of technology in memory enhancement.

However, I did not specify the meaning of technology. On reflection, this may have been either a weakness or a strength especially since one can argue that “technology is one of the keywords of our world, yet it is also one of the most confused” (Agar, 2020, p.377). Indeed, technology meant different things to different experts and included any means of “supplementing” or “complementing” human memory via language, inscriptions, books, chanting, music, art, etcetera as well as the more recent development of smartphones. The following quotations illustrate this view.

Technology has always augmented human memory. From chanting to inscriptions to books to smartphones, humans have been supplementing and complementing their memory capacities since before recorded history. (Computational Neuroscience)

Technology has already changed the capabilities of human memory by the ubiquitous use of smartphones. Because these are continuously available, people use them as an extension of memory. This is known in the research literature as “cognitive offloading.” This eases the burden on biological memory and can free up existing capacity for other information. However, it also creates an illusion that there is more in biological memory than there actually is. (Human Cognitive Neuroscience)

The freedom of response was further enabled when I asked participants to consider the potential impact of technology on the capabilities of human memory. I deliberately did not stipulate which capability might be affected since understanding which areas experts might focus on was relevant. Overall, there were many different examples of how memory capability might change and the impact this would have in the future.

**Short-term/working memory** — increasing our ability to commit more than seven items (+/- 2) for current use.

It could be that you're talking about short-term memory and about making it longer or making it easier to grab something to keep hold of whatever is there to pay attention more easily. Shopping would be a very different experience since you would be able to hold all the competing items, their variations, and their prices (and your internal mental matrix of the trade-offs) in working memory. (Computer Science)

### **Long-term memory**

“The enhancement of memory fidelity, such that long-term memories are more “photographic” in nature, retaining an improved precision and accuracy of past events” (Computer Science).

**Spatial** memory such as an intuitive grasp of 4D space.

**Semantic** memory enabling better/quicker/wider/deeper associations and inferences.

**Procedural** memory (greater “know-how”) expediting learning and allowing better decision-making and a greater understanding of self and others.

The most obvious application of enhanced memory was in medical/clinical fields, particularly therapeutic interventions for mental health. For example, it might enable someone with PTSD to revisit memories in a controlled way and build positive associations. Being able to improve retention and recall would tackle cognitive decline and possibly provide symptomatic relief for dementias such as Alzheimer's. Most thought improved memory would have a positive effect, which, depending on the exact nature of the change, could potentially be profound. As one expert asked, “What impact would these have? Tremendous, I presume. Pretty much all human societal activity is designed to operate within the bounds of human ability” (Computer Science).

Hypothetical future scenarios where we could potentially prevent memory degradation and/or store memories outside the biological brain were also explored. Some experts envisaged benefits such as memory restoration in individuals suffering from dementia or brain trauma and/or enhancing and extending normal human memory. Individuals drew parallels with traditional memory aids such as photos or videos and notes but imagined them realised as a more automatic and efficient neural interface, for example via BCIs. A few experts thought augmented memory might allow useful information to be retained or downloaded, thus enhancing knowledge and skills. These possibilities are illustrated in the following quotations:

Enhanced memory functions and cognitive functions as a whole If the memory capability in its native form is altered or enhanced, it could have a profound impact. The augmented human may be able to reach higher levels of understanding based on the more sophisticated associations and inferences he/she can make, utilizing the expanded memory capability. (Computer Science and Engineering)

If an interface could be created that essentially puts “Google” into your brain, e.g., you think instead of saying “Hey Google, tell me the papers that were published last year about memory-enhancing technology” and the result will essentially appear as thoughts, that would already be quite useful and likely increase human productivity in many areas tremendously. (Brain and Cognitive Science)

Experts were also asked to share their knowledge of any new technologies that could potentially improve or augment memory. This was both to check on their awareness of current research and to signpost relevant technologies. Both non-invasive and invasive technologies were cited although future trends tended towards invasive technologies.

Non-invasive developments included refinement of established techniques, such as the memory palace/method of loci, technologies such as virtual reality

(VR), and augmented reality (AR), or methods such as different types of transcranial stimulation that may temporarily boost the functionality of certain brain areas including memory.

Invasive technologies included implantable devices to supply electrical or optical stimulation, electrode arrays, as well as cochlear and retinal implants (already in use), and hippocampal or cerebellum prostheses. One expert mentioned the third arm created and used by Stelarc (an Australian artist) and noted that this type of body augmentation can result in fundamental changes in brain representations (Kieliba et al., 2021). While Stelarc was cited as an example of how prostheses can change the brain's representations of the body, his performance has also been described as "prosthetic selfhood" (Zylinska, 2002, p222.), which dovetails with the next theme of self and identity.

#### ***2.5.4 Personal Identity and Sense of Self***

In this narrative, I have tended to use the term personal "identity" rather than self. That said, I recognise that these are complex and nested concepts (Oyserman et al., 2012) and this perhaps partly explains why experts referred variously to self, identity, and personal identity in their responses.

Personal identity was explored in the context of Kandel's comment "We are in great measure because of what we learn, and what we remember" (2007, p10). Almost everyone agreed, mainly due to Kandel's caveat of "in great measure," as illustrated in the following quotation. "Kandel is not saying "we are who we are, solely based on what we remember," so I think it is vague enough to be true. The



real question is “in how much of a great measure” (Computer Science and Engineering).

Experts observed that Kandel’s quotation showed that while learning and memory are central to an individual’s identity, they are not the only contributors since responding to our environment is also key: “If ‘learn’ here also includes “learn to respond to the external world,” then I agree completely with this statement, also considering Kandel used in great measure in this statement” (Biomedical Engineering). Learning was said to be shaped by individual genetic heritage and the evolutionary development of humans (phylogenetics), which include instincts and environmental or situational factors. The interplay between nature and nurture was readily acknowledged and inherited characteristics were said to influence the choices we make and how and what we learn.

I have no argument with that statement. I guess there's the whole nature/nurture question: are we who we are because of learned experiences or because of innate genetic or innate embryological neural development prior to birth? Surely at the complex level of humans, we put tremendous emphasis on the importance of life experiences in shaping our personalities. So sure, I see nothing contentious in Kandel’s quote. Makes perfect sense to me. (Computer Science)

I tend to emphasize the inherited aspect more than the nurture part. Our genetic inheritance somewhat shapes the environments we, as individuals, learn from, and the choices we make. What or who we seem largely “channelled” through our inherited cognitive/ biological structures. (Philosophy and Psychology)

I guess we're in great measure who we are because of what we learn and what we remember but we are also who we are because of the situation we're in. So you know the conditions that we are placed in and what happens to us. In that moment, we have all of our memories and then on top of that, we have the moment and the input we're receiving. So the world around us is affecting us. Plus our memories are affecting us and together they make us who we are because that then produces a response. (Computational Neuroscience)

Memory, particularly unique, personal episodic/autobiographical memories, and mind were said to be incorporated into our sense of self and our identity. As one expert observed, “If you could hypothetically erase somebody’s memories, they would become quite a different person” (BCI) and another described it as shown below.

From a very long-term perspective, in addition to the memories that are created through memory consolidation and belong to a single person, I think that there's another kind of memories that are created over long periods by evolution and that are stored in our DNA and ultimately bodies. These sorts of memories, like instincts, sensory configurations, etc., are common to all humans and haven't really changed over the last 40,000 years. (AI)

While there are differing views about exactly how autobiographical memory contributes to our personal identity, we intuitively know that these personal recollections are crucial to who we are (Guerini et al., 2019). As Tippett et al. (2018, p.2) describe it “The act of remembering oneself in the past instantly links the present individual to their past self: mentally, emotionally, and experientially.” This perspective was illustrated by an expert in Human Cognitive Neuroscience who remarked that our ability to “remember events from our past gives us a sense of continuity of self.”

This sense of continuity or connectedness fits with the definition of personal identity introduced in Chapter 1 and relates to the themes of Time and Persistence discussed in this chapter. It indicates that we will be the same person in the past, present, and future (Vanderveren et al., 2017). This continuity of sense of self (or diachronic unity) seems remarkably stable even in populations where it might be expected the sense of self over time would be eroded, such as those psychiatrically unwell (Dorahy et al., 2021) or those with dementia (Baird, 2019;

Fazio & Mitchell, 2009; Tippett et al., 2018). Baird (2019) hypothesises that this is because the self is not one-dimensional.

Autobiographical memory not only contributes to our sense of self through individual reflection but also group or social memories via reminiscence with others (Fivush et al., 2011). It is the theme of shared or collective memories that is considered next.

### **2.5.5 Collective Memories**

Autobiographical memories are by definition personal to the individual, but several experts talked about group or collective memory, and as one expert remarked,

From a group perspective, I think it's (Kandel's quote) is missing the idea that we offload our memories to our environment and our friends, and so these become part of our identity and literally part of how we access our memories. Think of couples who live together for 50 years - when one of them dies, the one that remains truly loses access to a lot of their memories, because the only way that they can access them is by talking with their partner. (AI)

There are differing views over what constitutes a collective memory ranging from small groups to larger national or cultural recollections (Harris et al., 2008). However, one way of defining a collective memory that fits the context here is as "shared representations of a group's past based on a common identity" (Licata & Mercy, 2015, p194.). People frequently engage in conversation about shared autobiographical events from their lives, particularly those with emotional significance (Maswood et al., 2019) and this can result in individual memories converging to build a shared, collective memory. This, in turn, can build a shared identity and promote sociability (Brown et al., 2012).

However, simply sharing memories may not be enough to generate a collective or group memory. Coman et al. (2009) and Cuc et al. (2006) discuss the

impact of various factors on the formation of collective memory and conclude this requires cognitive factors such as social contagion as well as situational factors such as a dominant narrator.

A dominant narrator refers to the person who dominates group memories. This individual can vary depending on the situation, but that individual's story becomes the main story when people remember the experience. Social contagion can be defined as "a ubiquitous process by which information, such as attitudes, emotions or behaviours are rapidly spread through a group from one member to another without rational thought and reason" (Riggio & Riggio, 2022, p270.). It occurs in many, diverse domains from crime to mental health. In memory, social interaction can influence recall of shared events (Roediger et al., 2001), meaning they remember what they experienced differently. Social contagion can also cause individuals to remember events that they didn't witness, creating "false memories" in others (Meade & Roediger, 2002).

Both false memories and altered memories resulting from social interactions may become incorporated into a collectively shared memory (Fischer & O'Mara, 2022) and the experts in my e-Delphi study talked about how we have historically recorded and shared these collective memories through language, writing, photos, and video. However, developments in digital technologies have significantly influenced our sharing and recording of individual and collective memories (García-Gavilanes et al., 2017; Linke, 2015). With the advent of ubiquitous technology and social media platforms, memories can be shared even more widely, transcending traditional boundaries of space, time, and place

(Keightley & Schlesinger, 2014). This type of collective memory is not simply based on sharing among a small group, as one AI specialist remarked:

From a historical perspective, I would say that memories are the primary thing that defines and drives a civilization and that our record-keeping technologies like language, writing, video, etc. manage to capture a tiny fraction of this collective memory every generation. (AI)

### **2.5.6 Accuracy of Memory**

As discussed, collective memory can influence individual recollection so that a person amends their memory to align with another person or persons (Thorley, 2013). This “conformity” of memory or “social contagion” can generate imagined or incorrect memories (Gabbert & Wheeler, 2018; Paterson & Monds, 2018). Although, as I will discuss shortly, individual memory processes can also produce false memories.

There is copious research on the theme of false memories, which falls outside the scope of this thesis, and it was only mentioned briefly.

A memory may or may not be based on an actual event that happened in the past. I think some memories are entirely synthetic and created in dreams, etc. Typically, memories are partially reconstructed during the retrieval process, and this reconstruction process can sometimes lead to false memories (AI).

Accordingly in this discussion, I distinguish between memories that are fabricated and memories that may be inaccurate in some way. The prevailing expert view was that memory is frequently fallible and inaccurate, and they attributed these characteristics to the processes associated with memory. Experts noted that when retrieving memories from long-term storage, we also reconstruct, represent, and interpret these experiences, which can change the content and form of our memories. This process is described in the following quotations:

Memory involves a process of reconstruction, particularly for details of events that were not originally encoded or have been forgotten. The reconstruction process uses accumulated knowledge to fill in the gaps in our memory for events. e.g., If you try to recall your last visit to a restaurant, you could tell me that you found a table, looked at the menu, ordered food and something to drink, ate the food, paid the bill, and left. That information could be generated from the accumulated knowledge of many experiences of visiting restaurants, without actually remembering any genuine details from a particular restaurant visit. (Neuroscience)

Human memory is the ability to take in information and store it until it is retrieved. It does not refer to an exact copy of past experiences but one processed through the mind, and retrieval also can modify the content and form of the memories. (Philosophy and Psychology)

Many studies have supported the expert view that human memory is unreliable, which may well be justified. In contrast, a recent study (Diamond et al., 2020) indicated our memory is fairly reliable and those recalled details are more accurate than previously thought (albeit in the context of recalling one-time experiences). However, further research is required to substantiate this claim.

### **2.5.7 Forgetting**

As we remember, we also forget, and as one expert observed, my brief question about the purpose of forgetting is a profound one and in hindsight outside the scope of an online survey. However, experts still offered interesting insights on how they see the process.

Across multiple studies, non-pathological forgetting appears to universally consist of “an initial rapid decline in memory performance, followed by a longer period of slow decay“ (Ryan & Frankland, 2022, p173.). I am distinguishing between non-pathological or “normal” forgetting and pathological forgetting, which occurs as a result of disease or age (Small, 2021). This same paper described

forgetting as “ubiquitous”—a term commonly associated with technology but in this context means shared across several species.

Forgetting has traditionally been seen as a passive process and a weakness or “bug in the brain,” but, as these experts observed, in the last decade there has been a growing body of evidence that the human brain actively forgets and that this is an important feature—“purposeful forgetting,” as one expert called it. Experts claim forgetting has several purposes, as shown in Table 2.4.

**Table 2.4**

*The Functions of Forgetting*

Mitigating the bottlenecks to attention and action that we experience in short-term memory.
Allowing us to prioritise some information over others to enhance survival (since nobody can store and use all their memories).
Acting as a mechanism to help people to move on from negative thoughts and feelings including difficult and even traumatic experiences.
Forming part of the brain’s maintenance, rebuilding the “database,” and consolidating and updating the indexing of the memories.
Allowing us to generalise by building a representation and then updating/changing it. Without this selection, we would be data-bound and might not be able to learn new things.

These views are depicted in the following expert quotations:

Forgetting can be an important process. It may enable people to generalize in useful and creative ways, recognizing broad patterns rather than details. Also, in emotional contexts, forgetting may enable people to move on from difficult and even traumatic experiences. (Computational Neuroscience)

If you run a database and use it a lot but do not ever perform maintenance on it, then it quickly becomes slow and inefficient. The same is likely true for the brain. Forgetting is part of the maintenance, rebuilding the “database” and consolidating and updating the indexing of the memories. (Bioscience)

As the commentary and quotations indicate, forgetting appears to be an integral part of memory, and as Ryan & Frankland (2022, p.183) conclude, perhaps our definition of forgetting should move from memory failure to reflect the more recent thinking that “learning and forgetting are different aspects of a cognitive process.”

Learning is largely associated with the acquisition of new knowledge, and in this respect, forgetting is always considered bad. However, I think that forgetting is an integral part of human learning, different from machine learning. We do not know how the human forgetting process works and understanding this could lead to a major breakthrough in neuroscience. Perhaps forgetting is related to sleep and dreaming? It is hard to tell. (Computer Science and Engineering)

If the Thornton ancestor of 100,000 years ago had memories of which predator prowled along a specific route in the forest, and where other non-predator animals resided, and had no way of forgetting irrelevant information to survival, then you would not be here to write your email. (BCI)

### **2.5.8 Neurorights**

This section focuses on the ethical challenges associated with advancing neurotechnology or neurorights. According to the Emerging Issues Task Force of the International Neuroethics Society (2019, p104.), neuroethics “seeks to



understand and navigate the ethical tensions and conflicts that arise in the research and application of neuroscientific knowledge and techniques.”

In the final round of questions, I asked experts to consider a hypothetical scenario where we could hypothetically prevent memory degradation and/or store memories outside the biological brain (see Table 2.2). I am conscious that predicting or anticipating the future is no easy task in any research setting and this simple study has limitations. That said, experts offered many useful opinions, and one provided a detailed vision of the far future, summarised in the next section.

As discussed, many experts thought the ability to forget was crucial for information management. Hence even individuals who mentioned the benefit of enhanced intelligence wondered how an ability to retain all our memories would interfere with our brain and behaviour. As one expert in BCI said “being able to instantaneously recall vast tomes of data like a computer could quench attentional bottlenecks and give a person the equivalent of an absence seizure.” The following quotations illustrate these views:

First, I'm not sure whether “retaining all memories” is possible at all. To do that, we probably need to record and store all the neural activities in the brain for the whole life (very likely also have to include all external events that happened at the same time) since that's probably the only way to objectively retain a person's FULL memory. Any other way would inevitably introduce some kind of compression and interpretation which may lead to distortion. If the person is alive it might quickly become obsolete as part of the memory writing process is likely to be the updating of the memories and links between them with new information and associations. (Biomedical Engineer)

I think it would enable us to store our memories at their peak. Imagine being able to call the memory up for the day before your exams for all the classes you ever took. This would greatly enhance intelligence, although you begin to wonder how this would affect the structure of the brain itself. (Psychiatrist and Researcher)

As introduced in Chapter 1, research to better understand and potentially emulate the human brain is an active field and organisations such as The Human Brain Project have projects focused on neuro-informatics, which combines neuroscience with information technology (Bjerke et al., 2018). However, while experts were interested, and in some cases actively involved, in such advances, the concept—as described in my research—raised many concerns.

Our memories were compared to other forms of personal, sensitive data and if stored externally were seen to be at risk of security and privacy violations. Experts talked about individual memories being stolen, misrepresented, misappropriated, misused, or even “weaponized” for oppression, abuse, and torture. As well as the effect on individuals, experts also considered the impact on society, and some could envisage a world where the divide between the privileged and disadvantaged would increase still further. These themes are also integral to the public research presented in subsequent chapters.

Experts gave several examples of fiction on these topics including the short story “Funes the Memorious” by Jorge Luis Borges (1944) and the Black Mirror episode “The Entire History of You” (Armstrong & Welsh, 2011). The quotations below demonstrate some of the scenarios that experts imagined:

If this hypothetical “external grain” to use the Black Mirror term “grain” for the device that stores the memory, represented memories in a format only readable to my brain then it would be fine; if they were “hackable” then I would not want such a thing. (BCI)

This would really push the boundaries of what is real because what would prevent us from sharing memories from others or intentionally creating false memories (e.g., Total Recall, why not just have the memory of a good vacation instead of dealing with the painful reality of lost luggage etc.)? If you push the definition of memory to not just include explicit memory, then you could start adding knowledge and skills (e.g., The

Matrix, the scene where Trinity needs to learn how to pilot a Bell helicopter and downloads the memory/skill). (Psychiatry)

As this section demonstrates, ethical issues around developing neurotechnology are many and varied and include concerns about the effect on the individual: for example, the impact of augmenting memory on cognition and the societal implications such as technology not being accessible to all.

If side effects can be avoided then there may be many advantages to enhanced memory -- particularly procedural memory, as mentioned above. But if memory enhancement is an expensive private service, then it will also exacerbate inequality, which in turn amplifies various social ills. (Computational Neuroscience)

At the societal level, it might be beneficial overall, but for the individual, it has huge issues as it will cause humans to diverge from those who have augmentation and those who don't. It will accelerate the distance between the haves and have-nots. Like with AI, countries that develop these capabilities earlier will dominate and other countries might never catch up. (Bioscience)

Main advantages include improvement of life quality and advance of human intelligence; potential disadvantages are mainly in ethics related to beneficence, nonmaleficence, autonomy, and justice. It's not the disadvantage of the technology per se, but potential misuse of the technology. (Biomedical Engineering)

### **2.5.9 *An Individual Vision of a Far, Far Future***

One of the experts who participated in the e-Delphi study also described his vision of a world where mind uploading is possible. He explored the impact of some of the potential technologies for improving human memory. These ideas included the ability to share unprocessed memories, by which he meant that we would not be reliant on language to convey them. This would allow us to truly experience what another individual felt and increase empathy and connectedness. As Harper Lee said in *To Kill a Mockingbird* (1960, p.30) "You never really know a man until you understand things from his point of view until you climb into his skin and walk

around in it.” Without the limitations of working memory, we might place less reliance on hierarchical thinking and expand and deepen our associations and thoughts. More precise and accurate recall, for example, indexed by date and time, would allow us to revisit and check our recall against the original sensory data. Having more comprehensive and holistic recall might enable more fluid and imaginative thought and speech. These ideas illustrated the crucial role that memory plays in our day-to-day existence and how changing the shape and form of our memories would potentially transform humanity.

## **2.6 Limitations**

The first limitations come from the Delphi technique itself, as identified in Section 2.2 (see Table 2.1). These were present to a greater or lesser extent in this study. Specifically, the overall response rate was significantly lower than that quoted in several studies and below the 70% regarded by some as the minimum (Hasson et al., 2000) which may have reduced validity.

Although the Delphi method aims to reach consensus, this was not achieved. This might be partly due to the multi-disciplinary sample, but it is also likely to reflect the complexity of the topics. I also acknowledge that my decision on common themes was subjective.

While I am confident the sample was an expert one, in spite of best efforts, it was biased towards those who believe whole brain emulation is achievable or “protagonists”. All participants were male, typically aged 45 years or older, so the sample lacks diversity although, it does seem likely to be representative of fields

such as neuroscience where women, particularly at the higher grades are under-represented.

Lastly, the final question in round three was poorly worded, in that as well as asking what the implications would be if we could retain all our memories, it also asked what purpose forgetting serves. Although the two topics are related, it is poor practice to ask double-barrelled questions (Bowling, 2014). In addition, as noted previously, forgetting is such a vast topic, it was impossible to cover this fully in a short online study.

## **2.7 Discussion**

The objectives of this study were to understand how experts defined the concepts of mind and memory and the relationship between them and use this understanding for subsequent studies. These aims were met even if one of the key insights was that there is no universally agreed consensus on what constitutes memory and mind. At its simplest level, however, memory can be seen as the raw material of the mind although even experts disagreed on the relationship between mind and body (a finding that was subsequently replicated in research with the public). However, on balance, the weight of expert opinion was that the brain and mind are embodied, which reflects current research findings.

Human memory was acknowledged as fallible and prone to inaccuracies and bias, but these experts shared current thinking that forgetting is not a weakness but an adaptive strategy of the brain. The experts cited current research that promised a greater understanding of memory and mind. These advances are likely to have a profound impact such as new treatments for mental health issues

and interventions to halt or even prevent cognitive decline due to ageing and/or dementias.

Experts readily acknowledged the impact that technology has had on the way we supplement, store, and share our memories: for example, via cognitive offloading so that mobile technology becomes an extension of our brain. However, hypothetical future developments that augmented memory and mind or even allowed us to upload them were greeted with caution.

The first area of concern was the potential impact of changing human capabilities without knowing the effect this might have on us. For example, what impact would it have on overall cognition if our memory capacity was altered? The second involved scenarios where memories and minds were uploaded to an external platform. Experts could easily see how such private, personal data could be comprised and misused impacting the individual owner, concerns which the public subsequently shared. Experts also foretold public fears that access to such technology would be unfair and inequitable resulting in greater discrimination against certain individuals or groups.

## **2.8 Conclusion**

Based on expert classification, I decided to focus on declarative, episodic memory for my public research and how individual memories contribute to a personal narrative of our past and future lives. Hence the focus was defined as long-term memory rather than short-term or working memory (where we manipulate information) and explicit memories including episodic and semantic information which together form autobiographical memory.

I purposefully distinguished between autobiographical and episodic memory since episodic memory focuses on “event-specific knowledge related to past personal experiences” (Tulving, 2002), while autobiographic memory consists of episodic and semantic memory and creates one's personal history, which is constantly changed and updated to create a “running autobiographical record which is a constructive and reconstructive long-term memory that is unique to the individual” (McCarthy & Warrington, 1990, p. 296). I should acknowledge that we lack a universal definition of autobiographical memory (Guerini et al., 2019), but the concept of it as a unique, personal narrative is widely accepted.

The e-Delphi study added new evidence to the fields of memory and mind by sampling the perspectives of a range of experts. It also provided a multidisciplinary framework for the complex topics of memory and mind that informed the design of my public research. Chapter 3 describes the methodology for this programme of work.

## **Chapter 3 Public Research Methodology**

### **3.1 Introduction**

This chapter describes the multistage methodology for public research and details the methods for each stage. It also includes selected results that informed the design of subsequent studies. The public methodology uses qualitative and quantitative methods to explore different research questions (Anguera et al., 2018) over several stages. However, I follow (Bryman, 1988) in that the aim is to conduct good research and, hence, methods are chosen for the research problems posed.

The approach includes some novel methods such as longitudinal qualitative interviews and an interactive storytelling website, and it is important to understand how the approach and topics evolved through a process of research, reflection, discussion, and iteration. It is not intended to provide a comprehensive report of results for each stage as these are reported in subsequent chapters.

### **3.2 Research Questions**

“How does the public feel about neurotechnology that may transform memory and mind and ultimately allow us to mind upload?”

The constituent RQs were as follows:

- What consensus, if any, is there among experts on key concepts such as memory and mind?
- How aware of these technologies is the public and how does it respond?
- How does public perception compare with an expert perspective?
- How does the public describe and recall their past and imagine their future?



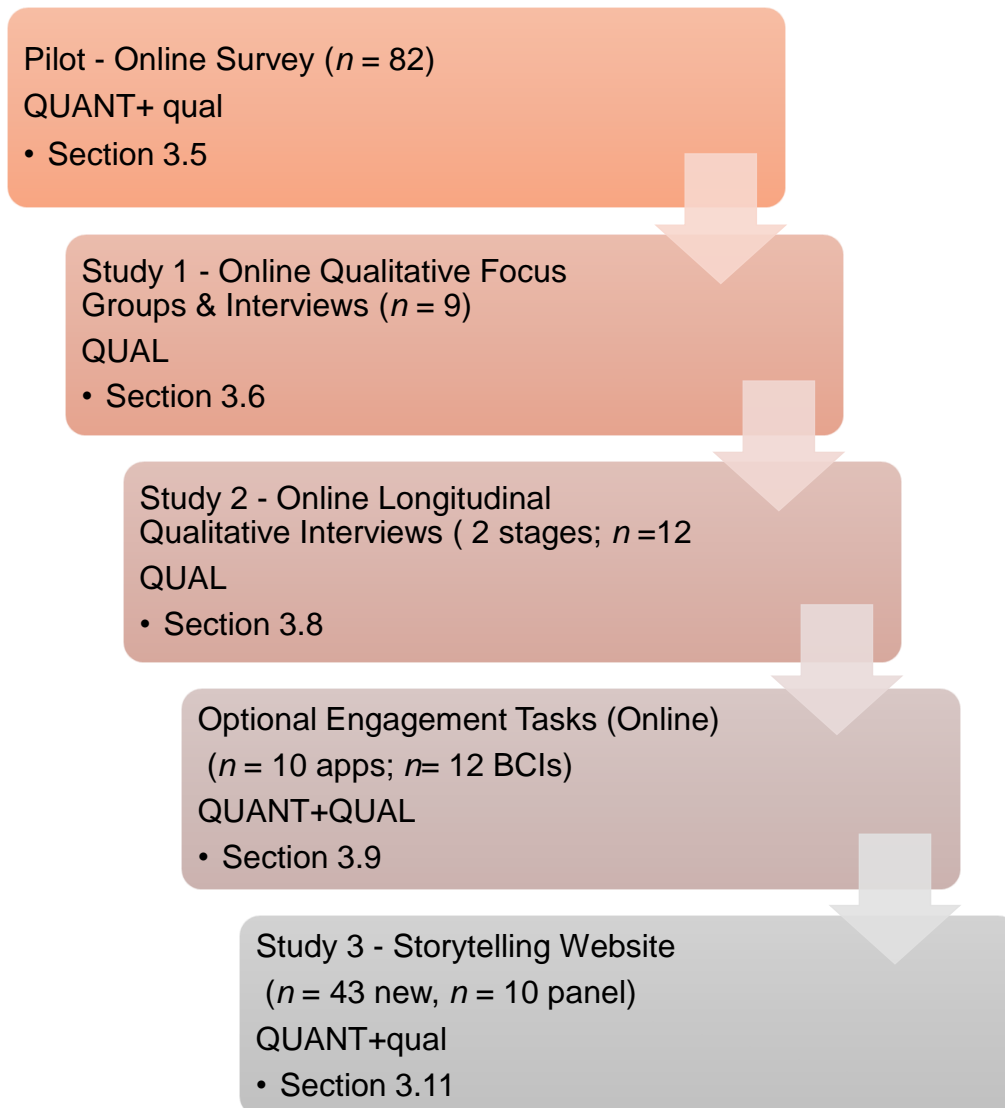
- How does the public respond to and experience future stories of mind uploading?

### **3.3 Overview of Approach**

Figure 3.1 shows the stages of my research with the public and also signposts to the relevant sections in this chapter. The notations below taken from Guest and Fleming (2015) denote the balance of qualitative vs. quantitative data for each study. Quantitative research (quant) is defined as collecting factual, numeric data. At the same time, qualitative (qual) captures items not easily counted or measured, such as experience, meaning, and perspective (Hammarberg et al., 2016; Yoshikawa et al., 2008). These definitions only describe the essence of each methodology, not their complexities. UPPERCASE signifies that the method is dominant while lowercase signifies the less dominant method. A plus (+) sign signifies that methods occur concurrently

**Figure 3.1**

*Multi-staged Public Research Methodology*



Studies like this, which utilise quantitative and qualitative research, are defined and described in a variety of ways. These include “mixed” (Onwuegbuzie & Johnson, 2006), “blended” (Thomas, 2003), or “multi-method” (Brewer & Hunter, 2006; Morse, 2003). In this instance, I use “multi-method,” as it better reflects the fact that quantitative and qualitative research were relevant at different stages in

the research process and met different objectives (Anguera et al., 2018; Bryman, 1988).

While there is some debate over the definition of multi-method research, I follow Brewer and Hunter (2006) as cited in Anguera (2018, p.2760) who defined multi-method research as “the practice of employing two or more different methods or styles of research within the same study or research program rather than confining the research to the use of a single method.” Multi-method studies do not require data integration (Creswell et al., 2016), and I analysed quantitative and qualitative data separately to ensure each retained its integrity (Bishop, 2015; Morse, 2003). Although, the findings from both contributed to the overall picture. Thus I was able to combine “the power of stories with the power of numbers” (Pluye & Hong, 2014, p.29).

### **3.4 Ethics**

I adhered to the University of Nottingham’s code of research conduct and research ethics throughout. Ethical approval was given for each of the research studies described. The School of Computer Science approved the initial pilot. The qualitative Interviews and focus groups for study 1 and study 2 and the engagement tasks were approved by the Ethics Committee and the Faculty of Engineering approval for the storytelling website was a separate application approved by expedited review since my lead supervisor is on the faculty ethics committee.

Ethical considerations for all studies are discussed below. Definitions are taken from The Belmont Report, Ethical Principles and Guidelines for the

Protection of Human Research Subjects (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (NCPHSBBR), 1978). The older definitions refer to “subjects” rather than “participants,” although the latter is typically used nowadays to reflect an individual’s active involvement in the research (Chalmers, 1999).

#### **3.4.1 *Informed Consent***

This embodies respect for participants and can be defined as the requirement “that subjects, to the degree that they are capable, be allowed to choose what shall or shall not happen to them. This opportunity is provided when adequate standards for informed consent are satisfied” (NCPHSBBR, 1978, p.6). As such, consent requires information, comprehension, and voluntariness. All research conducted as part of this thesis abides by this principle with participants given detailed but easily understandable information on study details. All participants had a proficient level of comprehension of the English language, both spoken and written. This was important since some of the themes dealt with complex concepts like life after death, personal identity, and consciousness.

#### **3.4.2 *Confidentiality and Anonymity***

Survey data and personal data were kept confidential throughout. Sensitive personal data, such as ethnicity, was treated by the guidance for special category personal data. Demographic information for participants recruited via Prolific was downloaded from the site and stored securely and separately to survey data and was only used for analysis. Participants were identified only by their Prolific ID

unless they chose to disclose their name during interviews or when emailing/messaging.

Pilot participants were initially recruited via the Call for Participants website and completed a recruitment questionnaire that collected both demographic and psychographic information, which was associated with their email address. This information was stored securely and separately from survey data. Again, individuals could choose to disclose their name or be known by a pseudonym.

Study 1 (online interviews and focus groups) and study 2 (online longitudinal interviews) via Microsoft Teams were both qualitative studies. Hence, additional steps were taken to ensure participants were in control of what they shared. Their consent for audio and video recording was obtained at recruitment and reconfirmed at the start of each discussion. Participants were asked to turn their cameras on during the discussion to facilitate interaction and engagement, but there was no pressure for them to do so. Those using a video feed were encouraged to use background effects to blur or disguise their location/setting while those who did not wish to share their video feed participated using audio only.

To maximise privacy and protect personal identity, participants were told to identify themselves only by their Prolific ID, although all subsequently volunteered their names. In one or two instances, when discussing particularly sensitive topics, a participant asked for the audio recording to be paused, which I did, and instead took detailed notes. Links to the privacy policies of Microsoft Teams were also provided.

With the participant's permission, the interviews were audio and video captured. Live video facilitated engagement and rapport and gave me a window into real-time non-verbal communication, such as gestures, facial expressions, tone of voice, eye contact (or lack thereof), body language, and posture. I took notes from the videos but primarily worked from verified transcripts of the original audio recordings.

For analysis and reporting purposes, verbatim quotes were only labelled by participant ID.

### ***3.4.3 Personal and Sensitive Information***

Mind uploading is a futuristic, hypothetical concept. As such, there are few risks associated with researching it. However, while the topic is not sensitive, it can be controversial, depending on an individual's personal beliefs, particularly around spirituality/religion/philosophy. Since mind uploading would theoretically occur when the physical body dies, death is also inherent in the topic.

There were several strategies to acknowledge sensitive topics and provide support, if required. I ensured participants knew that they did not have to answer any questions that they did not wish to and had complete control over what they contributed. Similarly, I signposted participants to relevant counselling services should they need to talk with a trained professional although this was not required.

In addition, I have over 30 years of industry market research experience, mainly in qualitative research. I specialised in healthcare and have researched many sensitive topics, such as terminal cancer, palliative care, mental health issues, and sexual dysfunction. I applied this experience in several ways. At the

outset, it enabled me to assess the study objectives and choose an appropriate method, such as focus groups or individual interviews. It also equipped me with the skills to write and use the discussion flexibly depending on the narrative I was presented with. I was also able to build rapport, engender trust and respond appropriately to participants' contributions, which was particularly important when they shared sensitive information, such as stories of abuse as found in study 2.

Study 2 (online longitudinal interviews) involved 12 individuals and their personal, autobiographical memories. In stage 1, participants shared personal recollections, and while many were positive, several participants entrusted me with upsetting or traumatic memories. In stage 2, participants predicted what memories they might make in the future, and on one occasion, this included end of life and a legacy for loved ones. However, all this personal information was willingly volunteered, and participants were fully informed and briefed at the start of the study.

Both the optional engagement task with BCIs and the storytelling website (study 3) included short clips of videos discussing future technologies and in the case of the website showing footage of a drama (Upload) and gameplay (Soma). Participants were made aware of this content before consenting, and the website also contained a disclaimer as shown below although no concerns were reported.

Due to certain project constraints, this story has used some images and videos from a drama shown on Amazon Prime called Upload as well as a game called Soma (from Frictional Games). You may feel that the characters lack diversity. I apologise for this and would like to understand your view on this. As such there are questions in the survey that follow this story to capture your thoughts on the characters portrayed. The different formats (drama vs. game) mean that the clips from Upload and Soma look different. As far as possible try to ignore this and focus on the themes

shown and the feelings they evoke. Some of the clips may be unsettling. If you are not comfortable viewing the content at any time please stop immediately and let me know at <mailto:angela.thornton@nottingham.ac.uk> or via Prolific messaging. We can then discuss and debrief on the content and find you additional support should it be required.

### **3.5 Pilot - Online Survey (QUANT + qual)**

#### **3.5.1 Objectives**

An early literature search using keywords and phrases<sup>1</sup> revealed limited research on public response to mind uploading, and the two studies focused on moral and psychological evaluations of people's attitudes toward mind uploading. Hence, I needed to start my research by establishing a baseline for awareness of and attitudes towards mind uploading. The first pilot study was therefore predominantly quantitative.

#### **3.5.2 Method**

The pilot study was a short online survey hosted by Qualtrics. I selected the online method in response to the pandemic and the enforced social distancing requirements. However, the fact it was time and cost-effective was also an important consideration at the start of my PhD.

#### **3.5.3 Materials**

On average, the survey took 13 minutes to complete and comprised six structured questions, one open-ended question, and five demographic questions (see Appendix A). The key measures were participants' awareness of and favourability towards mind uploading and their hypothetical willingness to upload their mind if their physical body was dying. In this study, "mind uploading was

---

<sup>1</sup> Mind uploading, mind transfer, +/- public



defined as converting a mind into digital data to allow it to be uploaded into an artificial carrier such as a supercomputer. This would allow you to live in a world of unbounded virtual experiences and effectively achieve cybernetic immortality”. This definition was created based on various discussions and I will return to this definition subsequently since it has limitations.

Apart from one scale – the Sci-Fi Hobby-ism scale (Koverola et al., 2020; Laakasuo et al., 2018), which is a 7-point scale, the attitudinal scales in the pilot were all 5-point Likert scales (Likert, 1932). The number of response choices (as well as analysis is much debated, and I will only summarise it here in the context of my choices.

I chose to use 5-point scales both in the pilot discussed here and in the mind uploading section of the website (study 3)<sup>2</sup>. I acknowledge the ongoing debate and the potential disadvantages of a 5-point Likert scale which includes less reliable and accurate measures of a participant’s true evaluation (Finstad, 2009). Nevertheless, a recent empirical study showed that using 7 response categories did not provide a significant advantage over using 5 response categories (Aybek & Toraman, 2022). This, together with the fact that 5-point Likert scales are more typical (Jamieson, 2004), hence more familiar to participants and easier to complete (Aybek & Toraman, 2022) led me to choose the 5-point scale. The debate over how to analyse data from Likert scales is covered in section 3.5.6.

---

<sup>2</sup> Questionnaires in the narrative engagement section of the website followed the convention of the researchers who devised them

### **3.5.4 Recruitment**

Participants were recruited via email using the University of Nottingham network and through the Call for Participants website (Call for Participants). This is an open platform that allows individuals to browse studies and choose which to participate in. Fieldwork was conducted during February, March, and April 2020.

### **3.5.5 Participants**

Demographics were matched with the same definitions and responses used in the Office of National Statistics Census (2011). These included the participant's age group, ethnicity, highest level of completed education, and current employment status. I also captured participants' sex following the 2011 Census which referred to biologically defined characteristics which are assigned at birth. Gender identity was not asked in any of the studies but will be considered in future work.

The inclusion criterion was that participants were 18 years or above. Most participants classified their biological sex as female (61%) compared to male (35%), and individuals ranged in age from 18–65 years and above. The majority (60%) were English, Welsh, Scottish, Northern Irish, or British with just under a quarter (24%), classifying themselves as from another White background. The remainder represented individuals from a range of ethnic groups, including Irish, White and Black Caribbean, Indian, Pakistani, Chinese, and African. Participants were generally well educated with just over three-quarters (76%) having at least an undergraduate degree. Their employment status ranged from employed part or

full-time, unemployed to retired although the best-represented group was students (32%).

### **3.5.6 Analysis**

Data validity checks to remove incomplete quantitative data and incorrect input (outside scale parameters) resulted in a final sample for quantitative analysis of  $n = 82$ . I analyzed quantitative data using IBM SPSS Statistics v.27. Due to the distribution of responses and the small size of some sub-groups, such as age, mainly descriptive statistics are reported. Investigating the relationship between science fiction hobby-ism and favourability towards mind uploading was investigated using Spearman's correlation coefficient. All open-ended responses ( $n = 85$ ) were explored using thematic analysis as described in chapter 2 section 2.3.

At this juncture, I acknowledge the debate over how to report Likert scale data. There is relatively little empirical evidence to support assumptions that Likert scale data can be treated as either interval or ordinal – the latter being where the responses can be rated but the distances between the points are not measurable (Jamieson, 2004). However, in 2021, Höhne et al. conducted a systematic review of scales that varied in terms of polarity (unipolar vs. bipolar) and labelling (ends only vs. every point). The authors concluded that the design of the scale can result in “considerable differences” in the data collected. Based on their results, end only labelled scales—unipolar or bipolar—are closest to being equidistant. This means that the sci-fi hobby-ism scales could potentially be treated as interval data. However, the 2021 study is relatively recent and has not been widely adopted.

There is a lack of consensus over whether (a) Likert scales are ordinal or interval data and (b) what descriptive statistics should be used when reporting. Theoretically, it should be the median for ordinal and mean for interval data, but means are often reported for Likert data. I have typically focused on the median when reporting although the mean and standard deviation (S.D.) are also reported.

### **3.5.7 Results**

Overall, the pilot met its objective of giving me an initial indication of public response. Two key findings informed the design of subsequent studies: (1) the majority of the public is unlikely to be aware of mind uploading and (2) those who are aware mostly have unfavourable perceptions. However, when asked to explain their favourability towards mind uploading, participants self-reported responses revealed a wide range of considerations which I needed to investigate further: hence study 1.

## **3.6 Study 1 - Online Qualitative Interviews and Focus Groups (QUAL)**

### **3.6.1 Objectives**

The study aimed to explore perceptions of and attitudes towards mind uploading in more depth than was possible in the short, semi structured pilot. I therefore chose a qualitative approach to answer questions from the standpoint of the participant (Hammarberg et al., 2016).

### **3.6.2 Method**

I considered several qualitative methods, including interviews, focus groups and observation (Hammarberg et al., 2016), and I chose focus groups to enable exploration, active discussion, and debate (Hennink, 2014) and specifically mini

groups of four to six since this allows individuals to participate more fully and equally and provide more information versus larger groups (Fern, 1982). The discussion lasted 60 minutes which was sufficient to cover the topics but of a duration that avoided participant fatigue or overload (Jennings, 2005; O.Nyumba et al., 2018).

At the time (Autumn 2020), faculty guidelines required any healthy participants coming onto campus to adhere to COVID-19 safeguards. These included wearing face masks and I had to consider the impact of mask wearing on verbal and non-verbal communication. Nestor et al. (2020) note that masks make displaying and perceiving facial expressions difficult given that communication is typically been 55% facial. Rather than compromise interaction and rapport, I decided to moderate online using platforms available and familiar to participants.

I considered the potential impact of using personal videoconferencing such as Microsoft Teams or Zoom vs. VR hubs such as Gather and Mozilla where individuals appear as avatars. Research in this area has produced differing results, but on balance, avatar representation may result in a lower level of trust than video representation (Pan & Steed, 2016; Riegelsberger et al., 2006). The authors of the 2016 paper hypothesise that this might be because only video can “present physical appearance and real dynamic visual interpersonal cues.” (Pan & Steed, p.9). Given the exploratory nature of study 1 and the importance of open engagement, I chose videoconferencing.

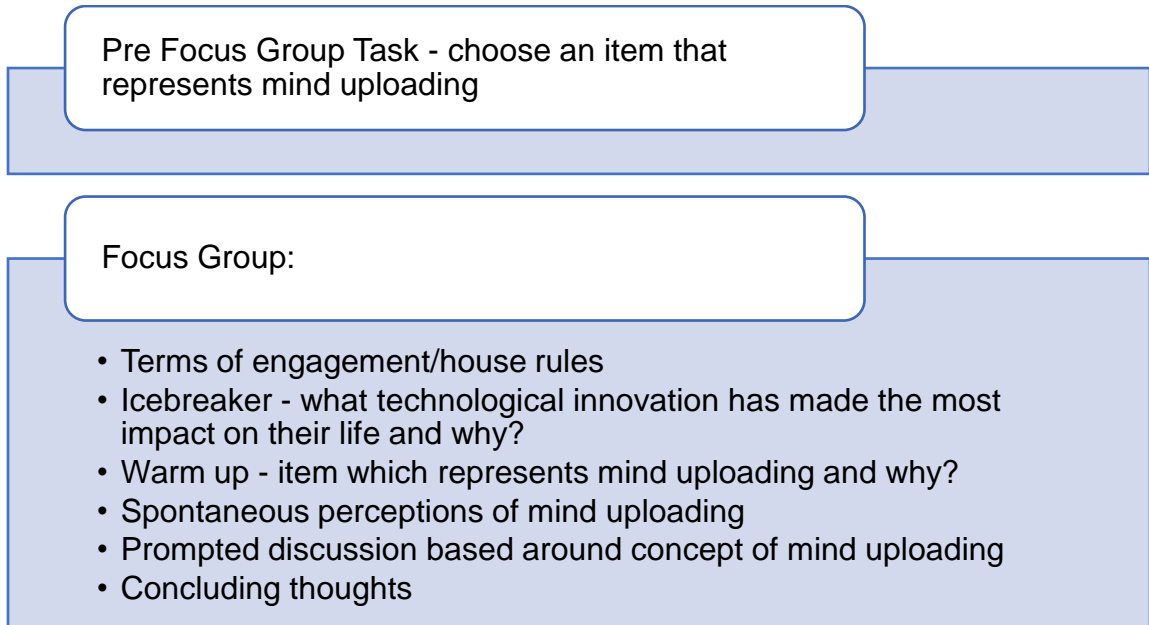
### 3.6.3 Materials

The structure of the discussion guide for the focus groups is shown in Figure 3.2.

The guide is in Appendix B.

#### Figure 3.2

##### *Structure of Focus Group Discussion*



The structure and content of the discussion guide were created to allow space and time for creativity and spontaneity rather than being prescriptive about the question areas. I used open-ended questions to facilitate a free-flowing discussion with a couple of carefully selected exercises to enable participants to articulate their thoughts and feelings and to prompt disclosure.

The guide was structured to move from general to more specific topics (Caroline Tynan & Drayton, 1988) and to consider the various stages of development in small groups (Finch et al., 2003): namely, Forming, Storming, Norming, Performing, and Adjourning. Spontaneous answers were encouraged

before stimuli materials or prompts although preprepared prompts were used to aid discussion as required.

Given that mind uploading is not part of the daily fabric of our lives, I decided it might be helpful if participants thought about the concept ahead of the focus groups. I used a simple pre group task for this that would allow participants to uncover feelings and thoughts that might be hard to express. Hence, the participants' task was to identify something that represented how they felt about mind uploading so this could be discussed in the focus group. Participants were encouraged to think expansively and told it could be anything at all for example a piece of music, art, film, literature, a physical object or a GIF, emoticon, or meme. Projective or enabling techniques like these can empower participants by giving them free choice and allowing them to naturally explain the thought processes or reasoning behind their choices (Richard & Lahman, 2015).

The focus group started with me giving a brief introduction where I explained the “terms of engagement,” for example, notes and recordings were taken for analysis only, all contributions were welcomed, and nothing was right or wrong. This was followed by an “ice breaker” on technological innovations—both those that have had a positive impact and those that have had a negative one—since mind uploading is a hypothetical future technology. Getting participants to critically reflect on their technology experience and consider positive and negative technologies set the scene for the following discussion. Participants also shared their choices on the items they had chosen to represent mind uploading.

The next section explored participant's preconceptions of mind uploading and the source(s) of these opinions. As this was the first qualitative study, it was important that I understood what had influenced participant's opinions. After spontaneous reactions had been explored, an outline of mind uploading was presented. The concept was only a brief introduction and one that deliberately focused on the science. The identity of the author (Michael SA Graziano, Professor of Psychology and Neuroscience at Princeton University) was not disclosed until initial views had been ascertained so that participant's opinions were not influenced by expert opinion (Rank & Jacobson, 1977). I chose Professor Graziano since he is a scientist and novelist and regularly produces articles and videos on topics of popular interest.

Subsequent discussions explored the potential pros and cons of mind uploading and what this might mean both for individuals and society before collecting any final thoughts and wrapping up.

#### **3.6.4 Recruitment**

I emailed the 20 individuals who had given their consent to be recontacted after the pilot to see if they would be willing to take part in this study and nine individuals consented. Study details were provided including an information sheet, the University of Nottingham consent form, and privacy notice for human subjects. Interested individuals also completed a short online questionnaire that collected demographic and psychographic information and checked their access and familiarity with online platforms: Microsoft Teams and Zoom. Fieldwork was conducted in October and November 2020.



### **3.6.5 Participants**

Two mini focus groups were convened, totalling seven participants: three in one group and four in the other. I conducted individual depth interviews with two participants who could not attend the groups. The recruitment questionnaire provided key demographics that informed the composition of the groups.

I carefully considered the degree of homogeneity or heterogeneity that should be represented by the group participants since this is much debated and lacks clear guidance. Researching a hypothetical topic like mind uploading poses different challenges to exploring views and experiences of a product or service. Hence some of the advantages of homogeneous focus groups, such as the comfort of shared experience and increased confidence to voice views (Sim 1998), did not apply and the small sample meant that demographic similarity was impractical. Hence, I convened heterogeneous groups, mixing ages, sex, and employment status as well as differing awareness and favourability to mind uploading. In theory participant's different backgrounds, experiences and perspectives would create a richer discussion (Wong, 2008) although as discussed subsequently this was challenging.

The nine participants comprised six females and three men—absolutes are reported due to the small qualitative sample. Their ages spanned 18 to 65 years. Participants ranged from being fairly aware to very aware of mind uploading and from not at all favourable to very favourable. Hence, the groups were heterogeneous both in terms of demographics but also attitudes.

### **3.6.6 Analysis**

All audio files were fully transcribed using the university's Automated Transcription Service (ATS), which uses Microsoft Azure and AI. All automatically generated transcripts were verified against the original audio, thus ensuring they were an accurate representation of discussions.

I conducted thematic analysis applying the same analysis process as previously described in Chapter 2.

### **3.6.7 Results**

Participant's responses showed a strong emotional response to mind uploading. While a minority were intrigued and excited, others were horrified by the prospect, and while I am an experienced moderator, it was a challenge to get participants to discuss and debate alternative perspectives. Hence the rationale for heterogeneous focus groups was not supported.

I found that perceptions of mind uploading are almost always based on science fiction presumably because it features there most prominently and has done so since the 1950s. As its name suggests, the genre is based on stories that involve science or technology and the fictional aspect often pushes the boundaries of what is imaginable. However, public awareness or knowledge of the scientific research underpinning the field of whole brain emulation, one hypothetical route to mind uploading, is extremely limited. These factors prompted me to consider the balance of science and fiction in my public research and how to encourage participants to evaluate their current perceptions and consider alternative perspectives.

## **3.7 Framing a Solution**

### **3.7.1 *Mental Models***

To meet the research challenges, I decided to draw on the concept of mental models. Mental models are present in many disciplines but the definition I am using here is drawn from cognitive science: namely, “a person’s mental representation of the way some aspect of the world works” (Holtrop et al., 2021, p.2). In the same paper, Holtrop (2021, p.2) who expanded on this definition and described mental models as “comprised of interrelated memories, conceptual knowledge, and causal beliefs that create an understanding of how something works in the real world and forms expectations about future events.”

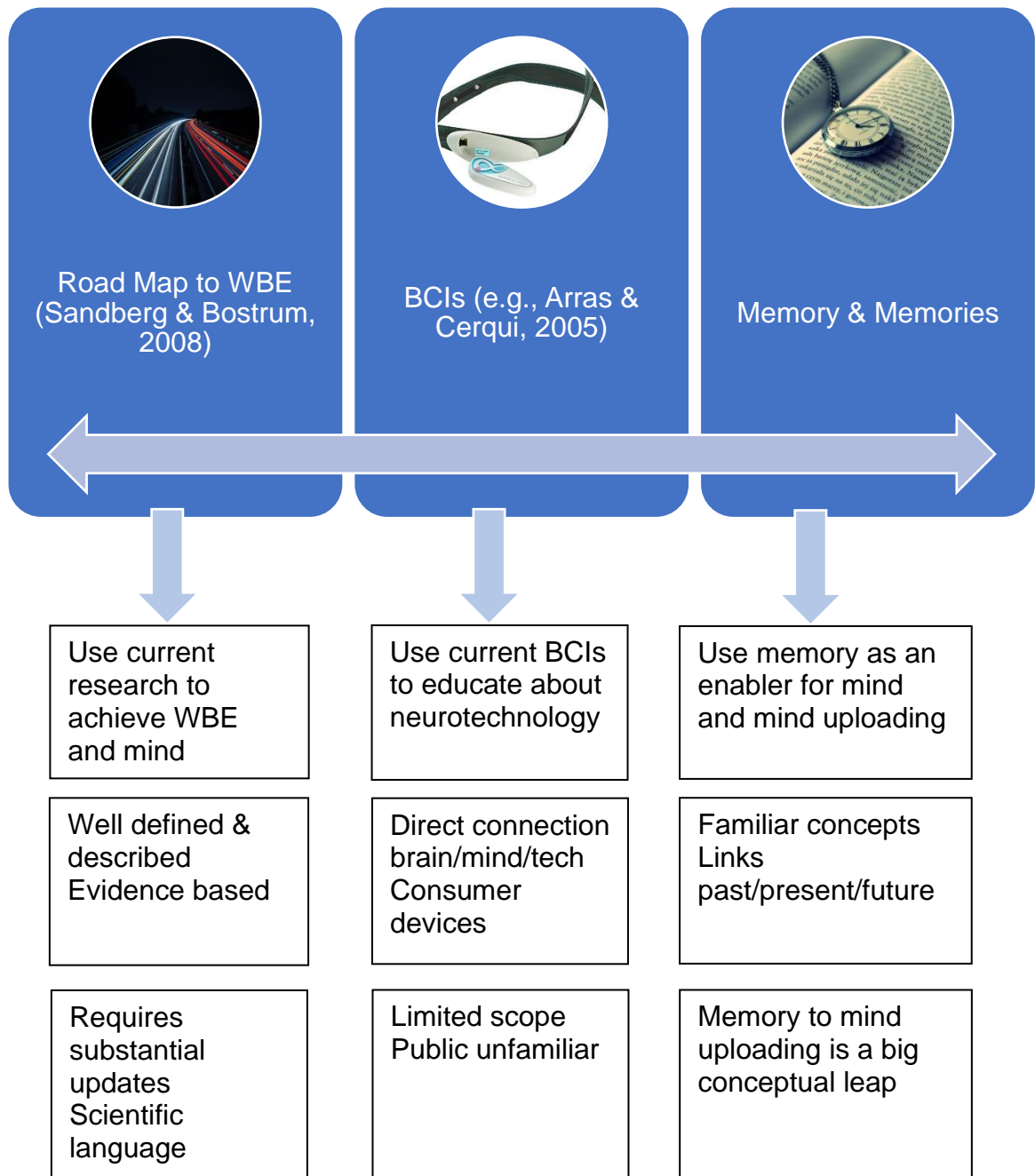
In my early studies, participant's expectations about what mind uploading entails, particularly the potential risks, appeared to be linked to deeply held beliefs on personal identity/selfhood, consciousness, spirituality, or religion, and the nature of human existence. These factors had important implications on the way I introduced additional information on mind uploading. More specifically I wanted to work with participant’s mental model of the “real world” and provide new information on mind uploading that would inform their expectations of this “future event” but could more easily be assimilated into their internal representations. Drawing on digital wisdom, (Petroni, 2021) I decided to use familiar concepts to build a bridge between the old and the new thus making it easier for participants to incorporate new information into their mental schema of the world.

### **3.7.2 *Pathways to Mind Uploading***

I initially considered three paths to the mind uploading road, each of which used scientific and technological developments to bring participants closer to the ultimate concept of mind uploading as shown in Figure 3.3. The complexity of the diagram means that it is on the following page.

**Figure 3.3**

*Potential Pathways to Mind Uploading*



This analysis informed my decision to build up from memory/memories to mind—a connection participants were comfortable with—and to find a way of encouraging participants to take the big step up to mind uploading.

### **3.8 Study 2 - Longitudinal Qualitative Interviews (QUAL)**

#### **3.8.1 Objectives**

The objective was for participants to use personal, autobiographical memories to revisit the past and predict a potential future. This was to encourage participants to think about their past and their future and utilise our skill of mental time travel (Tulving, 1985). The exercise would also build reflexivity in participants and myself (Calman et al., 2013; McLeod, 2003). I aimed to encourage unconstrained, creative thinking in readiness for the challenging and complex concepts of mind and mind uploading. In addition, I wanted to get to know my panel and build rapport and trust for the journey ahead. These objectives required a qualitative approach and one that allowed for extended engagement (Ochieng et al., 2021).

#### **3.8.2 Method**

Study 1 demonstrated the challenges of exploring the topic of mind uploading in a traditional focus group or interview. The “memory to mind bridge” was designed to facilitate the transition from the past to the future. However, I also needed time for participants to understand and explore the mind uploading concepts and for these to be assimilated (or not) into their mental schema. Hence, for study 2, I decided on longitudinal data collection, which not only allowed for a detailed exploration but also allowed me to build trust and rapport with the

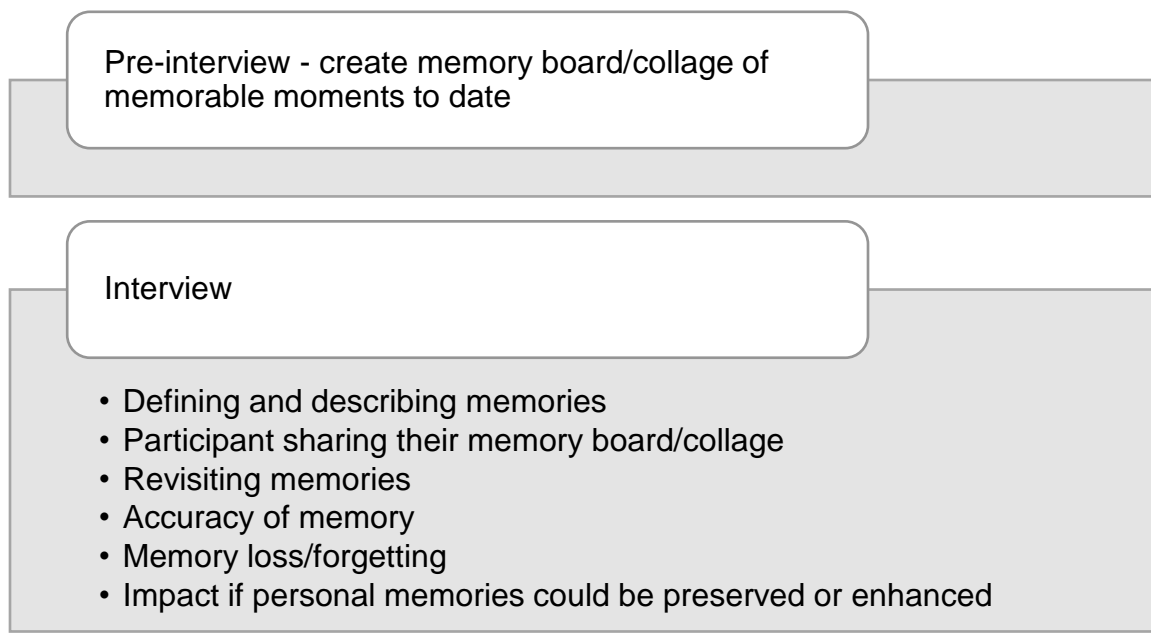
participants (Batty, 2020; Dickson-Swift et al., 2006). I conducted individual interviews rather than focus groups so participants and I could co-create individual and highly personal journeys into the past (stage 1) and the future (stage 2). The interviews lasted anywhere between an hour and two hours, depending on how much or little the participant wished to share.

### **3.8.3 Materials**

An overview of the interview flow for stage 1 and stage 2 interviews is shown in Figures 3.4 and 3.5. (Discussion guides are in Appendix C and Appendix D respectively. Where appropriate, I discuss concepts and methods relevant to both stages.

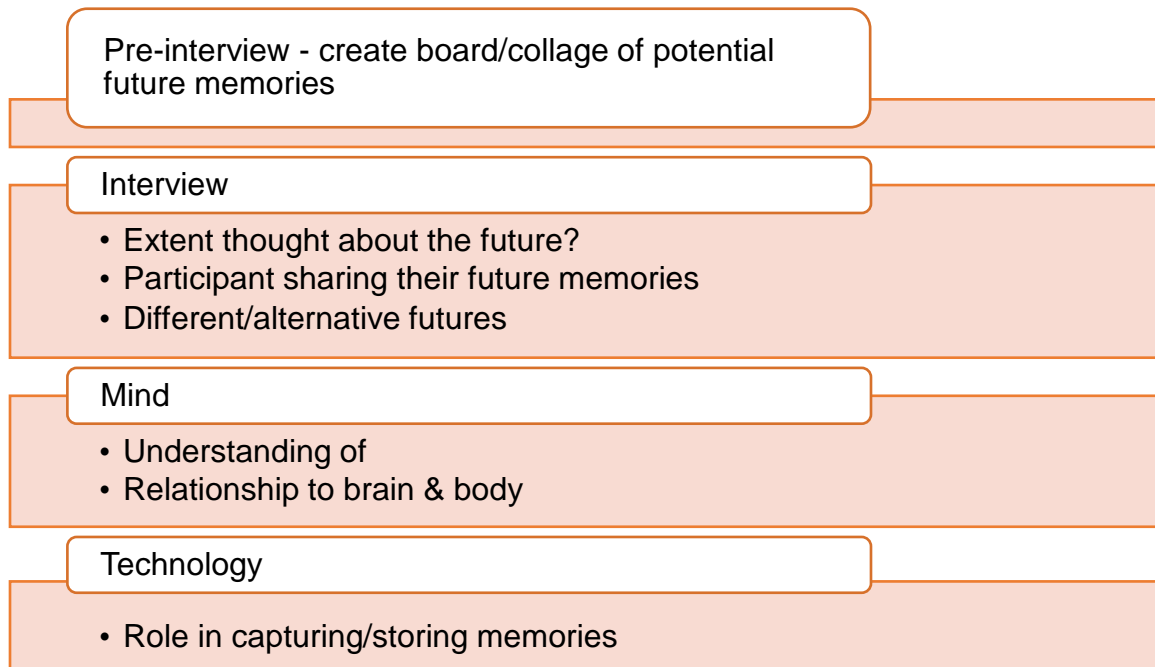
#### **Figure 3.4**

##### *Stage 1 Interviews - Discussion Flow*



### Figure 3.5

#### Stage 2 Interviews - Discussion Flow



As indicated above, stage 1 and stage 2 followed a similar process and free-flowing interaction style. Stage 1 delved into the participants' past, while stage 2 asked them to imagine the future. However, the premise was the same: namely, to explore the concept of memory through autobiographical memories and consider how it related to the mind. At the end of the interview, there was a brief discussion about the relationship between the brain, mind, and body and the role technology might play in the future. This was to encourage participants to consider such complex concepts ahead of the next stage of research.

#### **3.8.4 Recruitment**

Two of the 12 participants in stages 1 and 2 had also been involved in both the pilot and study 1. The remaining 10 of the 12 were recruited via Prolific, an



online research platform the strengths of which I considered outweighed the disadvantages such as convenience sampling and rapid responder bias.

#### **3.8.4.1 Prolific**

- One of the few research suppliers that my funder (EPSRC) permits.
- The only alternative to Amazon e-vouchers when paying participants. While Amazon e-vouchers have value, my supervisors and I previously challenged how well they meet the requirements for equality, diversity, and inclusivity. Other options such as “Love to Shop” vouchers would meet these requirements better but these, as well as charity donations, are prohibited. Prolific pays participants for completed studies via bank transfers so that they can choose how they spend the money.
- Prolific offers a large, diverse pool of 130,000 plus participants across 38 countries and allows for pre-selection of over 250 free demographic filters.
- Initial participant checks include identity verification, checks on IP address, device and browser, and VPN or proxy usage. New joiners are required to complete a first study as a test.
- Payment rates are fair, and as a researcher, I can approve and pay or reject based on data quality.

Stage 1 interviews were conducted in November, December 2021, and January 2022. Stage 2 interviews occurred during January, February, and March 2022.

### **3.8.5 Participants**

Participant demographics are shown below. I used absolutes due to the small qualitative sample.

- Seven males and five females.
- 10 out of 12 were white.
- Range of ages equally spread across age groups from 18–24 to 75–84 years (mean age = 47 years).
- Highest completed education: high school to a master's degree; although, the trend was an undergraduate degree or equivalent.
- Participants were employed full-time, part-time, or retired. One was unemployed and another a student.
- Five of the 12 lived in the UK. The remaining seven lived overseas, including Belgium, France, Greece, Portugal, and South Africa.
- Six gave their religion as Christian. Apart from one stating Judaism, the rest claimed no religion.
- Awareness of and favourability towards mind uploading at the time ranged from not very to fairly aware, and although favourability varied, no one was completely unfavourable.

These 12 participants comprised my panel of panellists who continued to be involved over time and, in the majority of cases (10), up to and including the final stage of the website survey.

### **3.8.6 Analysis**

All audio files were fully transcribed using the university's Automated Transcription Service (ATS), which uses Microsoft Azure and AI. All automatically generated transcripts were checked against the original audio, thus ensuring they were an accurate representation of discussions. I conducted a thematic analysis to identify common patterns within the qualitative data. The same analysis process as described in Chapter 2 section 2.3 was applied.

## **3.9 Optional Engagement Tasks**

In the following sections, I discuss the two optional engagement tasks involving AI-driven apps and videos of BCIs and report on key findings. Since both engagement tasks shared some characteristics, I have discussed both the apps and videos under the same headings where appropriate.

### **3.9.1 Objectives**

These tasks were included to ensure the panel's commitment and interest while the final study was designed and were inspired by research into potential methods discussed in detail in section 3.10. I also wanted to share with them some recent developments in digital technology that offered different perspectives on the power of AI and the potential role of consumer BCIs. I judged that participants' responses to these tasks could potentially provide useful data on design considerations for the website.

### **3.9.2 Method and Materials**

First, I gave panellists a list of four apps to choose from. They could try as many or as few as they wanted from this list and choose the length of interaction.

I wrote a brief description of each app based on the developer's site. I also provided links to each app's data privacy policies. The apps are shown in Figure 3.6.

These apps were selected based on (a) their accessibility and (b) their attributes. Accessibility included the apps being available for both Android and Apple products and that they were free to download and interact with. The selection was chosen to demonstrate how AI can enable interactive experiences and to appeal to the different personalities and interests of the panellists. For example, both Alter Ego and I Meet Myself focus on the psychological aspects of personality while Replika enables a personalised interaction with a customised avatar companion. Karen showcases interactive, tailored communication and interactions with a human face. In different ways, three of the four apps demonstrate a storytelling approach be that through engaging with an unfolding story or experiencing a personal journey of insight in Alter Ego, I Meet Myself and Karen. Replika is different in that it speaks to our interactions with an avatar which could be an exemplar for existing as an upload.

## Figure 3.6

### *Interactive Apps for Engagement*



#### **Alter Ego by Caramel Column Inc (v 3.6.11, 27 Dec 2018)**

- This game is for you if you want to analyse your personality. You are interested in literature, philosophy, or psychology. The ending of the game changes based on the choices you make.



#### **I Meet Myself by Loh Cai Jun (Version 2.07, 9 July 2017)**

- An immersive text-based journey that leads to self-discovery.



#### **Replika by Luka Inc (Version 9.5.1)**

- Replika is a chatbot companion powered by Artificial Intelligence (AI).



#### **Blast Theory (Version 1.99, 9 September 2020)**

- Karen is a life coach and she's happy to help you work through a few things in your life ...

After experiencing the apps, panellists completed an online questionnaire on Qualtrics lasting approximately five minutes. They indicated which they interacted with, described their experience with each, and, if they had explored more than one, were asked to choose a favourite. The questionnaire is in Appendix E.







The next engagement task which occurred two to three months after the interaction with the Apps and involved videos showing BCIS. Panellists were introduced to BCIs as technology linking our brains and minds to other devices. They were given links to five short videos (each under two minutes) and a sixth

video (slightly longer at 13 minutes), the latter described as one person's vision of the future. Please note that since the original study in early 2022, there have been some changes to the BCIs listed. The links are to the original videos that the panellists viewed. All the BCI information was freely available in the public domain via YouTube.

I identified and selected the examples in figure 3.7 to showcase non-invasive BCIs that use measures of brain activity to provide feedback and insight to users (Muse, BrainBit, and Neurable) or harness this technology to allow users to control devices with their minds (NextMind and Neurable VR). The final stimulus material—Uploading Memories—was potentially more controversial since it featured Elon Musk's opinions on current and future neurotechnology. However, despite this potential bias, I chose this video as it provided a thought-provoking overview.

**Figure 3.7**

*BCI Engagement Videos*

BCI	Link
<p><b>Muse headband</b> Brain sensing EEG technology which tracks brain activity and enables insights into mental state.</p>	<p>Muse</p> 
<p><b>BrainBit headband</b> Monitors electrical activity produced by cortical regions of the brain and records the activity as raw EEG data which can be processed for user readability.</p>	<p>BrainBit</p> 
<p><b>NextMind</b> A real-time brain-computer interface development kit, capable of translating brain signals into digital commands e.g., computers, AR/VR headsets.<sup>3</sup></p>	<p>NextMind</p> 
<p><b>Neurable</b> A headphone brain-computer-interface (BCI) device that uses brainwave sensors and algorithms to estimate focus in real-time.</p>	<p>Neurable</p> 
<p><b>Neurable VR</b> This uses the same technology as Neurable, but the brain-computer interface integrates directly into the VR headset,</p>	<p>Neurable VR</p> 
<p><b>Uploading Memories</b> Elon Musk discusses BCIs including Neuralink and the potential they may offer e.g., uploading memories and dream</p>	<p>Uploading Memories</p> 

<sup>3</sup> The startup company has since been acquired by Snap

Panellists were asked to watch the videos in the order given, as this reflected the sophistication of the technology. After watching all six videos, panellists completed an online questionnaire on Qualtrics lasting no more than 10 minutes. For each of the five devices, panellists wrote three words to describe their reaction. They indicated how likely they would be to use the device if given it to try, which removed the influence of affordability. Panellists also gave three words for the last video entitled “Uploading Memories” but were also asked which aspects they found either believable or unbelievable. The final question asked how they felt about the type of technologies depicted. The questionnaire is in Appendix F.

### **3.9.3 Recruitment**

12 participants had previously given their consent to longitudinal interviews. All these panellists engaged with the BCI videos and 10 with the AI apps. Fieldwork took place in March 2022 for the AI apps and in May 2022 for the BCI videos. This was shortly after the second stage of study 2 (January–March 2022) and before the launch of the website in January 2023 for the panel and February 2023 for new participants. Those who opted to engage were paid through Prolific in the same way as in prior research.

### **3.9.4 Participants**

The panel’s demographics have been described in section 3.8.5.

### **3.9.5 Analysis**

Quantitative data was analysed using IBM SPSS Statistics v.27. Due to the small sample size, only descriptive statistics are reported. I conducted thematic analysis, with traditional tools, to identify common patterns within the qualitative



data from the open-ended questions. This was the same approach described in Chapter 2.

### **3.10 Researching Future Worlds**

#### ***3.10.1 Objective***

To create an engaging experience to encourage participants to explore hypothetical, far-future worlds where mind uploading is a reality.

#### ***3.10.2 Evaluation of Potential Methods***

There is a large evidence base documenting the challenges of researching the future and more specifically future technologies, for example in the domain of Human-Computer Interaction (HCI; Benbasat, 2010; Coulton et al., 2016; Gaver et al., 2022) so I drew upon this research to assess potential methods for the next stage.

I reviewed a range of tools and techniques using online literature and websites. The techniques spanned established academic research methods such as design fiction/speculative design and Contravision as well as other mechanisms for engagement, such as virtual worlds and meeting spaces and interactive, AI apps. At this early stage, I was open to different techniques, albeit those which showcased technology and were appropriate for researching hypothetical futures. My preliminary list is shown in Figure 3.8.

**Figure 3.8**

*Potential Tools & Techniques to Research Hypothetical Futures*

Virtual meeting spaces	<ul style="list-style-type: none"><li>• Mozilla Hubs</li><li>• Gather Town</li></ul>
Virtual worlds	<ul style="list-style-type: none"><li>• Second Life</li><li>• SIMS 4</li></ul>
Websites	<ul style="list-style-type: none"><li>• Digital Humans</li></ul>
Established research methods	<ul style="list-style-type: none"><li>• Design Fiction/Speculative Design</li><li>• Contravision</li></ul>
Commercial Role Player Games (RPG)	<ul style="list-style-type: none"><li>• Nier Automata</li><li>• Soma</li><li>• Stellaris</li><li>• Detroit Become Human</li><li>• Cyberpunk 2077</li></ul>
Bespoke game	<ul style="list-style-type: none"><li>• Afterlives'</li></ul>
AI apps	<ul style="list-style-type: none"><li>• Replika</li><li>• I Meet Myself</li><li>• Alter Ego</li><li>• Karen</li></ul>

I assessed the strengths and weaknesses of each approach in the context of my research. My objective was to find a method that would encourage participants to engage and be transported to a future world of mind uploading. This was an important consideration because a key insight from the exploratory qualitative research I conducted in study 1 was that conceptualising the hypothetical future technology of mind uploading was challenging.

My assessment involved four key parameters all of which were important.

- Any academic evidence for the method,
- Ethical considerations, such as the approach being easily accessible to all regardless of their age and aptitude.

- The feasibility of accessing the technology within my PhD's budget and timeframe
- The feasibility of using it with my panellists who were globally dispersed and had differing levels of technology knowledge and experience.

The last two considerations involved factors such as the cost of equipment or materials, the cost and time for developing bespoke materials such as a game, the feasibility of distributing and collecting equipment and materials as well as the resources needed to familiarise and support panellists on any unfamiliar technology.

### **3.10.3 Games as a Method**

Of the options considered, games and digital games specifically were highly relevant to mind uploading in that they transport the player into “fantastic, hypothetical situations” (Simeone et al., 2022, p.3). With sufficient immersion and engagement, the player can suspend disbelief and enter fully into the gaming experience. Being able to replicate this experience was important since my earlier research had revealed strong opposing reactions to the concept of mind uploading and a reluctance to consider alternative perspectives. I was also aware of the challenges of depicting the topic in a way that encouraged participants to think deeply about the implications of mind uploading.

The most cost-effective option was a commercial game that could be run via Steam, an online game platform that is easy to install on a PC. The best match for my topic of mind uploading was *Soma* (Frictional Games, 2015). Several commercial games deal with futuristic worlds and themes of man vs. machine such

as Nier Automata, Stellaris, Detroit Become Human, and Cyberpunk 2077 (see Figure 3.8). Detroit Become Human is the most interactive with a branching narrative where every choice the player makes affects the outcome and the destiny of both mankind and androids.

However, while this interactivity and causality speak to my aim of enabling participants to engage with futuristic worlds, the themes depicted in the game do not reflect issues pertinent to mind uploading, such as clones or copies, personal identity, and immortality. These themes are discussed in more detail in Chapter 4 where I report on my research with the public.

In contrast, Soma does depict many of the key themes of mind uploading, even if it is classified as “sci-fi horror” and, as such, focuses on a dark, dystopian future. Since there was not a commercial mind uploading game that provided a balanced perspective of dystopian and utopian scenarios, I investigated a bespoke game. However, consultation with a range of specialists from the University of Nottingham showed this would require considerable investment (minimum of £25,000) and considerable development and testing time (6 months or more). The investment required and the time scale were outside the scope of my thesis. I therefore needed to find an alternative. Thankfully, subsequent discussion with my internal examiner who has extensive experience in Computer Science (McAuley. D. personal communication. 28<sup>th</sup> April 2022) offered a potential solution: namely, an interactive website that incorporated elements from existing high-end productions.

### **3.10.4 Website**

Given the constraints of my PhD budget and the time available to develop the website, the extent to which it could be made truly interactive was a challenge. I had to exclude some elements of a game such as branching narratives where the user's actions affect outcomes and challenges and quests. Hence my evaluation of a website vs. a game assumed a website which depicted the concept of mind uploading through a narrative approach but lacked true interactivity. Despite these potential weaknesses, the website had several strengths: namely,

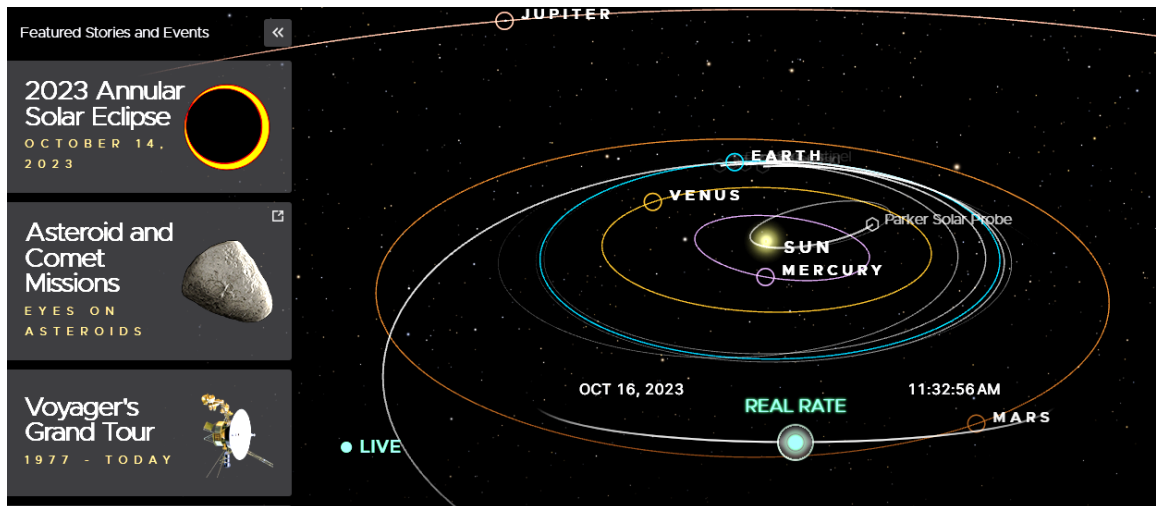
- It would be easily accessible to all on a PC, smartphone, or tablet and would not require specialised hardware and software.
- Accessing and navigating websites is a familiar task but while gaming is a popular pursuit with 62% playing games on an electronic device in the UK (Ofcom, 2021), not all participants would be gamers. Playing a game might require the acquisition of new skills which might detract from engagement.
- The website could make use of existing media with high production values and so reduce development costs and production time. These materials would be copyright compliant (e.g., fair dealing for non-commercial research and private study).
- A website could be designed and tested far quicker than a game which was important given my submission deadline.

- The costs of hiring an external developer to bring my narrative and research questions to life on a website would be significantly less than creating a bespoke game.

My objective was participants to engage with the experience. While there is ample evidence for this engagement or immersion in games (Coulton et al., 2016; Simeone et al., 2022), there is limited data for this on a website. However, I judged that another digital platform, if carefully designed, would allow participants to take on board the temporary reality of a far future world and reflect on the concepts being explored (Coulton et al., 2016). I therefore searched for websites that exemplified a narrative structure and visual elements using a combination of internet searches focussing on “storytelling” and/or “narrative.” I also approached colleagues for advice and one of those who has a background in website design suggested the Threejs website (**Threejs**). This website hosts examples of interactive 2D and 3D graphics on a web browser. Examples are shown in Figure 3.9, 3.10 and 3.11

Figure 3.9

NASA



<https://eyes.nasa.gov/apps/solar-system/#/home>

Figure 3.10

Opera North

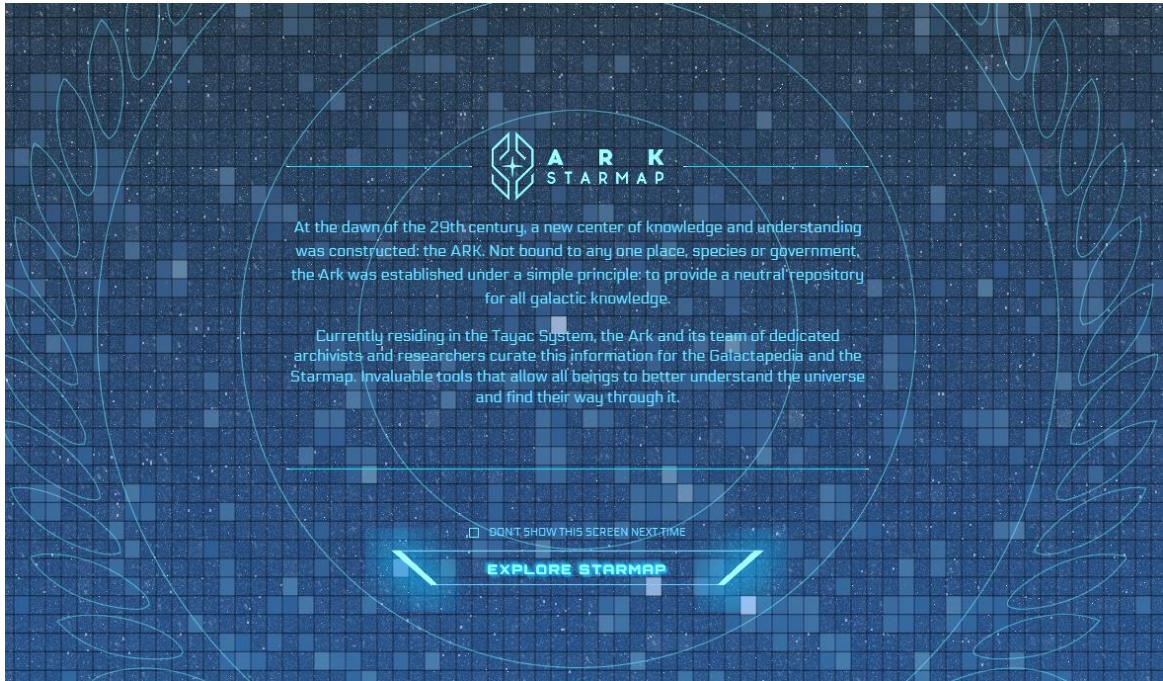


Opera North's production of Turn of the screw

[operanorth.co.uk/turn-of-the-screw](https://operanorth.co.uk/turn-of-the-screw)

**Figure 3.11**

*Robert Space Industries*



<https://robertsspaceindustries.com/starmap>

While these examples focus on different topics, they all have strong visual elements, a narrative element and interactivity. The NASA website allows you to have “eyes on the solar system” and explore different elements such as planets and moon, comets and spaceships as well as including narrative elements such as the story of the annular solar eclipse. The Turn of the Screw is an immersive trailer for Opera North’s production while Robert Space Industries allows you to navigate a far-future galaxy.



These examples and others, together with discussions with a web designer, convinced me that a website was a viable option, both in terms of my research objectives and time and budgetary constraints.

I had already collaborated with my industry partner on a concept for a mind uploading game. This involved me contributing to the story that introduced the topics of whole brain emulation and mind uploading via the main character who was studying and working in this field. The game then showed the main character living as an upload and facing various challenges and threats. This inspired me to create my narrative for mind uploading and hence the idea of telling a story through the website was born.

I follow one of the pioneers of narrative research — Melanie Green — in that I use the terms story and narrative interchangeably. She has a substantial body of work on story and narrative and was a major source of information and inspiration since her work introduced me to key elements of a narrative and how these contributed to the experience and created engagement. I follow the premise that “a narrative is a story, an account of a string of events occurring in space and time.” (Green M., September 09, 2014).

Storytelling as a research method is well established and known to effectively convey complex stories and increase the engagement of both the storyteller and listener or narrator (Rieger et al., 2018). Although I ended up refining elements of the method the concept was invaluable.

The theme of storytelling also reflected the journey my panellists and I had been on over the last few years. Participants had shared their stories of memories

and created a narrative for their future lives. Hence expanding this to tell the story of two characters in far future worlds via an interactive website was appropriate.

### **3.11 Study 3 – Storytelling Website (quant+ qual)**

#### **3.11.1 Objectives**

I had two objectives:

- To collect data on attitudes to mind uploading.
- To capture data measuring how effective the website was as a method.

#### **3.11.2 Materials**

Before detailing the method, I will introduce the materials I used for the website narrative. Storytelling methods typically centre on individuals telling their own stories, but this wasn't an option since in 2023 no one has a story of their mind uploading.

As mentioned, I did not have the budget to create bespoke scenarios so opted to use existing mind uploading media. Of these, the most suitable options in terms of content were an Amazon Prime drama—Upload (Daniels & Klein, 2020—present) and the first-person Role-Playing Game (RPG) mentioned previously—Soma (Frictional Games, 2015). Although these differed in style and story, both dealt with key themes identified in my previous research and are still available. A brief synopsis of each and the main characters follows:

Upload is set in a futuristic world where the rich and powerful can buy a utopian digital immortality. Upload is billed as a comedy and there are many light-hearted moments. However, there is meaningful commentary on many of the darker themes of mind uploading such as privacy, accessibility, and socio-

economic imbalance and as the series unfolds, more dystopian aspects emerge. The main character is Nathan, a software developer, aged 27 at the time of death from a punctured lung in a car accident. He is uploaded to Lakeview, by Horizon, a virtual world populated by uploads who exist as life-like avatars.

Soma's title is derived from the Greek σῶμα, which perceives the body as distinct from the mind or the soul. This indicated that the game developers had considered one key dualist argument against mind uploading: namely, that a mind (and soul) are not an emergent function of the (emulated) brain. Soma explores many relevant themes such as consciousness, identity, the self, free will, and subjective experience.

The main character, Simon, initially has his brain scanned in 2015 when he was involved in a car crash and sustained severe brain damage. He was in his late twenties at the time. However, Simon starts his existence as an upload many years later (2104) and his afterlife spanned several worlds, including an underwater facility on Earth. This is the only place to have survived a meteor collision. In the video clips, we meet another character called Catherine, a computer scientist whose brain was scanned and uploaded into a computer. The only other remnant of humanity is brain scans of people stored in a digital black box called the ARK. Simon's mission in the game is to help Catherine recover the ARK and launch it into space thus ensuring humanity continues.

From the original materials, I identified scenes I could edit and weave together to tell Nathan and Simons' stories. The clips I selected focused on key

themes from prior research such as copies/clones, immortality, subjective experience, embodiment, and humanity.

For a balanced view, videos were approximately the same length for each character. I created minimal written narration to link the video clips and used a third-party narrator, as this is typically seen as less persuasive than the first-person perspective (Brunyé et al., 2009; Pourgivi et al., 2003). I acknowledge that by choosing the clips myself, I may have introduced selection bias although the video footage available restricted my choices.

The website was built by an experienced web designer using the design concepts I provided and a questionnaire I created in Qualtrics. I piloted it as did my supervisor, the designer, and two friends to ensure the website was fully functional and that the participant experience was as seamless as possible. Once launched, the site was hosted by the website designer with access via a one-time link. There were two versions, one for the 12 panellists that included a link to remind them of the ethical code (they had already seen this on several occasions) and another with full ethical disclosure upfront for new respondents ( $n = 43$ ).

### **3.11.3 Method**

As well as telling the stories of the two protagonists, the website also collected detailed survey data. Initial questions measured awareness of and favourability towards mind uploading so that I could compare these with post-website data. These questions were followed by a five-minute video introducing mind uploading to ensure all participants shared a similar vision of the concept. This was important since while the panel had been on the mind uploading journey,

new respondents had not. Thereafter, embedded in the video section were questions on mind uploading concepts illustrated by the video clips.

However, given the novel method, it was equally important to gather data on how effective the website was as a storytelling method. The most widely used construct in storytelling assessment is (narrative) transportation, which is “cognitive and emotional immersion in a story, accompanied by vivid mental imagery” (Green & Jenkins, 2014, p.483).

As well as capturing transportation data, I also measured aspects of narrative engagement and identification as these contributed to a more detailed understanding of participants' reactions to the story. Identification occurs when people can experience the narrative through the perspective of a story character (Green, 2021; Green & Jenkins, 2014). Engagement is a broader concept and allowed me to study specific dimensions of the experience including understanding, attentional focus, emotional engagement, and presence (Busselle & Bilandzic, 2009).

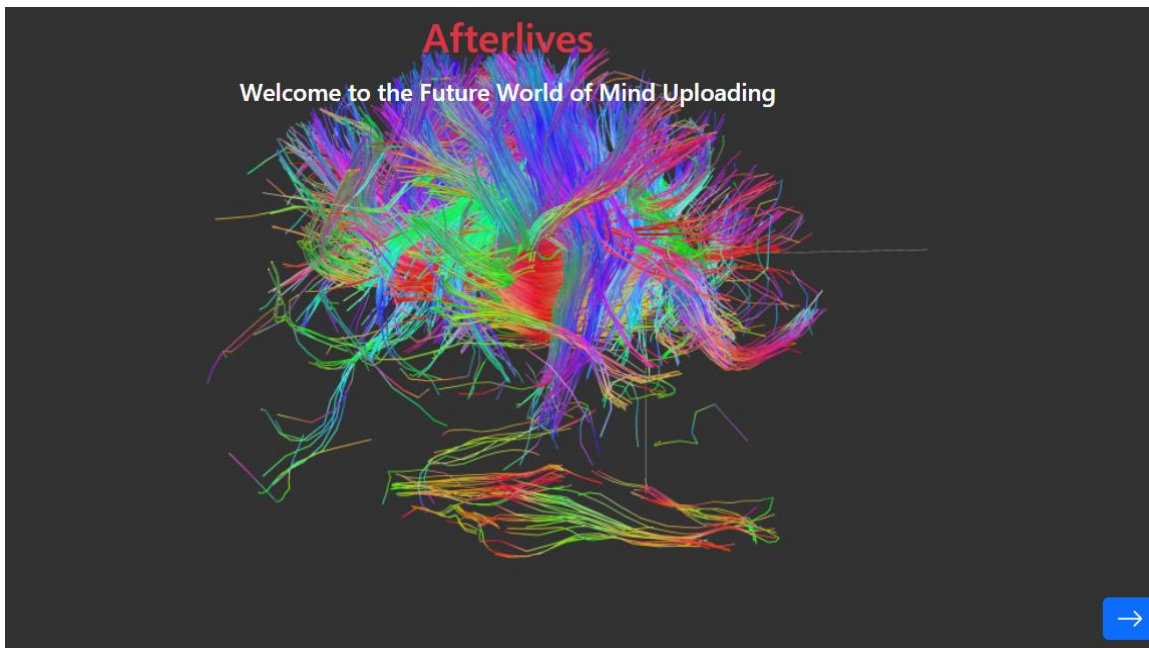
These elements were measured by a questionnaire completed immediately after the mind uploading stories so that the experience was still top of mind. These concepts, their measurement, and an evaluation of how well the website achieved them are discussed in detail in Chapter 6.

Following the engagement section, participants completed the final set of questions, which linked back to some key concepts of mind uploading and captured awareness and favourability ratings, post experience. I also asked how the website could be improved. On average, the website took panellists 53 minutes

to experience and new respondents 73 minutes, probably because the 12 panellists had gained familiarity with the concepts. A link to the main website is given underneath Figure 3.12 as well as a link that allows the website to be previewed without completing the survey. A copy of the survey is in Appendix G.

**Figure 3.12**

*Afterlives Website*



**Link to main website - Afterlives**

**Link to website preview**

**3.11.3.1 Website Survey and Story Flow**

The website narrative was linear and controlled by me as the author. The type of stimulus material, the data collected, its contribution to the study, and the key themes of mind uploading are summarised in Figure 3.13. Not all the scenarios

and questions related to specific themes. Some were there to provide context to the characters and story.

In summary, the website collected some preliminary data on awareness of and favourability towards mind uploading before introducing the topic via a neuroscientist. Thereafter, the story introduced the two main characters, depicted the process of their brains and minds being scanned and uploaded, and then showed aspects of their experiences as uploads in different worlds. At relevant points in the story, I embedded questions some of which related to the key themes and others which collected contextual data.

**Figure 3.13**

*Website Structure*

V- Video clip
N –Narration (written)
Q – Question

Element	Contribution	Themes
Q	Awareness of mind uploading (pre-test)	
Q	Favourability to mind uploading (pre-test)	
V	How mind uploading might be achieved (neuroscientist)	
N	Backstory on Nathan (Upload) and Simon (Soma)	
V	Nathan’s scan	
Q	Response to the scanning	
V	Nathan’s upload	
Q	Response to upload process	
V	Nathan’s first day as an upload	

	(premium facilities)	
Q	The appeal of life as an upload	
V	Nathan's experience with budget upload	
Q	Reaction to premium vs. budget upload	Accessibility
V	Simon's scan and upload	
Q	Response to the scanning	
Q	Response to upload process	
V	Simon considers existence as an upload	Subjective experience/being human
Q	Belief in using science and tech to develop humans	
N	Simon uploaded in different forms	Embodiment
Q	Attitudes to Simon's robot body	Embodiment
V	Simon's final upload – v.1	Copies/clones
V	Simon's final upload – v.2	Copies/clones/immortality
N	Survival	
Q	Surviving as a copy vs. original	Copies/clones
Q	Importance of your survival vs. humanity's	Individual vs species
N	Different possibilities	
Q	Which scenario is most likely	
	Questions on engagement	
Q	Appeal of immortality	Immortality
Q	The appeal of fixed life extension	Life extension
Q	Preference for immortality or life extension	
Q	The most appealing attributes of mind uploading	Perceived benefits
Q	The most worrying attributes of mind uploading	Perceived concerns



Q	Avatar vs. physical form	Embodiment
Q	Would you be truly “you”	subjective experience
Q	How would feel if uploaded	Subjective experience
Q	Views on no longer being human	Subjective experience
Q	Perception of a new existence	Subjective experience
Q	What makes life as an upload worth living	Subjective experience
Q	Willingness to upload	
Q	Awareness of mind uploading (post)	
Q	Favourability to mind uploading (post)	
Q	Improvements to story	
Q	Improvements to website	
Q	Evolution of website vs. game	
Q	If you have seen Upload before	
Q	If had played/seen Soma	
Q	Final comments	

#### **3.11.4 Copyright Law**

In addition to the ethical responsibilities to participants (covered in section 3.4), copyright law had to be considered since I was using media (Upload and Soma) created by another. I sought guidance from the University of Nottingham’s Copyright Officer beforehand and made use of the UoN’s exceptions whereby you can copy a “fair” proportion of a work without the prior permission of the copyright owner. These include fair dealing for non-commercial research and private study (Non-commercial; University of Nottingham Fair Dealing).

I downloaded official videos for Upload from Amazon Prime and clipped relevant segments using the video editor software Wondershare Filmora (Wondershare, 2023). For Soma, I clipped pieces from a YouTube walk-through of gameplay. University guidance advises us to be “wary” of using YouTube content not posted by the creator. However, in this instance the gameplay was posted by RabidRetrospectGames and the game creator (Frictional Games) allows this use of their content.

All clips were hosted on my YouTube channel as unlisted. This meant they could be seen and shared by anyone with the link, but they didn’t appear in YouTube’s search results. YouTube’s copyright procedures classified these as copyright-protected content but as instances where the owner allows the content to be used on YouTube.

### ***3.11.5 Recruitment***

The 10 panellists were already recruited, and I sourced an additional 43 new respondents for the website. 40 of these came from Prolific and three were convenience sampled from personal connections. Fieldwork took place in January and February 2023 for the panel and February, and March 2023 for the sample of 43 new participants.

### ***3.11.6 Participants***

The profile of the panellists was reported in section 3.8.5. The new participants ranged in age from 20 to over 80 years with a mean age of 30. The majority were white with approximately a third giving their ethnicity as black. Mixed race and other ethnicities accounted for 5% each. New participants resided in a

total of 12 countries, South Africa being the best represented, followed by the UK at 17%. A total of 39% were employed full time while over a third were students. Around a fifth worked part-time with slightly more unemployed but seeking work. Males and females were equally represented.

### **3.11.7 Analysis**

The final sample for quantitative analysis was  $n = 43$ . Before the study, I computed the required sample size. For this, I used data from my online pilot study and pilot data from a paper published by Laakasuo et al. (2018). Both these studies were conducted online via Qualtrics using independent samples. In addition, both studies asked several questions about sci-fi hobby-ism. From the duplicated questions, I chose one “I try to actively follow the latest developments in natural science or technology” and used this data in my sample size calculations. I acknowledge that this was subjective and there were other options I could have chosen.

I chose a value of 0.80 for power, as this is the generally accepted minimum standard (Cohen, 1992). The following values (see Table 3.1) were input into the Power Analysis in IBM SPSS Statistics for Windows, Version 28.0. I used the means (independent samples t-test) as the type of analysis. Table 3.2 shows the results of the power analysis.

**Table 3.1**

*Data Set for Power Analysis*

Study	Sample size ( $n =$ )	Mean	Standard Deviation (SD)

My pilot	82	4.40	1.04
Laakasuo et al	268	4.46	2.41

**Table 3.2**

*Power Analysis (from SPSS)*

	N1	N2	Actual Power	Test Assumptions				
				Power	Std. Dev1	Std. Dev2	Mean Difference	Sig.
Test for Mean Difference	31	31	.810	.8	1.04	2.41	1.37	.05

- a. Two-sided test. b. Based on noncentral t-distribution

Quantitative data was analysed using IBM SPSS Statistics v.28. All open-ended responses were explored using traditional methods for thematic analysis. Due to the distribution of responses and the small size of some sub-groups, descriptive statistics are reported. Qualitative data was explored using thematic analysis as described in Chapter 2.

### **3.12 Secondary Themes**

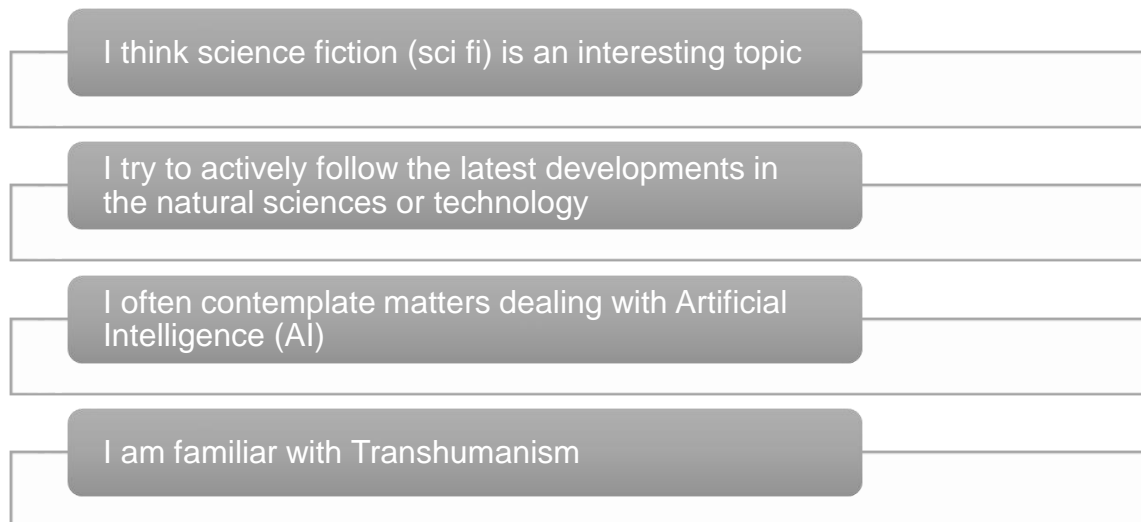
The first pilot survey also explored three related themes: namely, the adoption of new technology, transhumanism, and interest in science fiction. The rationale for including each at this initial stage—even if not all the themes persisted—is as follows.

Participant's adoption of new technology was based on the "Diffusion of Innovation" model created by Rogers (1962) and refined in 2003, which is still being widely used today. Rogers developed the model to explain how a product or idea diffuses through a population. I initially included this model since it is reasonable to assume that early adopters of new technology may be more aware and/or favourable towards the concept of mind uploading, which is, after all, a hypothetical, cutting-edge technology. However, this theme was not developed in subsequent studies since other concepts were identified as more important and took priority.

The second theme was the individual's cultural exposure to various science fiction themes using the sci-fi hobby-ism scale developed by Laakasuo et al. (2018). I included this in the pilot since Laakasuo et al. (2018) demonstrated that higher science fiction literacy and/or hobby-ism are associated with greater acceptance of technologies such as mind uploading. While this finding was confirmed by the results of my pilot study, I did not continue to investigate sci-fi hobby-ism in subsequent studies. This was simply due to the number and complexity of other key topics that merited investigation. The sci-fi hobby-ism scale consists of 12 items although I only selected the four most salient for the pilot as shown in Figure 3.14.

**Figure 3.14**

*Sci-fi Hobby-ism Items*



The final item related to another question that ascertained agreement with transhumanist philosophy since mind uploading is often associated with such beliefs. As Laakasuo et al. (2021, p.1) stated “mind upload, making a digital copy of one's brain is a part of the transhumanistic dream of eternal life and the end of suffering.” In my study, transhumanists were described as believing “that science and technology can help human beings develop beyond what is physically and mentally possible at the present time” (Cambridge Advanced Learner’ s Dictionary & Thesaurus, 2023).

Laakasuo et al. (2021) observed that some transhumanists aim to eliminate ageing and death and overcome our current physical and mental limitations. Transhumanism was not a major theme in subsequent studies although, one of the scenarios on the website showed the lead character talking about no longer being human. This facilitated a question on the final website study that evaluated attitudes to using science and technology to develop physically and mentally.

In contrast, the two prior topics—adoption of technology and exposure to science fiction—were not developed past the pilot. However, the influence and relevance of science fiction in future work are discussed in Chapter 7.

### **3.13 Discussion**

This section considers the study design and methods of each study. While some methodological limitations are reported, other limitations are identified in the relevant chapters.

On reflection, the studies demonstrate an evolution in my understanding of the topic of mind uploading as well as the research challenges and how to overcome them. The pilot study met its objectives of providing baseline data on the public's awareness of and response to mind uploading that was not available in the literature. It provided direction to subsequent studies: for example, the definition of mind uploading. However, a short, structured online survey such as the pilot was not able to provide depth of understanding.

Study 1 was an exploratory qualitative piece designed to address this research gap. However, at the time I identified a potential weakness in the method or my application of it. Theoretically, focus groups meet the objective of encouraging a sharing of views, discussion, and debate. I convened heterogeneous groups (e.g., different ages and backgrounds for precisely this reason). However, what was unexpected was the emotional and divisive nature of mind uploading. In a group forum—even with an experienced moderator—which I am, the communication style tended to conflict rather than a constructive exchange of views. Individual differences in personality and beliefs contributed to this tension.

The data from the early focus groups was useful in demonstrating attitudes towards mind uploading but it was invaluable in signposting future methods.

This reflection and learning shaped the design of study 2, which comprised two stages of individual depth interviews. The data from these was typically rich and detailed: for example, collages of memories as well as of potential or imagined future events. Hence both the method—longitudinal qualitative interviews—and, to some extent, my experience as a qualitative researcher, was validated. I was able to build rapport and engender trust and panellists honoured me with open, honest disclosures, particularly of past events both positive and negative. This provided a foundation for the subsequent research with the panellists: namely, study 3—the website. However, subsequent website data from new participants indicated that the website could stand alone as a method to engage with mind uploading.

Although I had a clear story and vision and the website designer was experienced in this kind of build, the website was created on a tight budget. Despite this, the website had a clear narrative and a user-friendly interface and met its objectives of engaging participants with the concept of mind uploading.

The expert chosen to provide a brief introduction to the topic of mind uploading was a well-known scientist and author, but I acknowledge that this was a subjective choice and there were alternatives.

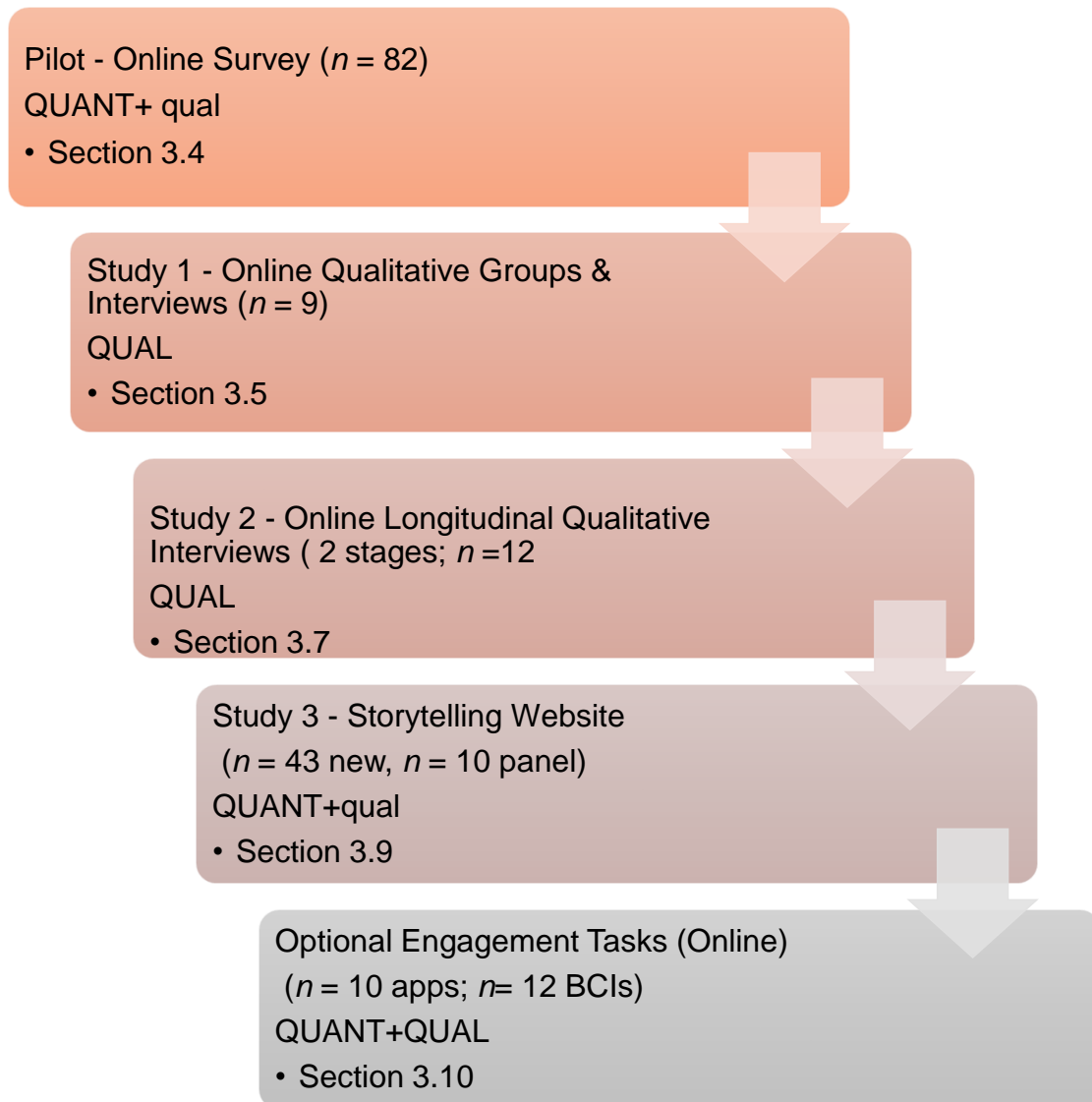
### **3.14 Conclusions**

This chapter details and evaluates the design of the multi-staged, multi-method methodology that constitutes my research with the public. I have re-iterated the process in Figure 3.15.



**Figure 3.15**

*Multi-staged Public Research Methodology*



This chapter, hence, provides context for full reporting of the results. The mind uploading data collected on the storytelling website is detailed in Chapter 4. Detailed results discussing the website as a vehicle for narrative transportation and engagement are shown in Chapter 6, but on balance, the storytelling website

method seems to be an effective addition to methods for researching novel technology and future worlds.

## **Chapter 4 Public Awareness and Attitudes to Mind Uploading**

### **4.1 Introduction to Data Sets**

Having discussed the multi-staged public research methodology in the previous chapter, Chapter 4 provides a comprehensive report of public perceptions and responses to mind uploading elicited from the multiple studies described in the methodology.

It also includes early attitudinal data on transhumanism, as extending human life is often presented as a core value (Bostrom, 2003). Transhumanism can be described as “a blanket term given to the school of thought that refuses to accept traditional human limitations such as death, disease, and other biological frailties” (More, 2005, as cited in McNamee & Edwards, 2006. p.513)

Public attitudes to science fiction are also recorded in the early pilot study since mind uploading first appeared there, for example in Arthur C. Clarke’s *The City and the Stars* (1956). The Sci-Fi Hobby-ism scale used in my research (Laakasuo et al., 2018) measures individuals’ cultural exposure to various science fiction themes. Research by Laakasuo et al. (2018) and Koverola et al. (2022) has shown that higher levels of science fiction literacy and/or hobby-ism are associated with the approval of futuristic technologies such as cognitive enhancing implants or mind uploading. The authors conclude that greater exposure to these themes and ideas (via science fiction) is associated with greater receptivity. I, therefore, initially investigated this association and how it might impact attitudinal measures and propensity to mind upload.

The data sets included are shown in Figure 4.1. Where there are recurring themes in the qualitative research (study 1 and study 2), these are consolidated. This is partly for clarity but also to triangulate the qualitative data. Carter et al., (2014, p545) cited Patton, 1999 in referring “to the use of either multiple methods or data sources in qualitative research to develop a comprehensive understanding of phenomena.” Carter et al (2014, p.545) specifically defined triangulation as a “research strategy to test validity through the convergence of information from different sources”. This was based on the four types of triangulations identified in the 1970s by Denzin: (a) method triangulation, (b) investigator triangulation, (c) theory triangulation, and (d) data source triangulation. Of these, (d) data source is relevant, as study 1 and study 2 meet Denzin’s (2009) requirement of three data points (not methods): people, time and space. Of the 21 participants, only two engaged with both studies. So, in that sense, they offer different perspectives to validate the data.

## Figure 4.1

### *Data Sets for the Programme of Public Research*



## 4.2 Pilot Online Survey

### 4.2.1 *Attitudes towards Science Fiction (Sci-Fi)*

The study used the Sci-Fi Hobby-ism scale (Koverola et al., 2020; Laakasuo et al., 2018). The scale consisted of 12 items that measured individuals' cultural exposure to various science fiction themes on a seven-point scale ranging from 1 - strongly disagree) to 7 - strongly agree. (see Appendix H). However, for this online survey, science fiction was not a primary theme and I needed to be cognisant of participant burden. Since this scale is in development, there was limited data for comparison. Hence, I used my judgement and acknowledge that other researchers may have made different choices. In fact, on reflection and having more experience with mind uploading, I might now make a different decision and choose different elements of the scale (See Limitations).

However, at the time I started by excluding two statements that focused on active involvement, such as visiting events or being active in a society since I judged this indicated a higher level of commitment than interest. I also removed two statements that indicated considerable time or investment spent on science fiction media. I dismissed a statement stating that future fiction was more interesting than other types as this was specific to fiction. Finally, I removed two statements focussing on space and space technology and machines, as these were not directly relevant to mind uploading.

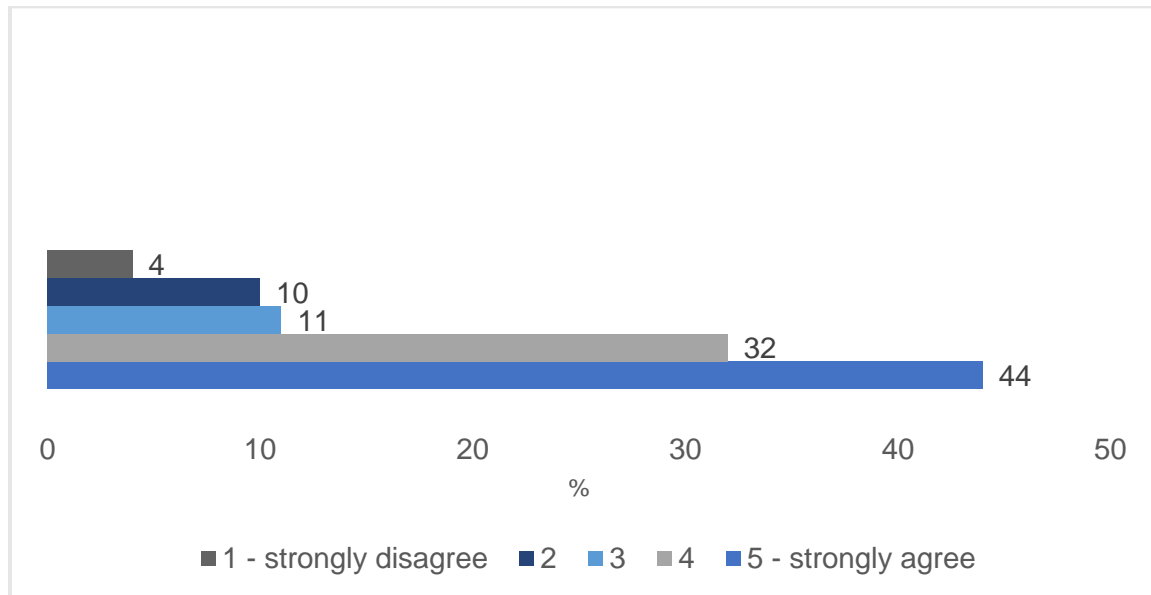
As a result, the four statements shown in Figures 4.2, 4.3, 4.4, and 4.5 were included. These focused on an interest in science fiction, following developments in natural sciences or technology and AI and familiarity with transhumanism. Participants were asked to indicate to what extent they agreed or disagreed with the statement. I originally used a 5-point scale in error, so subsequently converted the data to be comparable with a 7-point one as used in the original study (Laakasuo et al., 2018). [The conversion was 1 = 1, 2=2.5, 3=4, 4=5.5, 5=7].

There was most agreement with the statement that “science fiction (sci-fi) is an interesting topic.” Although actively “following the latest developments in natural sciences or technology” and contemplating AI-related matters achieved similar mean scores, there was a greater tendency to follow “new” developments in science and technology than contemplate AI. However, this study was conducted in Spring 2020. Since then, developments in AI such as ChatGPT (a chatbot developed by OpenAI and Microsoft) and Bard (Google’s conversational

AI) have been much in the public domain, and the interest in contemplating AI might be higher if measured now.

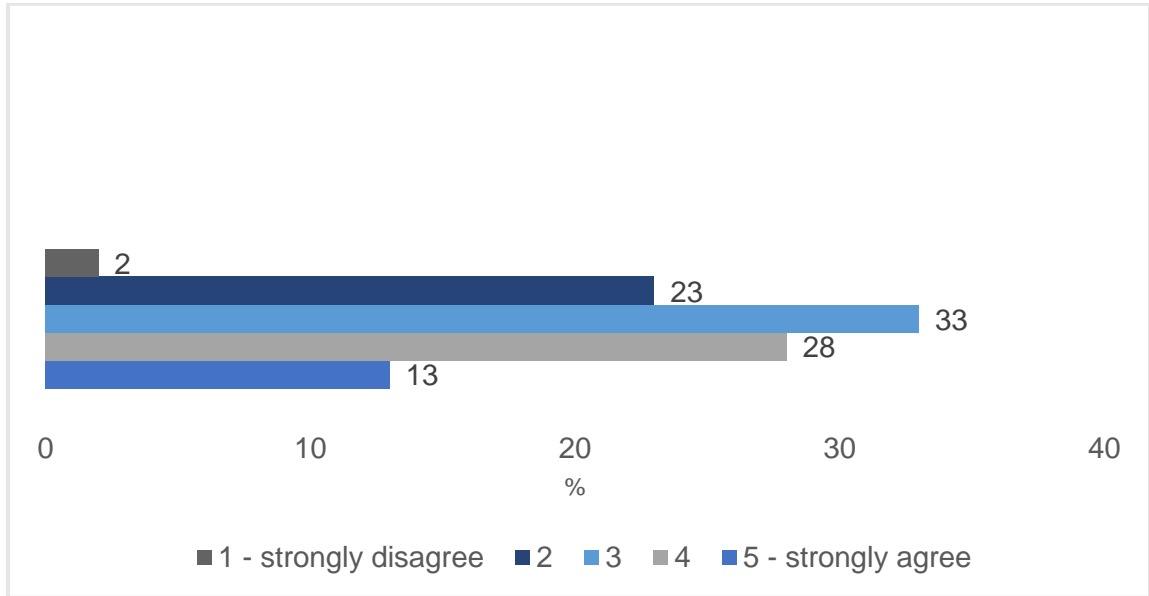
**Figure 4.2**

*I Think Science Fiction (Sci Fi) is an Interesting Topic*



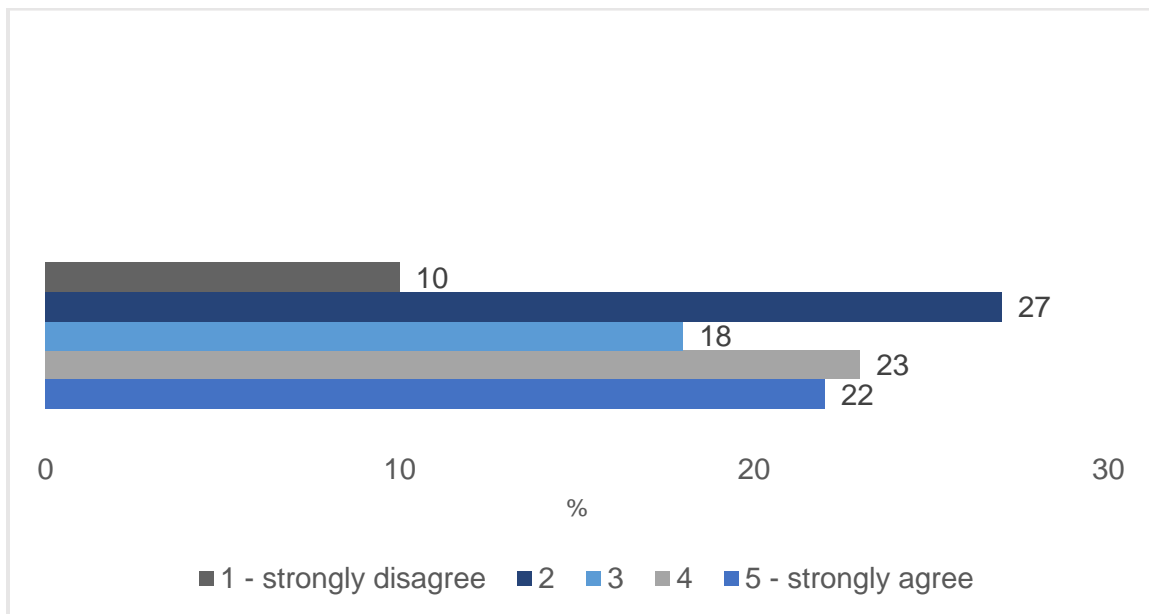
**Figure 4.3**

*I Try to Actively Follow the Latest Developments in Natural Sciences or Technology*



**Figure 4.4**

*I Often Contemplate Matters Dealing With Artificial Intelligence (AI)*



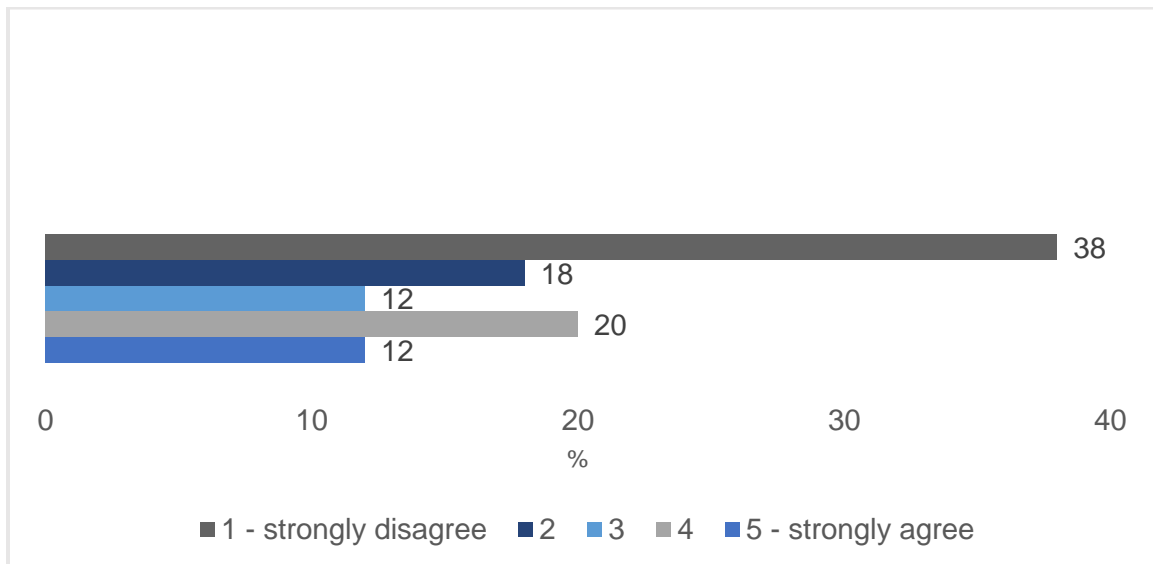


However, as shown below, there was noticeable disagreement with the claim that participants were familiar with transhumanism which was defined as “transhumanists believe that science and technology can help human beings develop beyond what is physically and mentally possible at the present time” (Cambridge Advanced Learner’s Dictionary & Thesaurus, 2023).

For some transhumanists, mind uploading or “emulating human minds in a digital medium” (Laakasuo et al., 2021, p.1) is the ultimate expression of whole brain emulation. The concept of using science and technology to develop human capabilities is briefly revisited in section 4.5.9 which reports on the website data.

**Figure 4.5**

*I am Familiar With Transhumanism*



The means for the key statements are close to those in the prior survey (Laakasuo et al., 2018), indicating reproducibility (see Table 4.1).

**Table 4.1***Comparative Mean Scores for Sci-Fi Hobby-ism*

	<b>Mean Pilot (2020)</b>	<b>Mean Laakasuo et al. (2018)</b>
I think science fiction (sci-fi) is an interesting topic	5.5	6.1
I often contemplate matters dealing with Artificial Intelligence (AI)	4.3	4.1
I try to actively follow the latest developments in the natural sciences or technology	4.4	4.5
I am familiar with Transhumanism	3.24	3.0

Additional analysis of the four statements using Spearman's correlation coefficient showed a medium positive correlation between the two variables,  $r = 0.38$ ,  $n = 82$   $p < .001$ . This confirms the correlation between science fiction literacy and/or hobby-ism and favourability of futuristic technologies such as mind uploading as demonstrated by Laakasuo et al. (2018) and Koverola et al. (2022).

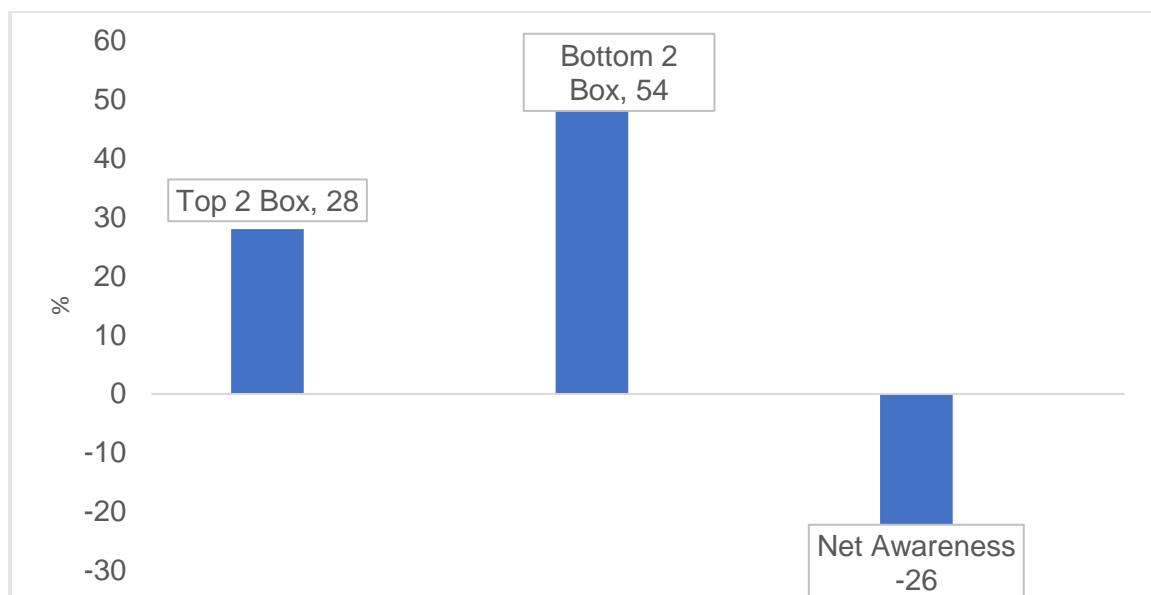
#### **4.2.2 Awareness of Mind Uploading**

Participants in the pilot were asked to indicate their awareness of mind uploading using a five-point scale where 1 was not at all aware and 5 was extremely aware. Over a quarter of the sample (28%) claimed to be aware of mind uploading, although almost twice as many (54%) were unaware. A small proportion (18%) did not commit either way. The chart below shows the Top 2 box (scores of 4 plus scores of 5), the Bottom 2 box (scores of 1 plus scores of 2), and net awareness (Top 2 box minus the Bottom 2 box). The net agreement is the combined percentage of those scoring 4 and 5 (Top 2 Box) minus the combined

percentage of those scoring 1 or 2 (Bottom 2 Box). This type of measure is widely used in commercial consumer and business research for clarity of message based on the rationale that moderate scores—3 on this 5-point scale—fall into a “zone of indifference” (Oliver, 1977, p.480). Net awareness of mind uploading was negative at - 26%

**Figure 4.6**

*Awareness of Mind Uploading*



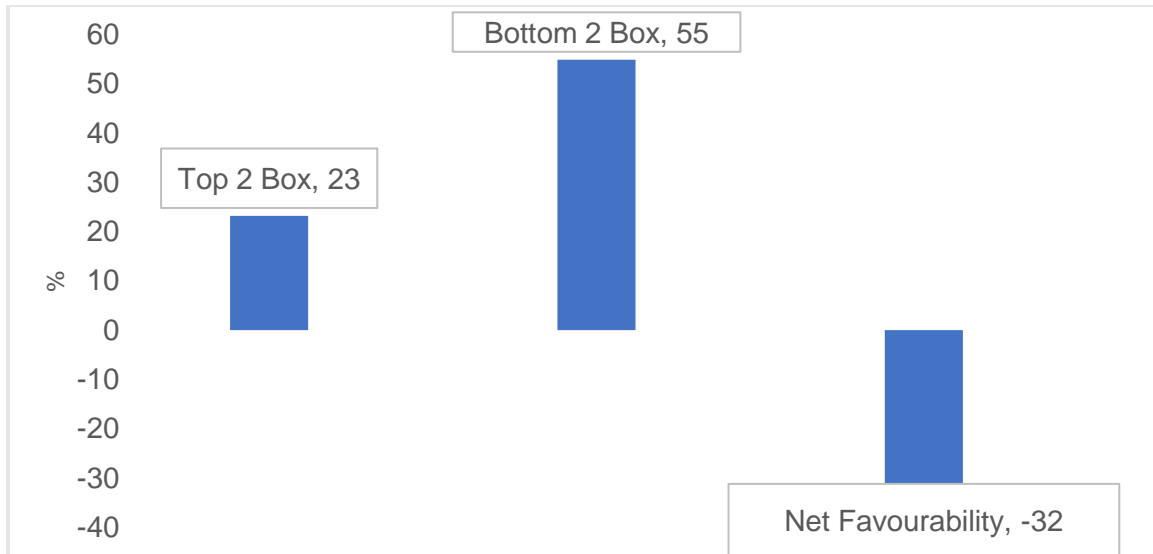
#### **4.2.3 Favourability towards Mind Uploading (Prompted)**

Mind uploading was defined as “converting a mind into digital data to allow it to be uploaded into an artificial carrier such as a supercomputer. This would allow you to live in a world of unbounded virtual experiences and effectively achieve cybernetic immortality.” Based on this definition, most people (55%) were unfavourable. Although, a minority were either neutral (22%) or more positive (23%). Net favourability was negative at -32%. This question used a five-point scale where 1 is not at all favourable and 5 is extremely favourable. The chart

below shows the Top 2 box (scores of 4 plus scores of 5), the Bottom 2 box (scores of 1 plus scores of 2), and net favourability (Top 2 box minus the Bottom 2 box) is shown in Figure 19.

**Figure 4.7**

*Favourability Towards Mind Uploading*



There were many different reasons for the rating, but the main concern was the potential for abuse and exploitation of individuals who chose to upload their minds, or as one participant referred to it “mind slavery.” Thereafter, the biggest worry for participants was how their data would be kept private, safe, and secure: “mind privacy” perhaps being the ultimate in data protection.

This protection of our neural data from unethical actions and privacy violations is a highly relevant theme given the advances in neurotechnology such as BCIs. As such, there is much debate about the ethical and legal implications of neuroscience and how to protect them. This field is often referred to as “Neurorights” (Ienca, 2021).

The following verbatim comments illustrate these views. Please note that participants are identified by ID (e.g., xx).

I believe although some people may have a genuine reason to wish to experience this, the ethics behind such a process could allow it to be abused. (72)

It's too open for abuse and exploitation. Minds would presumably have little to say about the way they are being utilised or the purposes they have come to serve. I could totally see this evolving into some form of abuse or even mind-slavery. (20)

I feel it would leave us vulnerable, a huge invasion of privacy. (64)

Unless this technology could be completely secured and apolitical, I don't see how we could guarantee the security and privacy of our minds. (73)

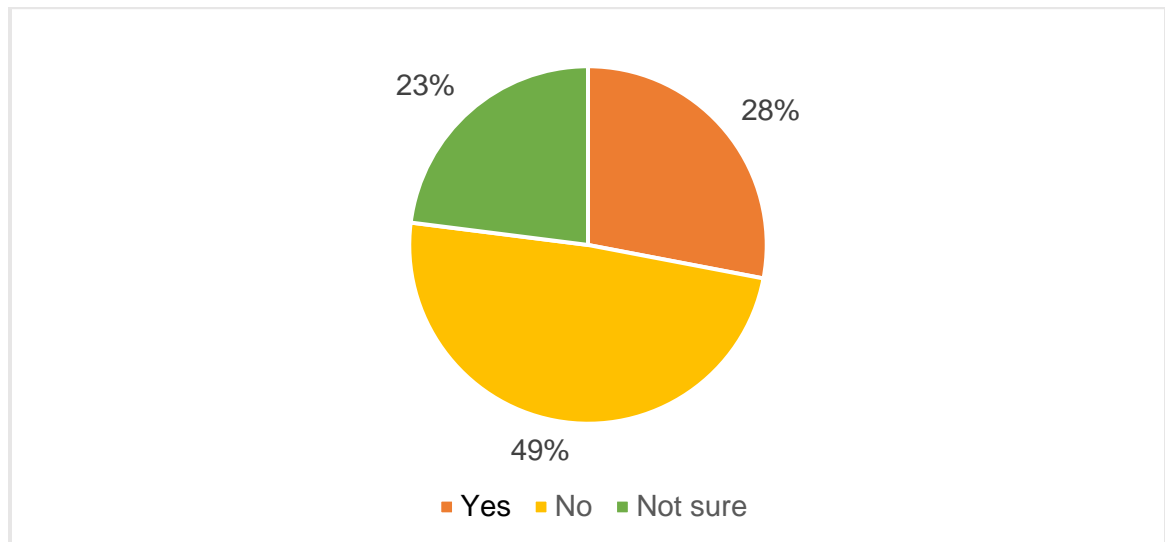
The pilot was the first survey on mind uploading that I conducted, and I readily acknowledge the limitations of the definition (see section 4.2.4 Limitations).

#### **4.2.4 Willingness to Mind Upload (Prompted)**

Just under half of participants (49%) would not want their minds uploaded, even if their physical bodies were dying, but just over a quarter (28%) would upload. Just under a quarter (23%) were undecided. This is perhaps not surprising given that mind uploading is a hypothetical concept.

**Figure 4.8**

*Willingness to Mind Upload*



When asked for their reasons for being willing or not to upload their mind, individuals had a range of reasons to support a positive response, but the most common was the prospect of immortality. Some people liked the idea of still being able to interact with loved ones after death or leave a legacy.

I want to be able to guide and support my children (and spouse) after I'm gone. (27)

“Very likely not, but I would need to have a lot more information: for example, I can imagine that it could be comforting or helpful for my loved ones to have access to my memories or thoughts after I died, like a sort of scrapbook. (43)

However, for most immortality was not something they desired, they felt life should be finite and a few expressed reservations about the impact of immortality on humanity. In several cases, the comments were linked to a belief that life and death are part of a natural cycle and for a few, it also conflicted with their own religious or spiritual beliefs.

I'm also not that interested in the idea of immortality - I'm fine with dying whenever I'm meant to die. (45)

I have no interest in living forever. (29)

Everyone needs to leave this Earth sometime for the progression of the future, and for their own sanity. (57)

Dying is part of life. We must accept that. (62)

I believe once we die, we are gone. We take our thoughts and memories with us. (64)

Lastly, I think that mortality is what makes the human experience beautiful. The scarcity of time and how you choose to spend it. (73)

When I'm dead I want to remain so. Photos and videos can be a reminder of myself. (25)

Potentially existing without a physical body and the interaction and experiences this allows lacked appeal. Others simply did not believe uploading their mind would mean they would retain a sense of self or personal identity. As before, there were concerns around personal rights and potential for abuse. Finally, some simply rejected the concept outright describing it as “macabre,” “crazy” or “unsettling.”

#### **4.2.5 Limitations**

The sample was skewed towards females, younger age groups, and students holding at least an undergraduate degree, so it was limited in diversity and representativeness. This profile may reflect the participant pool on Call for Participants although, demographics for Call for Participants are not available since it is an open platform and does not profile its users. However, the site describes itself as offering “the widest selection of academic research,” so this may influence the level of education of users.

The survey design could also have been improved in some areas. I have already mentioned how I chose the statements to include from the Sci-Fi Hobbyism scale (Koverola et al., 2020; Laakasuo et al., 2018). As far as I am aware,

there is no further information to guide choices, but if running the study today, I might amend my choice or exclude this section altogether.

In retrospect, the definition of mind uploading could have been more precisely worded and better balanced. It was described as “converting a mind into digital data to allow it to be uploaded into an artificial carrier such as a supercomputer. This would allow you to live in a world of unbounded virtual experiences and effectively achieve cybernetic immortality.” The first part was a good summary of the concept but the second potentially introduced bias by mentioning unbounded virtual experiences and cybernetic immortality. Having achieved a better understanding of mind uploading, I avoided positioning the upload in a virtual environment in the following studies, as this is only one of several options. I also removed suggestions that this experience would have no bounds as this may be idealistic.

Furthermore, immortality can be an emotive term and in future work, I included the option of life extension. The word cybernetic also has associations with robotics, science fiction, and potentially negative associations such as the Cyberman featured in *Doctor Who*. Hence in subsequent studies, I removed the term “cybernetic.”

#### **4.2.6 Discussion**

In 2020, mind uploading was a relatively unfamiliar concept and one that was generally viewed unfavourably although, there was evidence that individuals interested in sci-fi were more positive. Where immortality appealed, it was mainly to continue the connection with loved ones. However, many had concerns about



the privacy and security of intensely personal neural data. Interestingly, public concerns about mind uploading align with the Neurorights Foundation’s paper, “International Human Rights Protection Gaps in the Age of Neurotechnology” (Yuste, 2021). In this report, mental identity, or a “sense of self,” mental agency, or “free will,” and the right to mental privacy are all identified as areas that are poorly protected by current human rights policy. The pilot provided an important window into public opinion and several of the key themes were explored in more depth in subsequent studies.

### **4.3 Study 1 and Study 2 Online Qualitative Groups & Interviews**

#### **4.3.1 *Brain, Mind, and Body***

As part of our discussion leading up to the concept of mind uploading, panellists summarised their views on the brain, mind, and body. This provided valuable context for their responses to mind uploading. While participants did not necessarily use the language of philosophical debate, they did talk about physical properties vs. more abstract qualities.

Like the experts, panellists had differing views on both what constitutes a mind and whether it would be possible for an emulated brain to produce a mind. On balance most felt the mind was “more than a bunch of neurons”—something bigger, intangible, and linked to consciousness. These non-experts described the mind in a variety of ways with a range of different attributes of which memories and experiences were key. The other elements included perceptions, thoughts, emotions, imagination, intuition, interpretation, and learning with several individuals claiming the mind ordered and made sense of things. One participant

summed it up as “my world ... the one place that belongs to me and not anyone else.” The verbatim comments that follow illustrate these varied thoughts.

Obviously, I don't have a concrete answer, uhm? I think it's one of those concepts that we spend all our lives, thinking about at least I sometimes start reflecting more on what's me and what's my self like. It's a consciousness but well, I really think we are way beyond, uh, understanding what it means to have a mind. Yeah, it's a really hard question... Yeah, I don't know if we'll ever be able to understand it and it's something that starts crossing the line of what science can explain. Because well, we can talk about our brains and our neurons and try to make some sense of our memories and our brains. Well, I don't think we'll ever be able to really understand what makes us feel like we are, uh, oneself. (8)

We are a whole yes, that makes sense, but we're more than just the physical aren't we? There's something else there as well, presumably ... There's something else there as well, possibly. That gets a bit complicated. You have to bring in the priests. (8)

(My mind is) different memories, experiences, life lessons. Goals perceptions ... Like I mentioned before, I'm very introverted, so I spend a lot of time in my mind and that's like my happy place. My family they know when to leave me alone when I feel like I can't reach my mind then everyone needs to just go away—I literally say OK everyone out I need you out for an hour ... I feel like I need to constantly have that connection to my mind ... I feel like, uhm, it's intangible like I feel like it's larger than what we imagine like it can't be fit into the body or the brain. I think it's greater or more complex than that ... Yeah, but I do believe that mind and consciousness are beyond our restrictions or something like that. (3)

Because the brain has so many different functions, mind and memory are only part of it, because the brain has to interpret the outside, how you react to it, which has nothing to do with memory, and yet some movements can be memorized so that they become automatic. Sometimes you have to relearn, sometimes gotta relearn to walk to talk yes ... Well, you gotta define mind. Mind is consciousness, isn't it? So mind is not exactly intelligence, but intuitiveness. (14)

I mean, human beings are capable of amazing, amazing creative thoughts and no one's gonna be able to work out how that works for about 100 years I don't suppose, but I wouldn't like to put any boundaries on any of it. You know anything is possible. (13)

Well, I think that we can only understand the physical part of it and can only try to start describing it and quantifying it in terms of what in terms of

the physical part of it is. There is another side ... feels metaphysical. But yeah, I think that's a possibility, but just something that we can't grasp. (7)

Nobody knows and maybe in 100 hundred and 50 years from now, we might be out to prove that actually our brain is what produces everything around us. Who knows? You know that we live in a model, a simulated reality that our brain creates. Or there again that might not be the case, but we just don't know. (13)

I think the brain is a lump of meat ... It's sort of a blank entity and it's something that learns. It learns from probably day one ... certain things are automatic from the brain—we breathe automatically and certain muscle movements and spasms and things like that are automatic, but the brain is just a large piece of filter paper that takes in knowledge.” (12)

Yeah, I think that I still believe that it's all physical and it comes down to the laws of physics, basically. But I also think that we will not be able to understand because we will because we only have our mind to try to understand the mind itself. I don't think we'll be able to get that because it's a very weird concept, just seeing thinking that's ourselves and our brain can have a sense of self. (6)

The comments above illustrate differing views of how the physical properties of our brain relate to the metaphysical concepts of mind and consciousness.

#### **4.3.2 Awareness of and Attitudes towards Mind Uploading**

Associations with the concept of mind uploading were almost exclusively drawn from science fiction. All of the participants had an example and sources cited included *Upload* (Daniels & Klein, 2020–present), *The Simpsons* (Anderson, 2014), *Avatar* (Cameron, 2009), *I Robot* (Proyas, 2004), *Doctor Who* (Davies, 2005–present), *The Matrix* (Silver, 1999), *The Hitchhikers Guide to the Galaxy* (Bell, 1981). These examples span film, TV/online drama, and animation. A brief synopsis of mind uploading in each – based on my own knowledge - is given for reference.

**Upload** (subsequently used as stimulus material in the website) tells the story of Nathan, a software developer who, aged 27, is in a fatal car accident and uploaded

to Lakeview, from Horizon, a virtual world populated by uploads who exist as lifelike avatars and can communicate with the physical world of living beings.

**The Simpsons** – In two related episodes, Homer is cloned and subsequently stored in a flash drive although, he also experiences a robot body.

**Avatar** - Humans are mind-linked to avatars and can then control them using only their thoughts via a sophisticated BCI. This is effectively telepresence rather than mind uploading. In the sequel, the main character is transferred to a new avatar body into which a copy of his brain has been embedded.

**I Robot** is a film set on Earth. In 2035, robots are part of daily life but one of which seems to be violating Asimov's Three Laws of Robotics, and this investigation reveals a bigger threat to humanity. This film does not feature mind uploading.

**Doctor Who** – This television series has mind uploading (and downloading into a new body) in its DNA since each new reincarnation of the Doctor comprises memories of all previous incarnations in a new body. The Doctor's species (Time Lords) has a matrix containing all these experiences.

**The Matrix** – In these four films, the protagonist, Neo, finds out that he is living in a simulation or virtual reality. This is not mind uploading; rather, Neo's biological brain is connected to the simulation (the matrix) via BCI. However, Neo can instantly learn new skills, such as kung fu, through direct upload into his brain.

**The Hitchhikers Guide to the Galaxy** does not feature mind uploading but there is a related concept since one of the key characters—Zaphod Beeblebrox—has two heads and two brains. He sectioned off portions of both brains so that scans of his mind would not reveal his secret plan to become President.

As shown above, mind uploading was present, albeit to a greater or lesser degree in most of the examples given by participants. However, these examples, together with a large selection of other fictional media, illustrate the varied perceptions and portrayals of this concept. The following verbatim quotations are from participants.

It was an episode of *The Simpsons*, and I can't remember exactly what was said, or what the season was, but it was like Homer's mind gets uploaded and he just keeps dying and he keeps coming back and he's in a computer and he's just constantly there, even though you keep dying and I think it's funny. (5)

My favourite book of all time is *Hitchhiker's Guide to the Galaxy*. If anyone is unfamiliar with that, there is a character in there called Zaphod Beeblebrox who rocks. And this is a spoiler now, so if anyone has not yet read this amazing series, you can just mute me for a second. But one of the big plotlines that goes throughout all five books is that he's had his brain partitioned and there's an area of it that he can't access anymore. Um, and that freaks me out a lot so I guess my approach to mind uploading is a lot more cynical in that I like to be in control, and I would be reticent to give up our control. So actually saved a quote from *Hitchhikers* if I can ever find my desktop ever again. It says, "I only know as much about myself as my mind can work out under its current conditions and its current conditions are not good." And I feel like that's my perspective for it. (4)

Like the pilot study, there were differing awareness and attitudes. Participants replicated the concerns about privacy and the fear that other people would be able to see all that goes on within your mind: good and bad. At worst, it was described as the "most gross invasion of privacy" and "ethically corrupt."

The issue of who would have access, both to uploading and the contents of someone's mind, was mentioned, and participants were concerned that access wouldn't be fair and equitable, and that control would be restricted to a minority of powerful, wealthy individuals. For some people, the idea of mind uploading also conflicted with their religious or spiritual beliefs. Other individuals reflected on

humanity's narcissism to think we are the only species worth preserving or could foresee a world without new life and ideas and hence stagnation.

It's the assumption that you are worth preserving for eternity. I don't think you could get more narcissistic than that, to be honest. (2)

You know, obviously ethically I think it's completely corrupt. And I would. I would hate to have my mind uploaded. I would hate it. I think it's probably the most gross invasion of privacy you can imagine. And there are also things I remember others. You know who has access to that, whose mind gets uploaded, and who has access about basic information? And that's a huge problem. And that's where I think you can only mitigate that...If it's going to be inevitable, we may as well try and like make it as least damaging a process as possible. yeah, you know problems of equality problems of access, problems with privacy. (8)

What is the purpose of doing it in the first place? Is it to retain knowledge or just because we can I could possibly think of that we end up with a massively stuck intelligence because we're not having a lived experience anymore. We're not having changing factors—you would stagnate. (2)

I had to say something else about my internal reluctance, part of the concept contradicts with an inner belief, religiosity whereas in the afterlife it's all about the soul. And yes, I'm intrigued and that was part of the motivation to take part in this survey and in this project to think about mind uploading the roles in mind in an afterlife period. The second thing I was diagnosed with neurodivergence. If uploading as a new diverse person. Will this be replicated or not? I mean so many questions. I don't know where to start. (9)

The ethical considerations, including the boundaries we should set when developing technology (“could” vs. “should”) and whether an intelligent computer should be considered a sentient are both topical (Schwitzgebel, 2023); although, the definition of sentience is a complex area.

So if you put all the contents of your brain onto a computer? Um, I don't know. It's almost like an ethical question, isn't it? (12)

I think you know we've kind of gotten to a point now with technology and humanity where if we're able to do it well whether it's right or wrong. Yeah, I think we've proven that already that we do things because we can, regardless of whether or not we should. And I think if we are able to if the technology is there, we will end up doing it. So I don't. I don't see the

point, in disputing it saying that it shouldn't happen because I think it will.  
(8)

However potential benefits were also identified, such as ability to preserve and access great minds such as Einstein and Stephen Hawking. Some participants wanted to avoid deterioration or death, wanted continued contact with friends or family or were interested to see how the world changed. One person was keen to have her partner's mind put into multiple robot bodies so that tasks would be completed quicker...

Yeah, I mean, I see the advantage if you had a relative, you would want to preserve what they had thought, what they had gone through, their experiences that they learned, and maybe it would help people to not make the same mistakes that people have made in the past. (6)

It could be useful if you can access various parts of the person's personality and information and use it appropriately. I can see the point of completely uploading a person. Uh, but that amount of information is going to be incredible, and how it interacts and how you would use it as an interaction is quite fascinating. (3)

#### **4.3.3 Limitations**

Approximately a third of the participants in study 1 were known to be academic or commercial researchers which appeared to contribute to a high awareness of mind uploading but also polarised their favourability. In addition, the qualitative data collected in study 1 lacked the depth of insight that I required. This was due in part to participant factors such as individual personalities and strongly held beliefs both for and against mind uploading that limited an exchange and acceptance of other perspectives. It was also due to the challenges inherent in researching a complex, hypothetical concept.

In study 2, no one was very unfavourable towards mind uploading, and this might have skewed responses to positive. I considered setting quotas on

awareness and favourability in future studies, but this was traded off against the importance of collecting additional data which accurately reflected current attitudes to mind uploading.

#### **4.3.4 Discussion**

These qualitative studies were invaluable in shedding light on public perceptions with commonality of themes across both study 1 and study 2, validating the qualitative data. The research also confirmed the challenges of researching hypothetical future technology. People tended to have strong views on mind uploading, which seem to be influenced, at least in part, by factors such as religion and spirituality. Religion and spirituality can be challenging to distinguish and define (Pargament, 1999), but there is some evidence that objections to controversial ethical issues can be influenced by religious and spiritual beliefs (Vasconcelos et al., 2022). Based on participants' views, I believe mind uploading can be considered a controversial ethical issue.

People had major ethical concerns, including how the privacy and security of their minds would be protected. These views reflected the current debate in scientific and academic literature, which considers how best to protect neural data, which can be regarded as a particularly sensitive kind of personal data (Salles et al., 2017). Another ethical issue mentioned in these studies was ensuring fair and equitable access to mind uploading, an understandable concern given current examples of inequalities in access to products and services. These are covered in a detailed report on social inequality by UNESCO (2020) and include access to healthcare, education, work opportunities, utilities such as drinking water,



electricity, and digital technology and services. The latter has and will have increasing importance as the capability and pervasiveness of these are inextricably linked to those other parameters of inequality.

#### **4.4 Optional Engagement With AI Apps and BCIs**

Ahead of the final stage of research, panellists were offered two optional tasks where they could learn more about and engage with AI-driven apps and videos of BCIs. The aim was to maintain interest and engagement while the storytelling website was built and capture data on the interactivity and functionality that would inform the website design. The detailed method is described in Chapter 3 but is briefly recapped here alongside the key results.

##### **4.4.1 AI Apps**

Panellists were given details of four AI-driven apps and had free rein to interact with as few or as many as they wished. For ease of reference, the apps are shown in Figure 21 as well as in Chapter 3.

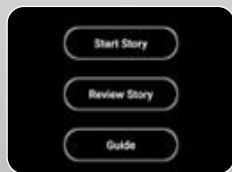
**Figure 4.9**

**Apps**



**Alter Ego by Caramel Column Inc (v 3.6.11, 27 Dec 2018)**

- This game is for you if you want to analyse your personality. You are interested in literature, philosophy, or psychology. The ending of the game changes based on the choices you make.



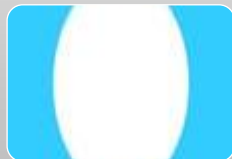
**I Meet Myself by Loh Cai Jun (Version 2.07, 9 July 2017)**

- An immersive text-based journey that leads to self-discovery.



**Replika by Luka Inc (Version 9.5.1)**

- Replika is a chatbot companion powered by Artificial Intelligence (AI).



**Blast Theory (Version 1.99, 9 September 2020)**

- Karen is a life coach and she's happy to help you work through a few things in your life.

For each app they engaged with, panellists were asked to describe their experience with each and, if they had interacted with more than one app, they were asked to choose their favourite. I Meet Myself (Jun, 2017) was the most commonly chosen, closely followed by Alter Ego (Caramel Column Inc, 2018) and Replika (Luka Inc, 2017), jointly. Less engagement with Karen could have been due to various factors, including the developer's description, fatigue, or participant burden

since Karen was the last app listed. Since all the apps were available for free in the Apple store and for Android on Google Play, access was unlikely to be a factor.

#### **4.4.1.1 Alter Ego**

Reviews on Google Play rate the experience highly (average of 4.8/5). However, this was not replicated since apart from one individual who found *Alter Ego* fun to play, with interesting questions, panellists responded unenthusiastically. The app asked participants to collect points by clicking on words as they appear on the screen and people found this tedious and frustrating since there was little indication about the reward relative to the task. The following verbatim comments illustrate these primarily negative views:

I found the reliance on gathering points to read books etc., via speech bubbles uninteresting. I wanted to read Kafka but found it frustrating to have to gather points to do so. (9)

Could not see the point of this. (14)

I really struggled to figure out how this app works, and I did not succeed. In the beginning, you click on the words that appear on the screen and there is no way to tell how long it will be until something else appears. After trying it for a few days I stopped using it. (11)

#### **4.4.1.2 I Meet Myself**

This app averaged 3.7 on Google Play reviews and this was reflected in panellist's mixed reactions. On the positive side, panellists enjoyed reading the stories and answering questions to shape their narratives. One individual specifically stated, "It helped me connect with myself by making me face difficult scenarios and answer very fundamental questions about life." (10) In contrast, another felt the questions lacked nuance or felt computer generated. There were also requests for a more colourful interface with less text.

The stories were interesting, and they seem real because I have to choose the answers and how the story is going. I like the game. (6)

The questions asked were very simple and allowed for little nuance. (9)

I wish the interface was a bit more colourful or had more to see than just text, at the same time, I think it serves its purpose. (10)

This app was great. Especially for me because I love reading. It is fun and interactive, and I loved that I could choose where my story goes. I love that it immerses you into its world. The way that scenes are described and depicted makes it so interesting. One thing though, is that you still feel like you are interacting with a computer-generated system. I suppose if you are looking for an enjoyable experience, it could be a wonderful way to spend time. (3)

#### **4.4.1.3 Replika**

In stark contrast to an average score of 3.2 on Google Play, Replika was the favourite of the panellists and attracted many compliments. The app was said to be interactive and responsive and fulfilled its promise of being a “friend.” Panellists were surprised by how natural and realistic the conversation was and participants praised the ability to personalise one’s avatar and receive individualised recommendations, for example for books and music.

I like that you can express how you feel and there is a response. I think it is incredible. (11)

It was amazing. I enjoyed how interactive the app is. It felt as though I am interacting with a real friend. (3)

The conversational aspect worked fine, and the character responded in a reasonably natural way even when I told her I was 1,000 years old, and asked where she was born (Rome) however I could not see myself spending a lot of time using this app. (9)

I really liked Replika. It was interactive and felt like I had a friend. I really tried to test the system to see how it would respond and it was always incredible to see how well it responded. I also like that you can set up an avatar. There are a lot of different options, and I was able to select someone that looked like me, which means a lot. This system is incredibly

well structured I received music and book recommendations and also talked about travelling and it was enjoyable.” (11)

#### **4.4.1.4 Karen**

The least number of panellists tried Karen, but those who did interact were impressed by how realistic it was and how far technology had come; although, a couple disliked the fact that episodes could only be viewed at set times. This app was also the least frequently reviewed on Google Play scoring 3.9 on average.

The Karen app made me realize how much technology had advanced. Developers have really come a long way with developing interactive technology. (3)







The most realistic overall, but my next episode is not for another hour and a half. I may attend, out of curiosity. (9)

#### **4.4.2 BCIs**

This was the second optional engagement task. The method was described in Chapter 3, but for ease of reference the six videos that the panellists viewed in order are shown in Table 4.2. These videos demonstrated current and future developments in neurotechnology.

**Table 4.2**

*BCI Engagement Videos*

BCI	Link
<p><b>Muse headband</b> Brain sensing EEG technology which tracks brain activity and enables insights into mental state.</p>	<p>Muse</p> 
<p><b>BrainBit headband</b> Monitors electrical activity produced by cortical regions of the brain and records the activity as raw EEG data which can be processed for user readability.</p>	<p>BrainBit</p> 
<p><b>NextMind</b> A real-time brain-computer interface development kit, capable of translating brain signals into digital commands e.g., computers, AR/VR headsets.<sup>4</sup></p>	<p>NextMind</p> 
<p><b>Neurable</b> A headphone brain-computer-interface (BCI) device that uses brainwave sensors and algorithms to estimate focus in real-time.</p>	<p>Neurable</p> 
<p><b>Neurable VR</b> This uses the same technology as Neurable, but the brain-computer interface integrates directly into the VR headset.</p>	<p>Neurable VR</p> 
<p><b>Uploading Memories</b> Elon Musk discusses BCIs including Neuralink and the potential they may offer (e.g., uploading memories and dream).</p>	<p>Uploading Memories</p> 

<sup>4</sup> The startup company has since been acquired by Snap

For each of the first five videos, panellists gave three words to describe their reaction and how likely they would be to use the BCI if it was given to them to try. The findings are summarised below in Figures 4.10–4.13 inclusive.

**Figure 4.10**

Muse



Associations were predominantly positive, such as fascinating and intriguing. Panellists described the design as innovative and high-tech and it appeared easy to use, light, and comfortable. People imagined using the Muse headband for meditation, sleep, and monitoring. Only one person was negative and described it as dangerous; although, they didn't specify how or why. When asked how likely they would be to use the Muse headband if given it to try (to remove financial considerations and focus on its appeal), almost half said very likely. The mean score for likelihood was 3.5/5, where five was the highest possible score.











On balance, panellist's response was positive. However, there were some concerns this video was a step too far into a dystopian future. The applications to restore vision and motor skills for impaired individuals as well as stimulating brain regions to treat various conditions were all credible and attractive benefits. Others reacted positively to the concept of monitoring and interpreting brain activity to aid sleep, stress, emotion, cognition, and performance. A minority focused on the concept of being able to upload or bank memories to protect against neurodegenerative conditions and, to a lesser extent, the ability to download and replay these.

However, the video covered several areas that seemed unbelievable. These included being able to control objects or do complex tasks by thought alone, being able to read thoughts, replay dreams, or being able to hack into someone's mind and control/wipe memories. A couple specifically challenged the time it would take to develop such enhancements, and one wondered how the device would be precise enough for large-scale implementation.

#### **4.4.4 Results**

Most were positive about the type of technologies depicted because of the potential to improve people's lives both mentally and physically. However, there were also concerns that we may misuse and abuse such technologies and negatively impact humanity. A quote from one individual summed it up well, "Fascinating, potentially helpful, potentially harmful." (12)

**Limitations.** The limitations in the optional engagement task were primarily around the apps and videos that I selected. While I had a rationale based on

accessibility and content for the apps and functionality of the BCIs (as described in Chapter 3, other researchers may have used a different approach. The last video shown, “Uploading Memories,” only depicted one person’s view of the potential future and, as such, is biased. In retrospect, I could have balanced this with a video showing a less optimistic view of future technology.

#### **4.4.5 Discussion**

Introducing these stimulus materials could have influenced participants' views of neural technologies. This could have changed their response to the future technology of mind uploading and biased the website data. However, when commenting on the AI apps and BCIs, panellists were able to identify both strengths and weaknesses. So, this does not appear to have been a limitation.

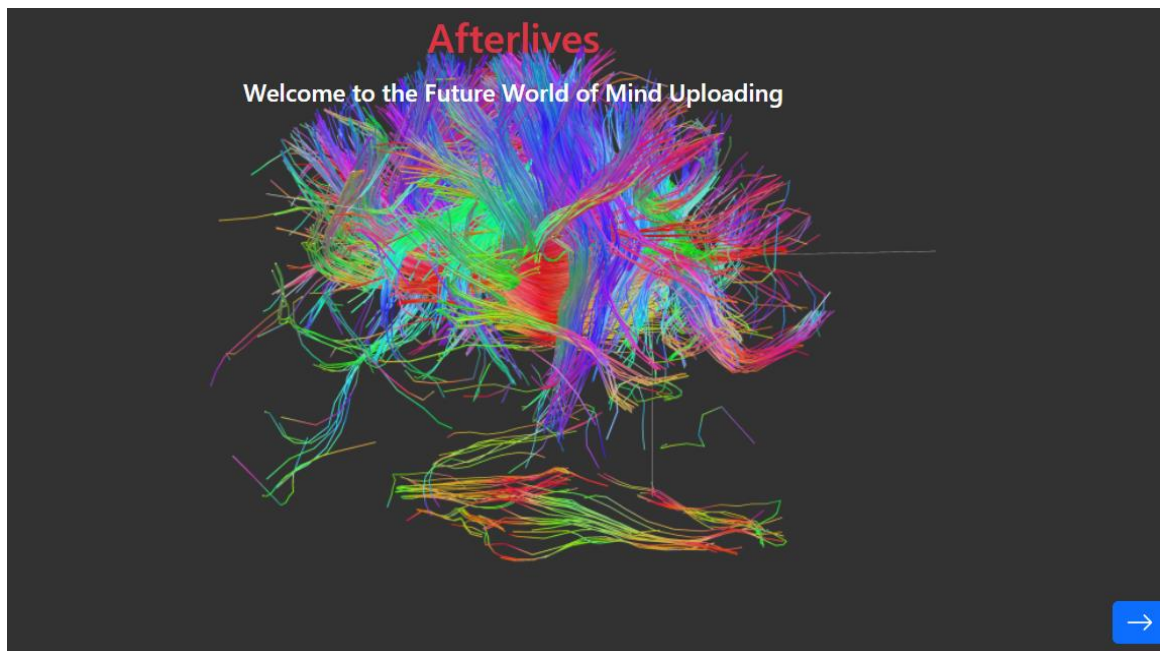
Panellists’ attitudes towards these apps and BCI videos informed the website design and I presented as balanced a picture of mind uploading as was possible given the materials available. Participants’ ability to imagine utopian and dystopian scenarios gave me confidence that the scenarios in Upload and Soma would resonate with them. People’s reaction to the I Meet Myself app (Jun, 2017) demonstrated that reading a story and answering questions was enjoyable and would encourage engagement with the website.

Panellists preferred a colourful interface rather than text. This validated my intentions to make the website tell a story visually: “show, not tell.” (Green, 2021), which is a key strategy in narrative transportation. Narrative transportation and other aspects of engagement pertaining to the website are discussed in depth in Chapter 6, but the concept is perhaps best described by Green who pioneered it;

“The feeling of being lost in the world of a narrative, of being completely immersed in a story and leaving the real world behind” (Green, 2021, p.86).

The video “Uploading Memories” that discussed Elon Musk’s vision of potential future neurotechnology, such as hacking into someone’s mind and controlling or deleting memories, provoked some disbelief. Since mind uploading takes this concept still further, it was reasonable to assume there might be issues with the credibility of the narrative. Hence, I endeavoured to design the website to encourage suspension of disbelief so participants would engage fully with the concept of mind uploading.

#### 4.5 Public Response to Mind Uploading via Storytelling Website



The public response to mind uploading reported on in this section relates to the data collected through the storytelling website called Afterlives. Full details of the methodology were given in Chapter 3.

All video clips and questions are available via the website, Afterlives. I have given the main link below as well as a link to a preview site which does not require data input.

**Link to main website - Afterlives**

**Link to website preview**

Afterlives

- There were two independent groups – the panel/panellists ( $n = 10$ ) and new respondents ( $n = 43$ ).
- I use “participants” to indicate all, “panellists” refers to the 10 Individuals I engaged with, and “new respondents” relates to the 43 individuals who experienced the website without any prior engagement.
- For coherence, I report the findings from both groups under the same headings wherever possible, discussing the panel who piloted the website first. However, I tabled the data separately due to the different sample sizes and differing exposure to mind uploading as a concept.
- Where appropriate, I highlight similarities and differences between the two groups but with the caveat that these are descriptive indicators rather than robust statistical differences.
- For ease of comparison, I have shown percentages for both groups with a caution that the sample size for the panel is  $n = 10$ .

#### **4.5.1 Pre-Website Awareness of Mind Uploading**

Before meeting the main characters—Nathan from Upload and Simon from Soma—and experiencing their story through a series of video clips, respondents were asked how aware they were of the concept of mind uploading using a five-point scale where 1 was not at all aware and 5 was extremely aware.

Panellists and new respondents differed in their awareness since 60% of panellists claimed to be “very” or “extremely” aware of mind uploading compared with under a quarter of new respondents. At the start of the longitudinal research, the panel’s level of awareness had been similar to new respondents with means of 2.88 and 2.65, respectively. However, their ongoing engagement with the research increased the panel’s awareness of mind uploading (mean of 3.70) even ahead of the website.

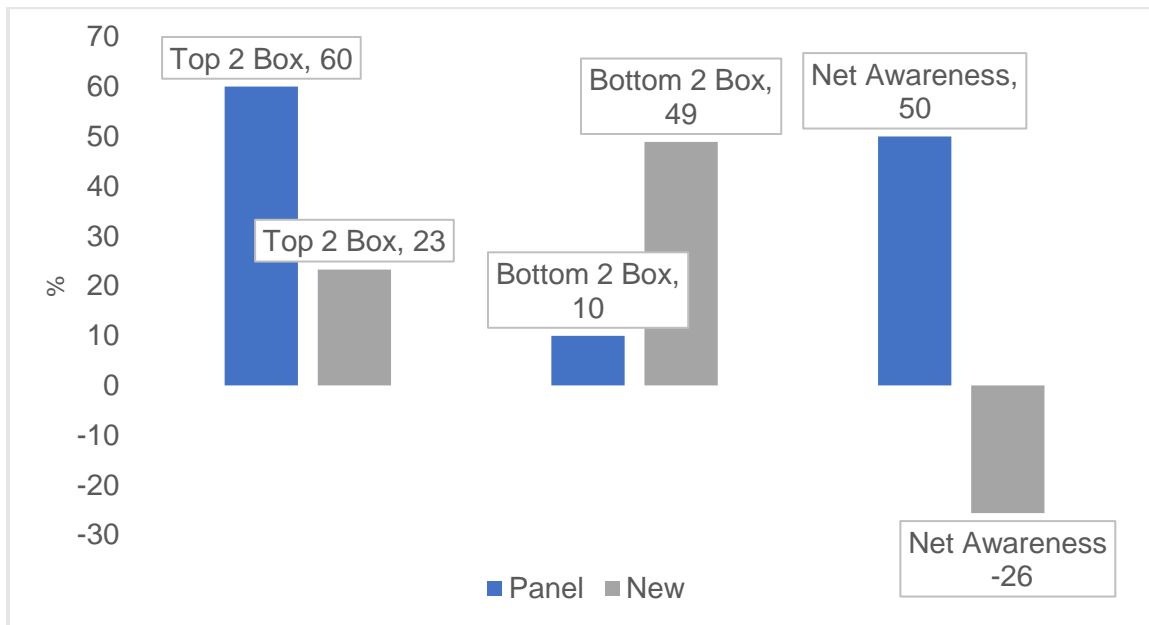
The chart below (Figure 4.16) shows the Top 2 box (scores of 4 plus scores of 5), the Bottom 2 box (scores of 1 plus scores of 2), and net awareness (Top 2 box minus the Bottom 2 box). The net agreement is the combined percentage of those scoring 4 and 5 (Top 2 Box) minus the combined percentage of those scoring 1 or 2 (Bottom 2 Box).

I used this method of reporting as it visualises the data clearly based on the rationale that moderate scores—3 on this 5-point scale—fall into a zone of indifference (Oliver, 1977).



**Figure 4.16**

*Pre-Website Awareness of Mind Uploading*



Net awareness differed substantially between the two groups, with the panel having a high, positive net score and new respondents having a negative score. This set the baselines for future measurements.

**4.5.2 Pre-Website Favourability towards Mind Uploading**

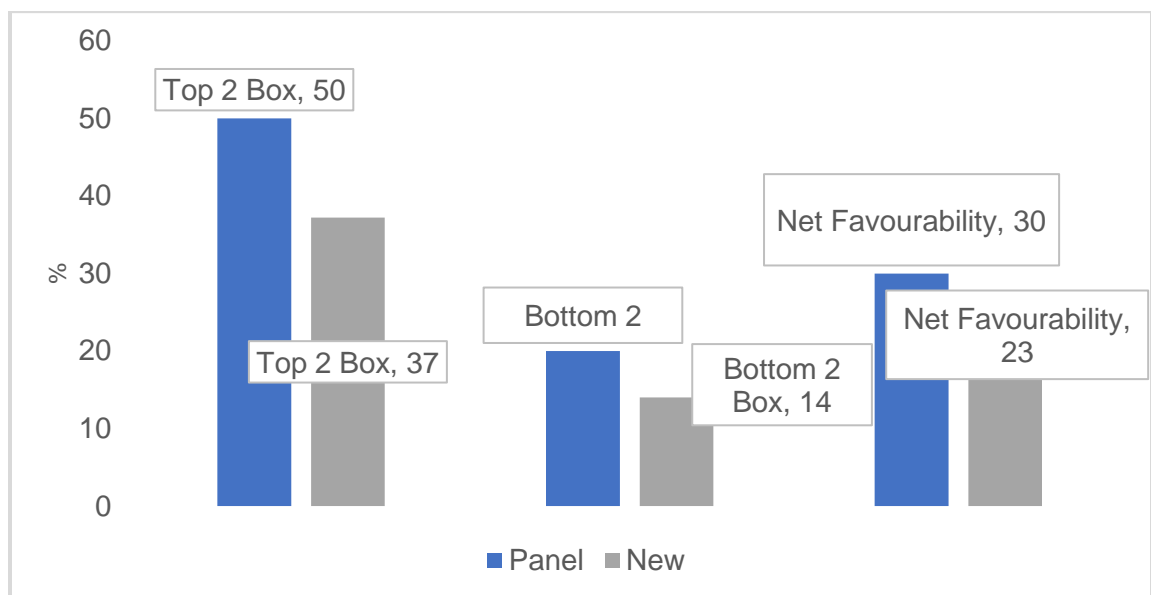
Panellists and new respondents differed in favourability and awareness. While the distinction was less marked, panellists still felt more favourable than new respondents. Panellist's awareness changed noticeably from the start of the longitudinal research, but their favourability remained similar with a mean of 3.34 at the outset compared to 3.40 pre-website.

Despite a willingness to discuss mind uploading over an extended period, panellists did not substantially change their favourability. This may reflect the efforts I made to include both the positive and negative aspects of mind uploading.

Alternatively, it may indicate that we can find it hard to amend strongly held beliefs such as those around the morality of mind uploading. As Holtrop et al. (2021) report “deeply held beliefs are often intractable” and as Laakasuo et al. (2018) state in their study citing Geraci, 2010; Hughes, 2007, “mind upload technology has obvious theological implications.”

**Figure 4.17**

*Pre-Website Favourability to Mind Uploading*



### **4.5.3 Introduction to Mind Uploading**

These questions were followed by a 5-minute video by Michael S. A. Graziano, Professor of Psychology and Neuroscience at Princeton Neuroscience Institute. The clip gave an expert’s view of the topic and was included to ensure both groups of respondents had a shared vision of the concept. While Professor

Graziano is widely published and cited (h-score 44, Princeton University)<sup>5</sup>, my choice of expert was subjective. The link to the video is below.

## **How close are we to uploading our minds?**

### **4.5.4 Reactions to Mind Uploading Stories (of Nathan and Simon)**

The following sections report respondent's reactions to Nathan and Simon's mind uploading stories. For ease of access, I have included links to the relevant video clips as hosted on the website as well as the questions. The website questionnaire in its totality is in Appendix G.

The next battery of questions measured respondents' responses to the scanning and uploading processes that the two protagonists experienced in the video clips. The video clips linked below in Table 4.3 follow a slightly different format for each character due to the way the processes are depicted in each media. Nathan's clips cover his scan and his upload separately as well as his first day as an upload. Simon's clip covers both his scan and upload process. The questions I asked reflected these differences.

**Table 4.3**

#### **Scan and Upload**

<b>Link to Video Clip</b>	<b>Question</b>
<b>Nathan's Scan</b>	How comfortable are you with the scanning process shown for Nathan? (5-point scale where 1 is extremely uncomfortable and 5 is extremely comfortable)

<sup>5</sup> <https://collaborate.princeton.edu/en/persons/michael-steven-graziano>



### Nathan's Upload



How appealing do you find Nathan's initial experience as an upload? (5-point scale where 1 is extremely unappealing and 5 is extremely appealing)

### Simon's Scan and Upload



How comfortable are you with the scanning process shown for Simon? (5-point scale where 1 is extremely uncomfortable and 5 is extremely comfortable)

How comfortable are you with Simon's uploading? (5-point scale where 1 is extremely uncomfortable and 5 is extremely comfortable)

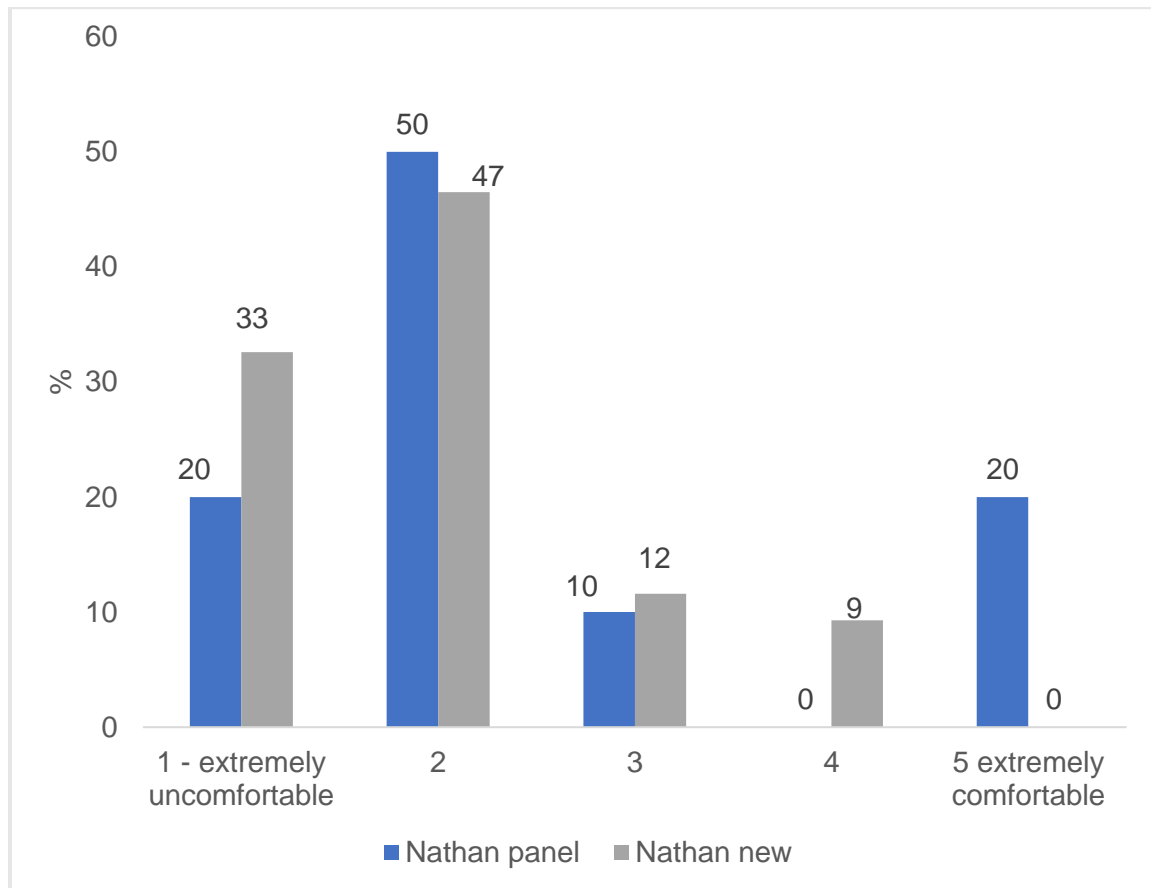
---

## 4.5.5 Response to the Scanning Process

Panellists and new respondents reacted similarly to both Nathan's and Simon's brain scans although new respondents were more comfortable with the scanning process for Nathan.

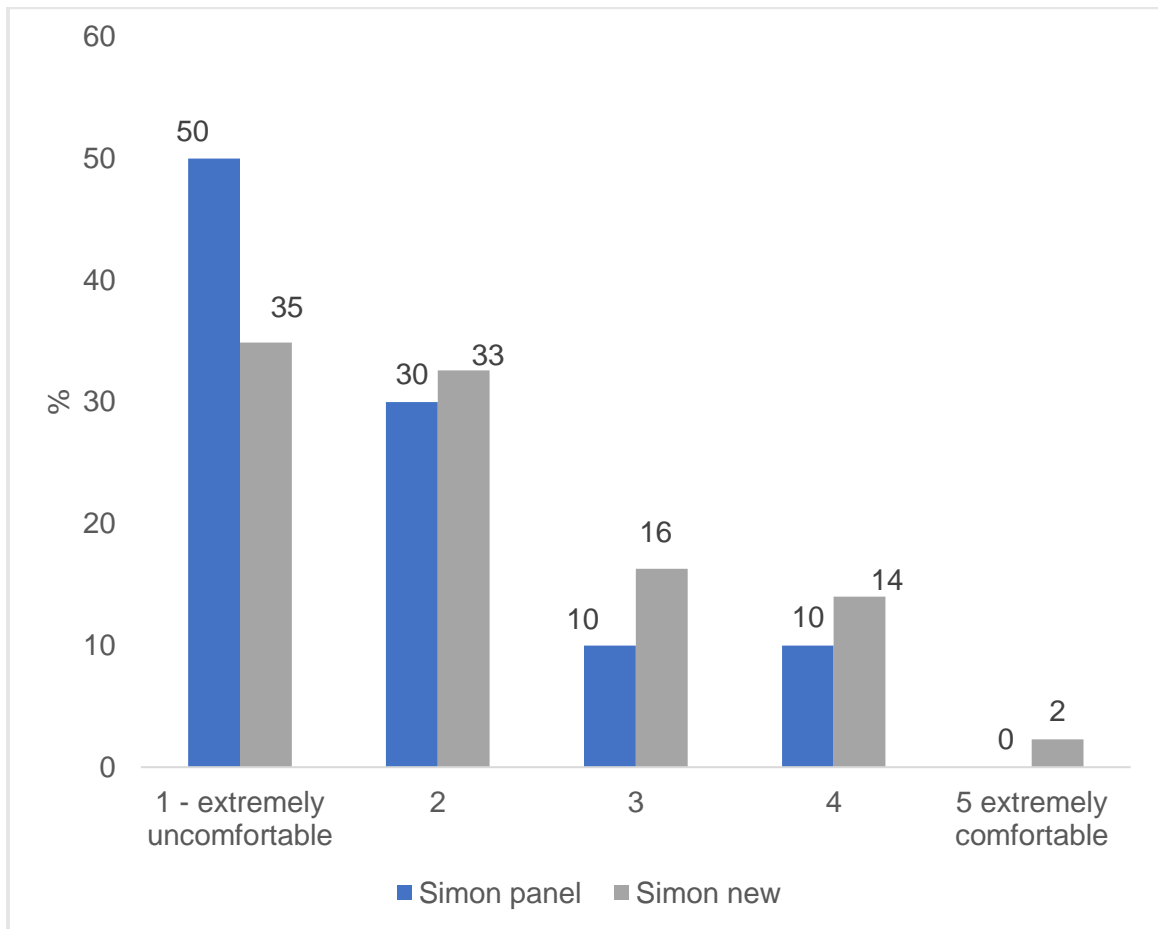
**Figure 4.18**

*Extent Comfortable With Scanning Process for Nathan*



**Figure 4.19**

*Extent Comfortable With Scanning Process for Simon*

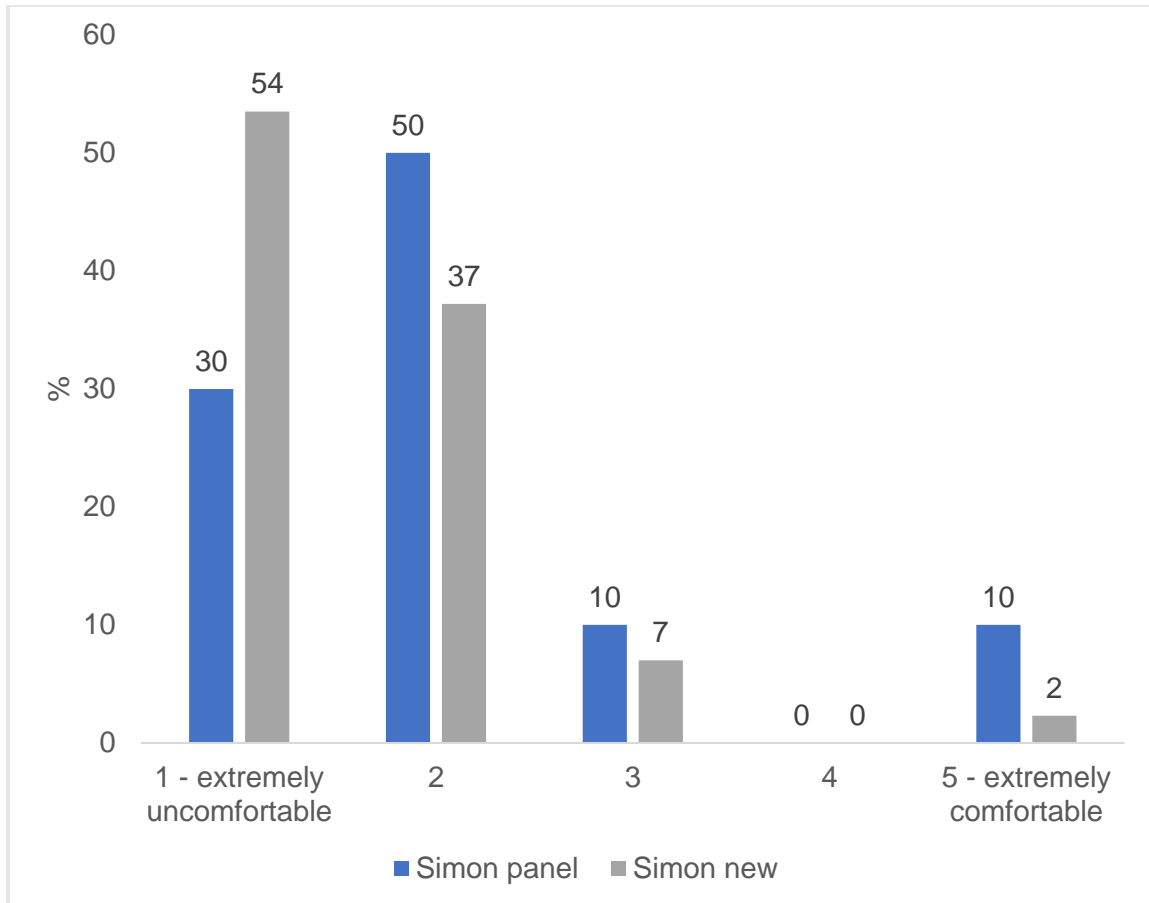


**4.5.6 Reactions to Uploading**

Direct comparisons between Nathan and Simon’s uploading experience have to be drawn with caution due to the differences in stimulus material. While Nathan’s scan and upload are depicted separately across three clips, Simon’s scan and upload occur in one clip.

**Figure 4.20**

*Extent Comfortable With Simon’s Scan & Upload*




However, it appears, that panellists were more comfortable with Simon’s scan and upload than new respondents (means of 2.70 and 1.60 respectively). I hypothesise that the panel’s extended exposure to the topic of mind uploading may have made them more accepting of the potentially negative aspects of the process.

#### **4.5.7 Response to Nathan’s Upload and Initial Experience**

This spanned two video clips, one of the uploading and one of Nathan’s first experiences when he uploaded to a luxury afterlife resort (Lakeview). Respondents were asked how appealing they found Nathan’s experience as a precursor to a follow-on question based on a different, scenario with “capped” resources (scenario 2).

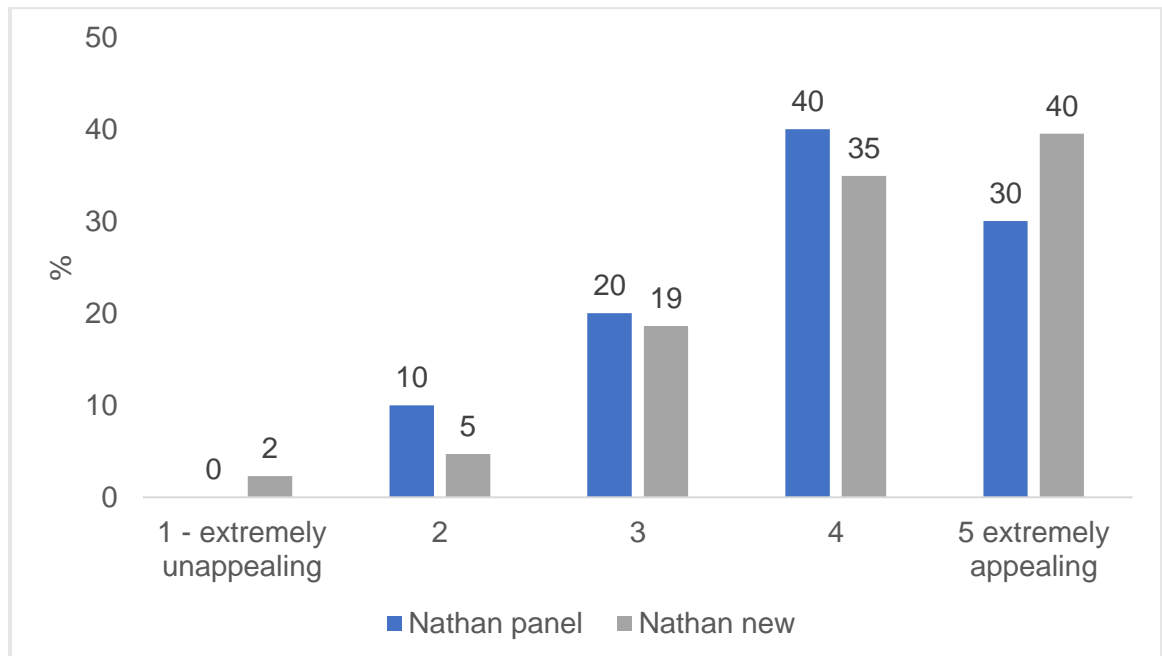
**Table 4.4**

*Nathan's First Day*

Link to Video Clip	Question
<b>Nathan's First Day (scenario 1)</b> 	How appealing do you find Nathan's initial experience as an upload? (5-point scale where 1 is extremely unappealing and 5 is extremely appealing)

**Figure 4.21**

*Appeal of Nathan's Upload*





Both panellists and new respondents tended to find Nathan’s afterlife appealing which likely reflects the positive portrayal of Lakeview as a high-end, luxury resort.


**4.5.8 Level of Appeal of Unlimited vs. Limited Resources**

Nathan’s initial upload was to a luxury resort, with unlimited data, which in a digital afterlife equates to “life.” As indicated above respondents reacted positively.

However, I also included a clip of an alternate scenario where Nathan is downgraded to a floor where uploads only have 2GB of data a month. Once this has been used the uploads are effectively “paused” or “frozen” until the next month’s data allowance. This explored whether respondents felt living forever was worthwhile even if it was constrained in some way.

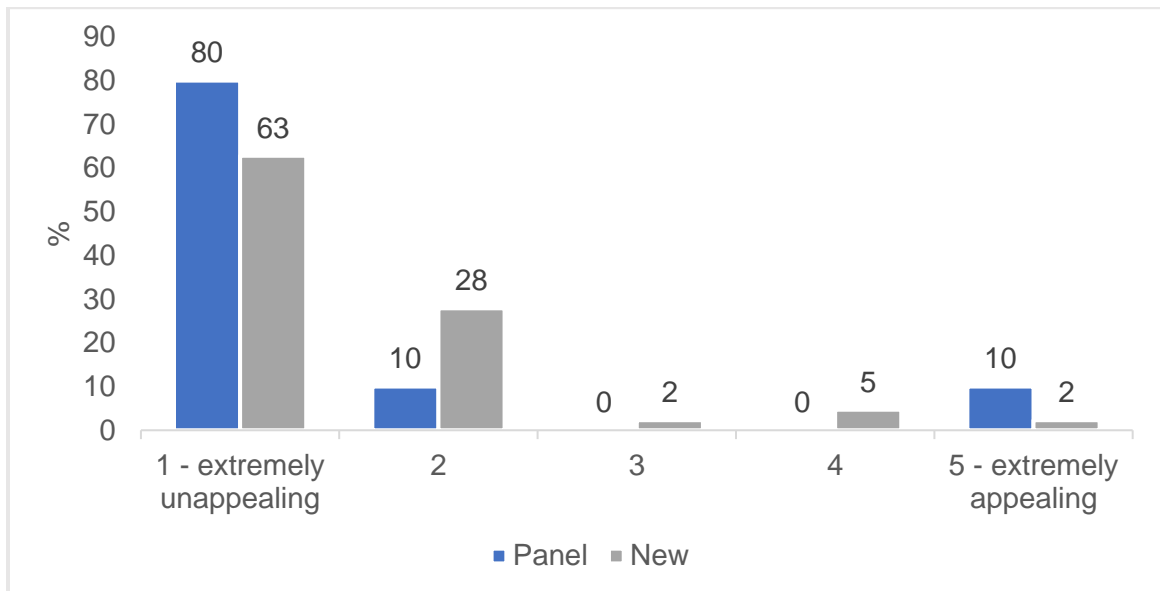
**Table 4.5**

*Nathan Scenario 2*

<b>Link to Video Clip</b>	<b>Question</b>
<p><b>Nathan (scenario 2)</b></p> 	<p>Based on this second scenario, how appealing do you find Nathan’s experience as an upload? (5-point scale where 1 is extremely unappealing and 5 is extremely appealing)</p>

**Figure 4.22**

*Appeal of 2GB Upload*



This was a far less appealing scenario, but it wasn't dismissed completely out of hand. Respondents were asked to trade off the two options and decide which existence was worth having.

In which scenario do you feel Nathan's existence as an upload is worth having?  
Choose one only.

- Lakeview if resources are unlimited (first clip) (1)
- Lakeview with limited resources (second clip) (2)
- Lakeview with either unlimited or limited resources (3)
- Neither scenario at Lakeview (5)

The clear majority (70% panel and 80% new) opted for unlimited resources. However, only a minority (20% panel, 9% new), would reject both scenarios at

Lakeview. This may indicate that even a much-constrained existence was seen as better than no existence at all.

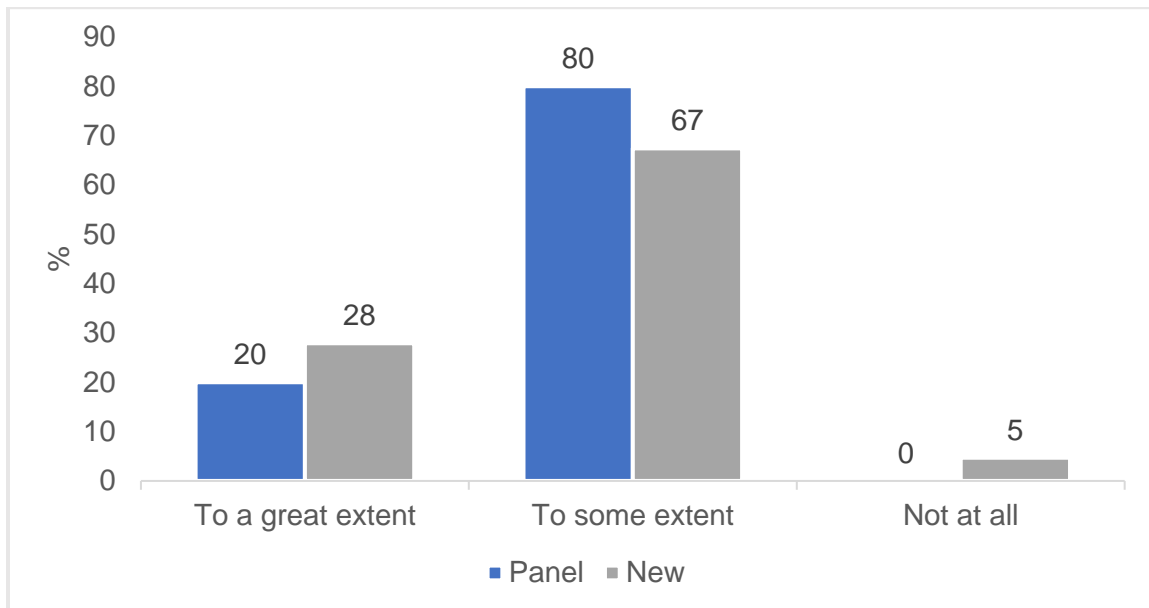
The concepts of life extension and immortality have been discussed from the perspective of ageing and society (Davis, 2022), the ethical desirability of life extension vs immortality (Rantanen, 2012), and why there may be limits to human longevity (Gavrilova & Gavrilov, 2019; Olshansky & Carnes, 2019), to name a few. However, this is the first study to collect data and examine immortality in scenarios where access to resources and hence the quality and quantity of the “afterlife” differ.

#### ***4.5.9 Advancing or Changing what it means to be Human***

The next few videos and questions considered potential scenarios where uploaded Simon is embodied in different forms, which potentially changes what it means to be human. While the online pilot study measured awareness of transhumanism, it did not explore attitudes toward it. The website survey, however, asked specifically about using science and technology to expand our physical and mental capabilities even if this was not identified as transhumanist.

**Figure 4.23**


*Belief in Using Science & Technology to Develop Both Physically and Mentally*



All panellists and nearly all new respondents believed in using science and technology to develop. However, using science and technology to enable a robot body (as per the video example in Table 4.6) was less appealing, particularly for panellists. As one stated “I would feel anxious if I woke up in a body that I didn't recognize. Especially if it wasn't human.” It may be that embodiment as a robot did not fit the panellist's perceptions of how science and technology could be used to extend their capabilities and this theme will be explored in subsequent research.

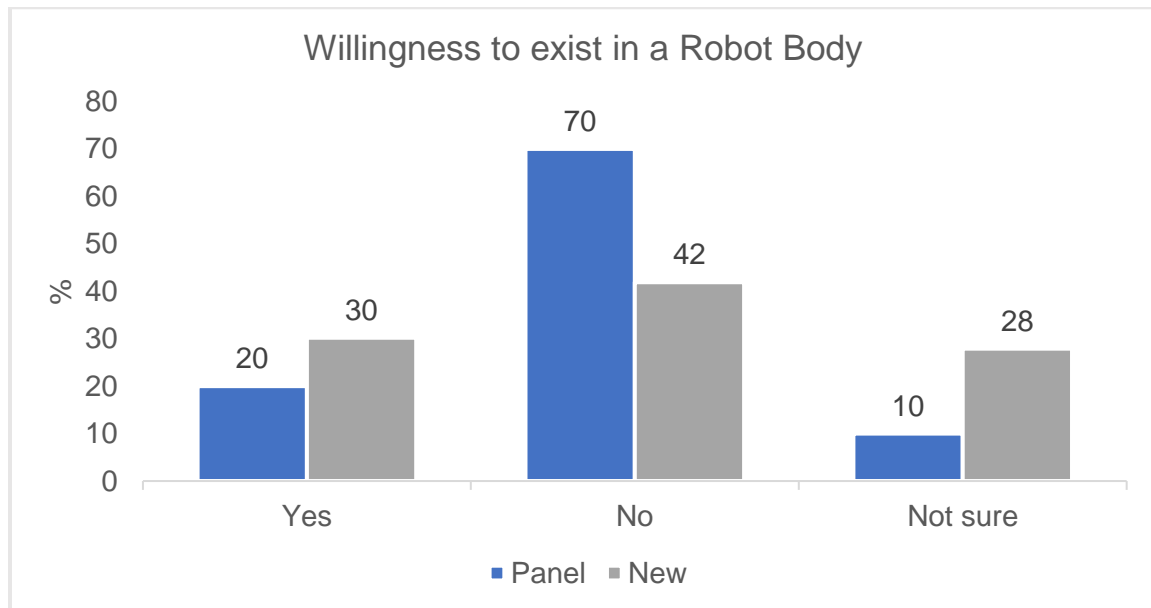
**Table 4.6**

*Simon's Embodiment*

Link to Video Clip	Question
<b>Simon's Alternative Embodiment</b> 	In this clip Simon's arms and hands look robotic. If it was the only choice, would you want to exist as an upload in a robot body? Choose one only. Yes No Not sure

**Figure 4.24**

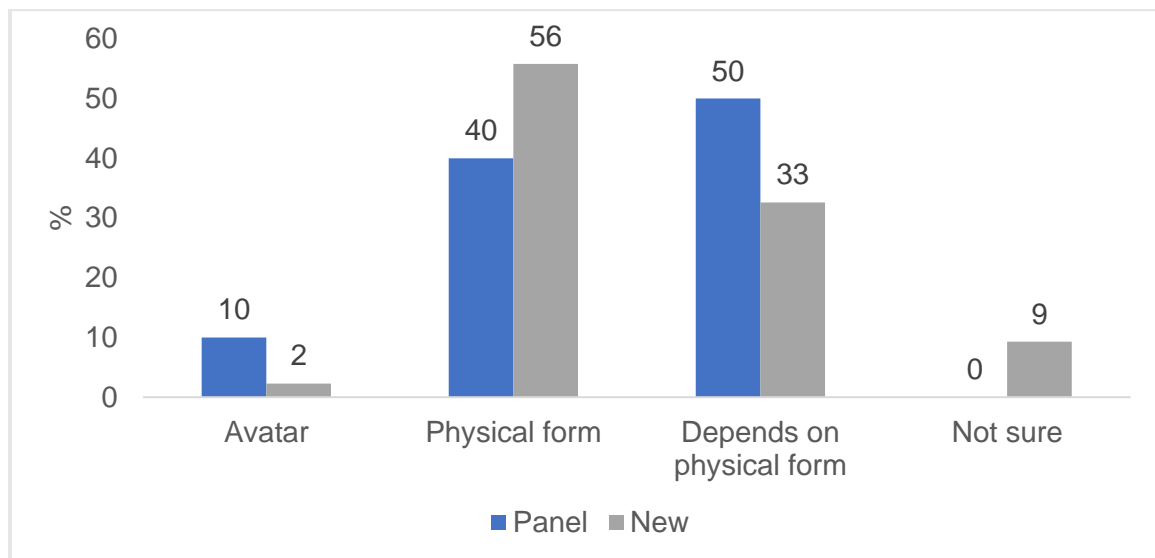
*Willingness to Exist in a Robot Body*



Subsequently, respondents were asked about their preference for a continued existence, either like Nathan as an avatar in a virtual world or as embodied/downloaded into a physical form like Simon.

**Figure 4.25**

*Preferred Form*



Existing as an avatar in a virtual world was the least appealing option even if virtual reality and virtual worlds are fast becoming familiar experiences. New respondents were more likely to commit to a physical body (including a robot body) than panellists. However, a substantial proportion of both groups stated it depended on the physical form. The limited appeal of spending an afterlife as an avatar reinforces the importance we ascribe to being embodied and comments made throughout the research indicated some discomfort with the concept of living in a virtual, simulated environment and hence disconnecting from the real world.

Taken together the responses to existing in various forms are intriguing and indicate areas for further research. Participants supported the concept of using science and technology to develop but how this was realised in a mind uploading scenario was important. Most participants wanted to be downloaded or embodied and the type of physical form mattered. A robot body didn't meet most people's

needs, so this warrants further investigation in subsequent studies which could potentially explore acceptable options such as “organic” and “hybrid” forms.

#### **4.5.10 Uniqueness and Survival**

Participants were shown two videos, one after the other (See Table 4.7) that showed alternate endings for Simon’s upload. Nathan’s uploaded life did not feature an ending since one was not available from Upload.

**Table 4.7**

*Simon’s Ending*

---

**Link to Video Clip**

---

**Simon's Final Upload**



**Simon's Alternative Upload**



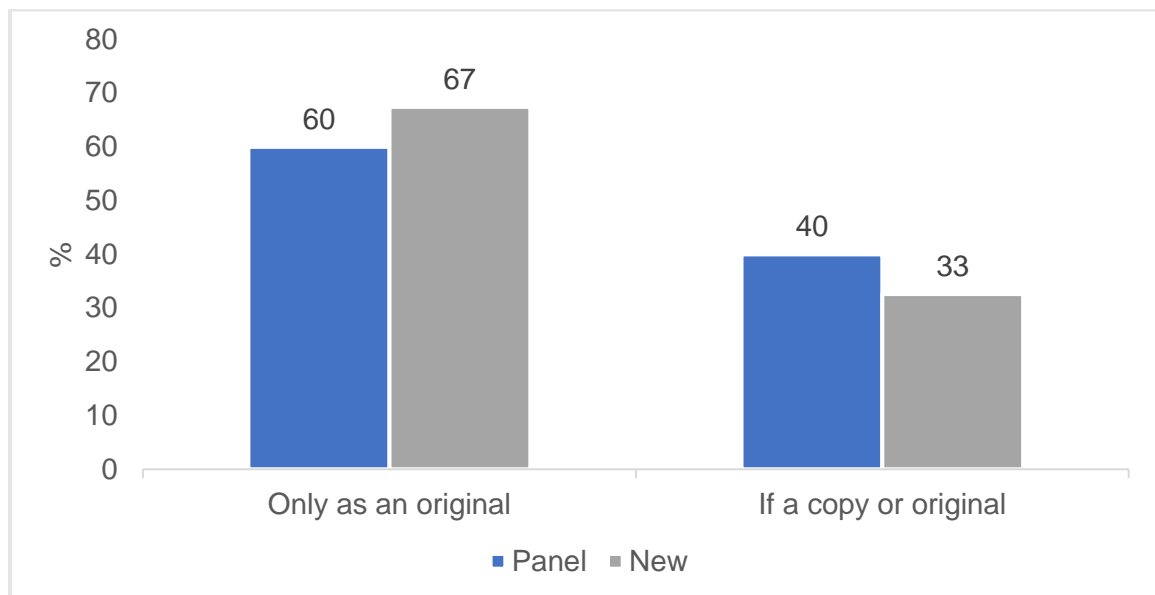
---

These videos, specifically the first clip, showed an upload surviving as an original and a copy. Although fully describing and defining these concepts falls

outside the scope of the website, I will explain the context. The first clip (labelled “final” to reflect the game) showed Simon feeling he was just a copy that has been left behind while the “original” Simon had been sent into space in the ARK. Simon was distressed by the thought of being a copy. As he said to Catherine, the copies are “not us.” Hence, it is possible that Simon’s negativity influenced the respondents. However, as shown in Figure 4.26, while most would want to hold onto their originality, a substantial minority (33%–40%), particularly panellists, would also accept surviving as a copy, even if the question of whether or not you would still be you was unanswered.

**Figure 4.26**

*Willingness to Exist as a Copy vs. an Original*



When asked to pick their survival or that of the species, there was a clear difference of views between panellists and new respondents with four-fifths of the latter opting to save humanity. The panellists were more evenly split between saving the species (60%) and saving themselves (40%). This may reflect



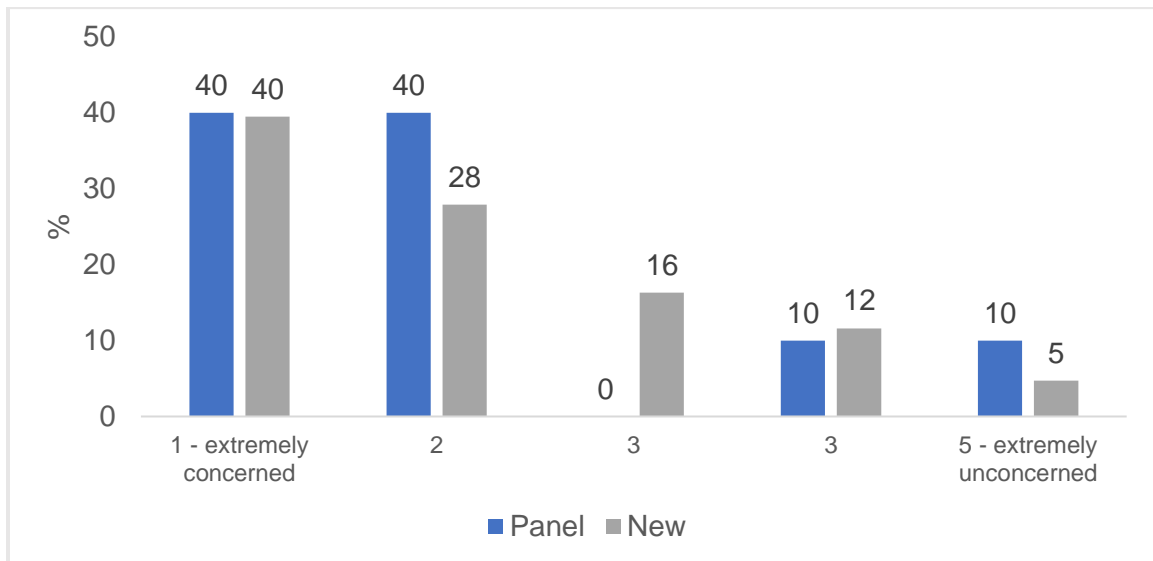
personality differences or be a result of the panel’s extended engagement with the topic and potentially more time to reflect ahead of the website.

#### 4.5.11 Subjective Experience

The issue of being an original and other aspects of subjective experience were explored further in subsequent questions, including how concerned respondents were that they would not truly be themselves. The designers of Soma (Frictional Games, 2015) chose to focus on the subjective experience or the “feelings” of consciousness, which reflects the recent focus on exploring what it would mean if an artificial system or intelligence became conscious (Key et al., 2022). As shown in Figure 4.27, the majority had noticeable concerns.

**Figure 4.27**

*Extent Concerned “Not Truly You”*



I used a projective technique where respondents had to complete the sentence, “If I was an upload I would feel ...”

Such techniques yield a wider range of responses compared to direct questions and provide a better understanding of thoughts and feelings (Doherty & Nelson, 2010; Donoghue, 2000; Kujala et al., 2013). From my prior work (study 1 and study 2), I knew emotional and sometimes unconscious attitudes are important when discussing mind uploading. While responses from new respondents were often negative, panellists tended to be more positive, albeit cautiously in a few instances. The following word clouds (Figure 4.28 and Figure 4.29) and verbatims illustrate some of the positive feelings and reactions:

**Figure 4.28**

*“If I was an upload, I would feel ...” Positive Associations*



Amazed and strange at the same time because it is a whole new experience to me. (49)

Curious about a brand (brave) new world. (8)

Intrigued. Would I experience things the same way when I was still human? (3)

**Figure 4.29**

*“If I was an upload, I would feel ...” Negative Associations*



A bit anxious and excited at the same time. (25)

Ethereal and disembodied until I got used to the transition, then I would be able to explore the experience, push boundaries and rationalise the abilities to build on the experience. (59)

It would feel strange, adventurous, and rather unsettling. (56)

I think it would feel strange, a completely different world, I would have to learn a lot of things all over again. My consciousness would also be a little disturbed. (33)

I will feel disconnected much like Simon. (48)

I would feel weird, and I would also feel slightly uncomfortable. (21)

I would go through many emotions, but I will be mostly scared. (30)

Incomplete, I would not feel like myself. (45)

Lost and empty, without meaning and reason to live. (38)

Trapped in an immaterial world, without conscience to exist infinitely but actually, without a meaningful purpose. A very unappealing condition of existing (not living). (26)

In one of the clips from Soma, Simon is asked a series of structured questions about his subjective experience as an upload, and I replicated three of these questions and the pre-coded answers on the website. While these do not necessarily conform to accepted survey design principles, particularly in terms of the wording of response options (see Table 4.8), they are intuitively understandable.

**Table 4.8**

*Evaluation of Soma's Questions and Responses*

Question	Response Options	New Suggestions
Are you troubled by the fact that you are no longer strictly human?	No Somewhat - I would feel I had lost myself Yes - I would mourn my previous existence I wouldn't care as long as I got to carry on	To a great extent To some extent Not at all
How do you perceive your new existence?	It would be a direct continuation of my previous self It would be like being born all over again - a complete do-over It would be something completely different and nothing to do with my previous self Like a new chapter in my life	A direct continuation of my previous self A new identity/self
Do you think this new existence will be a life worth living?	Like a new chapter in my life Maybe we could find a new sense of meaning in this world No, it's too detached from reality and everything I know	To what extent do you think this new existence will be a life worth living? To a great extent To some extent

---

Yes, but with less meaning	Not at all
----------------------------	------------

---

Nevertheless, the questions posed interesting and relevant questions about an uploaded life, such as what it means to be human, continuation of self, and whether a continued existence as a version of you would have meaning.

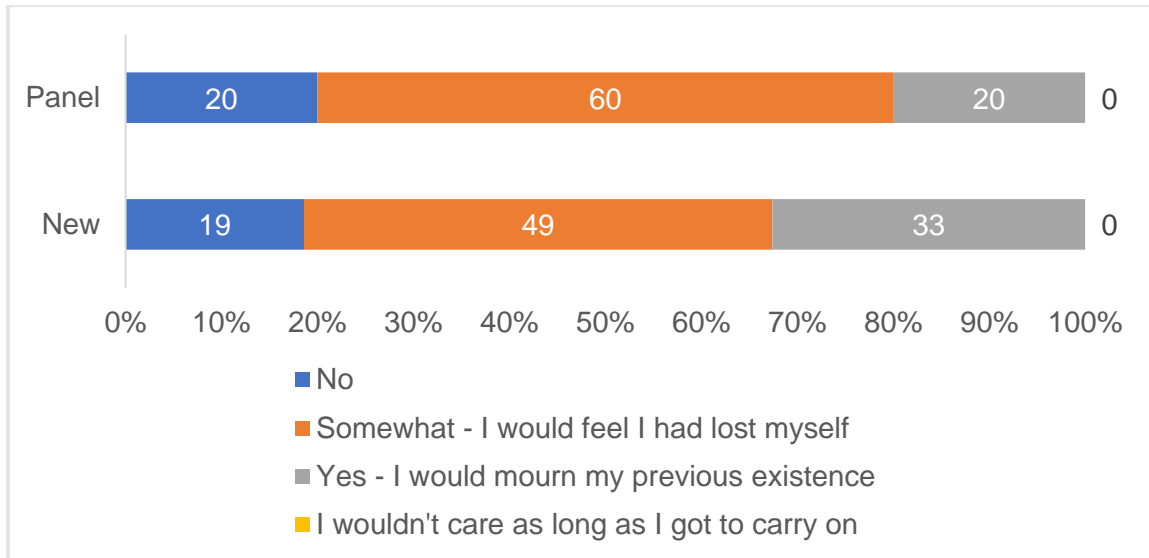
I contacted the game developer (Frictional Games) several times before designing the website so I could understand their rationale for the questions and answers and incorporate this into my analysis. While I have not had a direct response, I have located an interview with the Creative Director that confirms one of the most important themes in Soma is consciousness, and he provides an interesting perspective on how this is relevant to the horror genre that Frictional Games are known for.

What is frightening or not is a very subjective thing, but for me personally, the disturbing aspects of consciousness are far more terrifying because they are not just a fantasy. A monster, no matter how scary, is just fiction and nothing to worry about. But once you start to grasp the unsettling aspects of what it means to exist, those will stick with you forever. You can never run away from it; only try to not think too much about it. The goal is to open up this chasm of unsettling ideas, and then force the player to stare into the abyss. (Grip, 2015)

The three questions and response options are shown below.

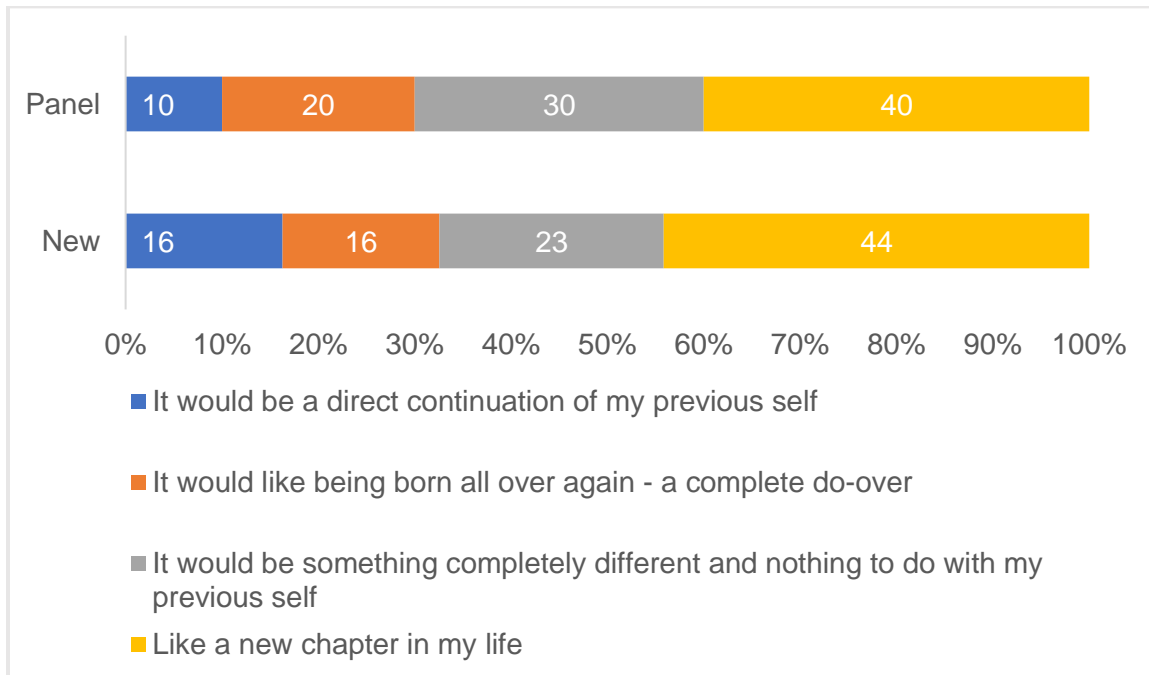
**Figure 4.30**

*I would be troubled by the fact that I am no longer strictly human?*



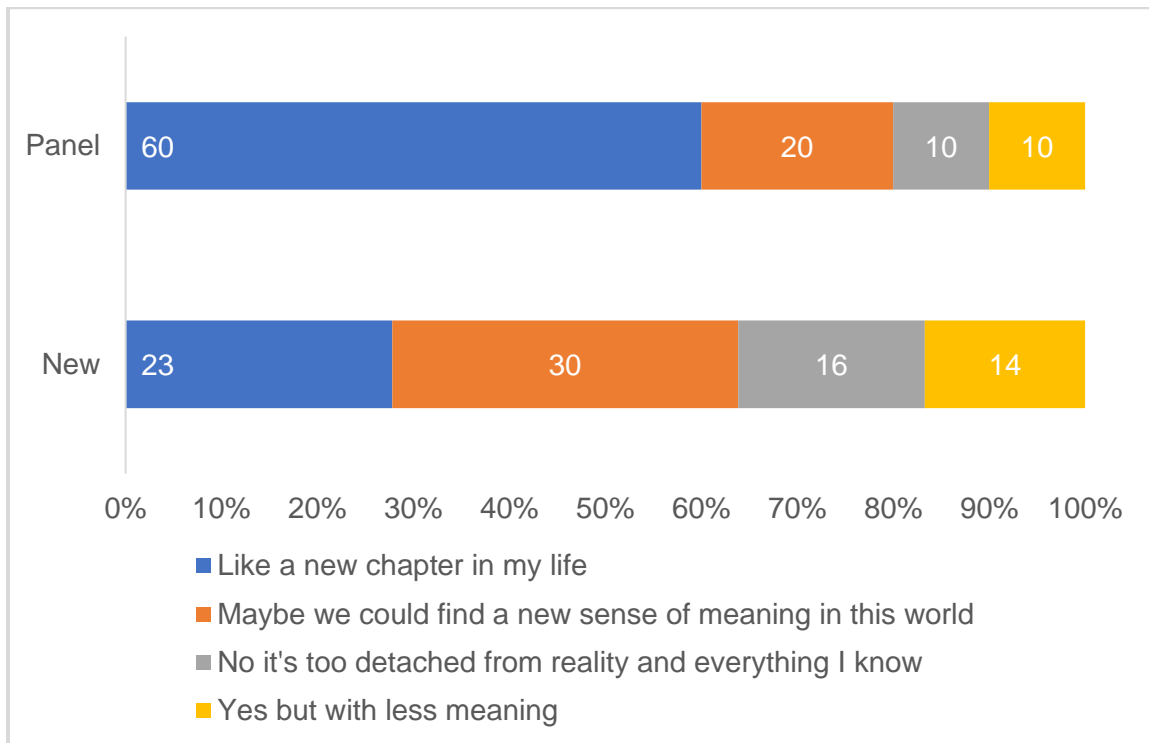
**Figure 4.31**

*How would you perceive your new existence?*



**Figure 4.32**

*Do you think this new existence would be a life worth living?*



Simon's responses in the game differed from those of the participants. Simon claimed he wasn't troubled by the fact he was no longer strictly human. He perceived his new existence as a direct continuation of his previous self and that his new existence would be a life worth living as much as his previous life.

In contrast, most participants were troubled about no longer being strictly human and most often felt that they had lost themselves. How participants perceived their new existence varied; although, most saw it as a new chapter in their life. Unlike Simon, only a minority of participants regarded the new existence as a direct continuation of their previous self. However, the majority felt this new existence would be worth living and most reiterated it would be a new chapter.

Panellists and new respondents had differing responses to this set of questions. Panellists were more likely to suspect they would have lost themselves being no longer being human, which may have reflected their greater negativity towards a robot body. However, they were more inclined to see the new existence as something completely different and a new chapter in their lives although the reasons for this are unknown.

Overall participants seemed most allied to the concept of psychological branching identity (Brueckner, 2005; Cerullo, 2015; Graziano, 2019; Walker, 2011), whereby at the point of branching (e.g., on upload the original and the copy would be the same: both “you”). This concept is considered further in the Discussion (section 4.6).

Following this section, participants were asked the following open-ended question, “What would make a new existence as an upload worth living for you”? The wording was chosen since I did not want to be prescriptive by defining what would make this new existence worth living.

Participant’s spontaneous replies were varied but some themes emerged from the analysis. By far the most prevalent was still feeling connected to others—especially loved ones—and continuing to experience feelings and emotions.

Having real-life quality relationships, and emotions. Having true to life familiar people around me, as avatars. (12)

Just living a normal life and being able to be near my loved ones. (21)

Having loved ones around me, still having problems to solve—could be abstract like math, some research, art. (37)

Having my loved ones around me. (43)



Thereafter, life as an upload would be worth living for new possibilities and experiences and one or two relished the prospect of no boundaries or limits.

More possibilities than my previous life. (6)

I think that learning or doing things that I didn't dare to do in my previous life would make it worth it. Also having the possibility to talk and engage with people that I didn't get to spend much time with. (10)

To experience things that I do not dare before. (48)

However as reported elsewhere, several felt that they would need a purpose or a cause to make existence worthwhile.

A purpose in the world I found myself in. (35)

“Maybe if we could help towards a cause? (29)

Some would also want a better quality of life for example without pain or sadness and for a couple maybe a chance to fix their mistakes.

Fixing my previous errors. (29)

If I could be far away from pain as an upload. (33)

Two participants specifically requested no memory of their previous life so neither a copy nor an original, a complete rebirth.

Being able to physically experience sensations and interact with the world was also mentioned by some, which relates back to the desire for a physical form previously discussed.

A few felt life as an upload in a new world would be worthwhile if it was more peaceful and ethical. Linked to this a few felt preserving knowledge might educate future generations and prevent from making the same mistakes although they did not specify which mistakes.

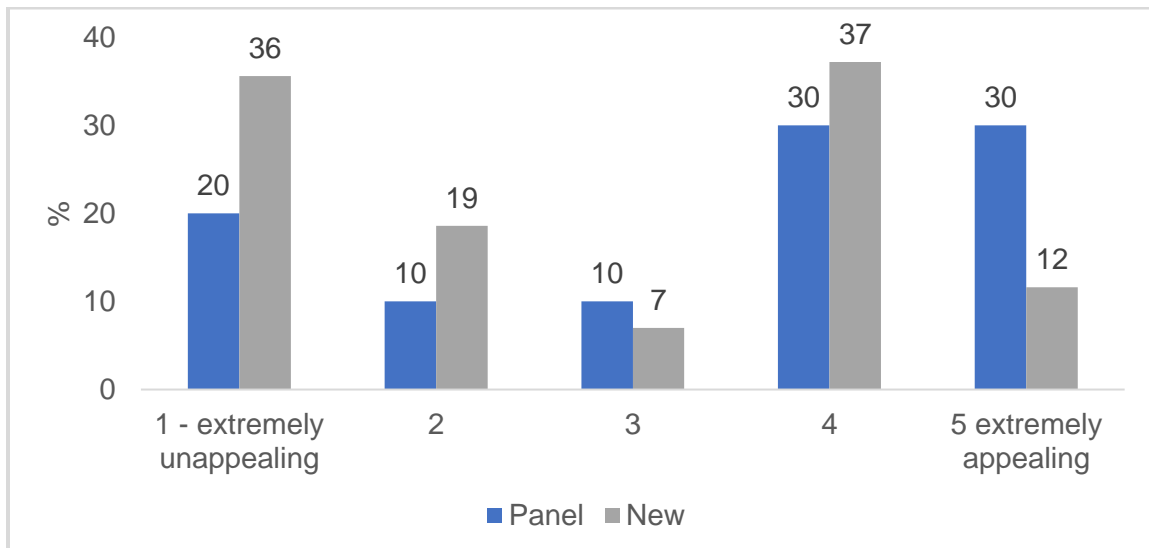
#### 4.5.12 Immortality vs. Life Extension

Respondents were asked about the appeal of living forever/immortality vs. life extension: The latter was defined as “a fixed term of extra life which you decide.” I chose this definition to indicate that participants could control the span.

A defined period of extra life was more appealing than living forever and most chose this option. However, panellists found both options more appealing than new respondents and showed a greater inclination to immortality which may reflect individual differences. Around a fifth of both audiences did not choose either.

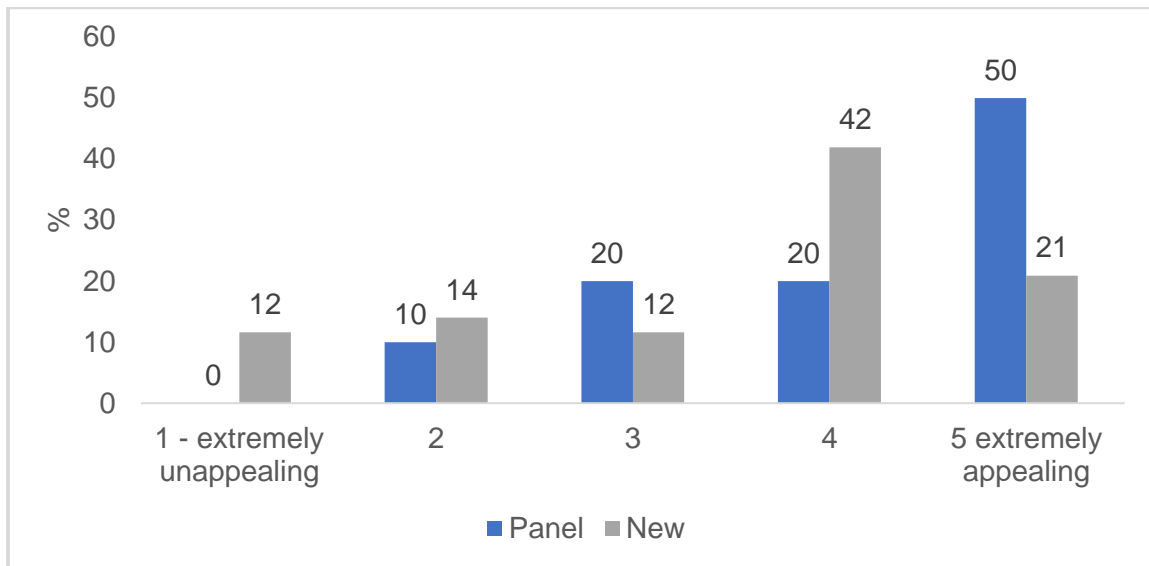
**Figure 4.33**

*Appeal of Immortality*



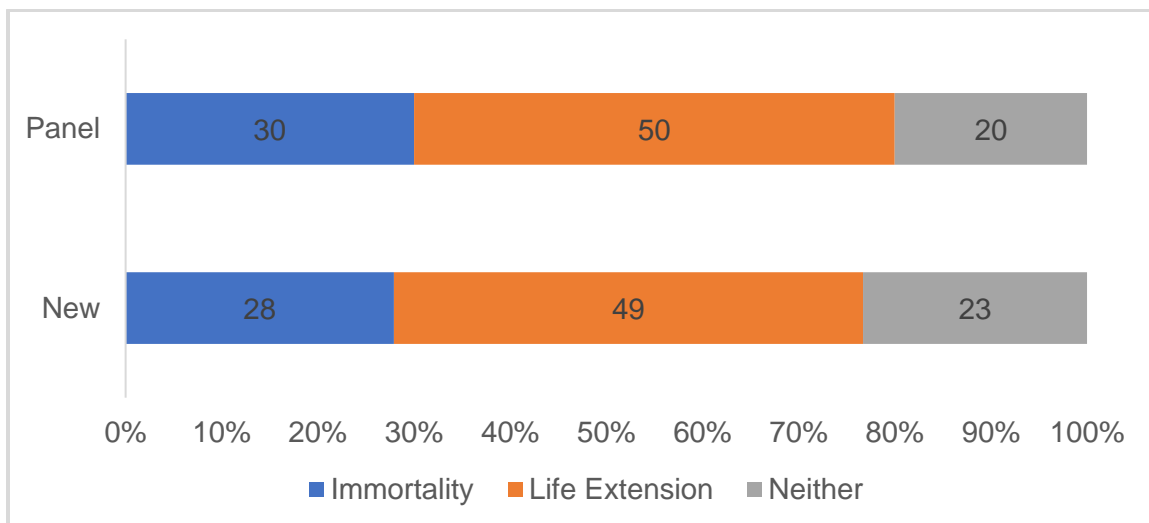
**Figure 4.34**

*Appeal of Life Extension*



**Figure 4.35**

*Life Extension vs. Immortality*



Several respondents opted for life extension to ensure they would have time to say their goodbyes to loved ones and/or to allow them more time to experience life and pursue their goals and dreams. Life extension gave them control and

certainty by allowing them to choose when they died. The following verbatims illustrate these views.

Life extension as an option can minimise the grief of a sudden, unexpected loss, too early under circumstances, as a sort of second chance on Earth. (9)

I get to decide whether I want to continue living or not. (25)

Immortality seems too lonely and boring. On the other hand if you die too early life extension could help you achieve what you didn't have enough time to do while you were alive. (46)

I see this decision as an intermediate solution. (51)

Life extension is the best option, living forever could be kinda boring. (36)

To finish my purpose and say goodbye to people who are dear to me. (54)

However, the rest chose life extension as the “safer” option due to concerns and fears about immortality. These included:

- The unknown, the uncertainty
- Experiencing too much
- A very different world, an “out of body” experience
- Living in a world that they don't like or a desolate planet
- Ending up lonely, alone/last of humanity
- Becoming “bored” or “exhausted” or “tired” of living
- Losing their purpose
  - Serving a “life sentence” with no option to die
- The “magic,” “precious gift” of life becomes meaningless

After living for a very, very, long time you could get simply get tired of living. With immortality you would have no choice but to live. This could be worse than dying. (27)

Immortality seems too lonely and boring. (46)

Living forever brings me more fear than not living forever, uncertainty is something scary. (52)

Living forever/immortality could be very unpleasant if I do not like the world I'm uploaded into. (56)

I don't think I could understand and accept the idea of immortality as a whole. I think that knowing that I will die helps me give purpose to my life and get the most out of life. I think that if I were to live forever at some point I would be bored, or exhausted. (10)

Immortality sounds like serving a 'life sentence' indefinitely, removing some of the excitement or magic of the precious gift that life is. (9)

Because immortality is scary if you don't know all the details. (6)

Those who opted for immortality had two main reasons: first, a fear of death/a wish to avoid it for themselves or loved ones and, second, a love of life and the wish to carry on discovering and experiencing it without limit. Individuals hoped that they wouldn't suffer significant diseases or disabilities as immortals or that a cure would be found in their extended lifetime. The following verbatims highlight these views.

Because you know that you can do anything at whatever time because you have forever to live. You can go on adventures and take risks and not die. (26)

Because life is beautiful and there are many ideas and things to be discovered in the future. (51)

I am fearful of death, the idea of living as long as I'd like to is very appealing, but only if I also had to choose to end my life if I wished to. (19)

I am scared of death and want to go through experiences for a very long time. I don't want life to be short. (55)

Life extension sets me a limit just like the real world does and I don't think I could handle the fear of death twice in a row. (45)

Living forever is most appealing to me because I have a fear of dying, I want to live forever and experience what life is evolving to. (40)

However, around a quarter of new respondents and two panellists didn't want life extension or immortality. For a few, both options went against their religious beliefs, and others stated that death is a natural part of life. As one said "I feel comfortable with the cycle of life. There is a charm in becoming compost"

(8). The following comments expand on these thoughts.

I am religious, so I feel like God has a plan for my life and I am only supposed to live a certain amount of time. (30)

I do not find the idea of living forever appealing because I feel that as humans we should not try to be God. We were created to die one day so we should all come to terms with that and not try to find ways to live forever. (21)

Life has its value because it ends, and you have to enjoy it while you can. (38)

Death is a part of life. You live and you die, that's it. Immortality doesn't exist in the natural world. Even the universe dies in the end. (44)

I think the beauty of life is the spontaneity and randomness, this minimises that. (53)

Possibly without knowing it, respondents touched on some of the philosophical discussions around immortality. Buben (2022) summarises Sartre's writings such as his play *No Exit* (1989) where three recently deceased people arrive and interact with each other in an afterlife. For many, this is a prime example of Sartre's comment that "Hell is other people" and hell seems to be through the judgment that others make on the way you have lived your life and your weaknesses.

Buben (2022) adds his examples of other "hellish" ways to spend immortality such as "in solitary confinement, in excruciating physical agony, floating aimlessly through empty space, or even in a state of boredom." While

respondents did not seem to consider hell as other people, in fact for many that was the reason for a continued existence, they certainly considered loneliness, boredom, a lack of purpose or meaning, and the uncertainty of living forever.

A recent finding shows that VR creates an effect called “time compression,” where time goes faster than you think (Mullen & Davidenko, 2021), which is another perspective on immortality and one which I might explore in future work.

#### ***4.5.13 Key Positive and Negative Attributes of Mind Uploading***

Drawing on prior research and published literature as well as popular culture, I identified 13 positive attributes for mind uploading. This list was based on my understanding of the field supported by current science and technology and, as such, may not be exhaustive. I asked respondents to rank the three most appealing attributes in order from one to three, where one was the highest. First place was allocated three points per vote, second two points, and third one point. I used colour coding to highlight the top three choices for the panel and new respondents.

Analysis of these ranked responses showed that being there for loved ones after death was the most important for new respondents and joint second for panellists. Otherwise, the two audiences diverged with panellists choosing new perspectives and experiences as their clear favourite, followed by continuing to learn and develop while new respondents opted for increased happiness and well-being and no physical pain.

The full list of attributes, their points, and placings are shown below in Table 4.9. First place was allocated three points per vote, second two points, and third

one point. Colour coding is used to highlight the top three choices for both the panel and new respondents.

**Table 4.9**

*Most Appealing Attributes of Mind Uploading*

Attribute	Number of points		Placing	
	Panel	New	Panel	New
New perspectives and experiences	12	24	1	5
Continuing to learn and develop	9	25	=2	4
Being there for loved ones after death	9	51	=2	1
No physical limitations	8	20	=5	6
No physical pain	8	34	=5	3
May allow humanity to survive	7	17	7	8
Preserving brilliant minds	6	18	8	7
Being able to control emotions/feelings	9	4	=2	=11
Increased happiness and well-being	4	38	9	2
Being able to enhance cognitive abilities	3	8	10	10
Backing up memory so that nothing is lost or forgotten	2	13	=11	9
Instant communication with other uploads	0	2	13	13
Less consumption/impact on the planet	2	4	=11	=11



Using the same approach, I also identified thirteen negative attributes for mind uploading and asked respondents to rank the three most worrying from one to three. Fears that life would lose its meaning were ranked in the top three by both groups although otherwise, the two audiences differed. Panellists were concerned with the risk of hacking, lack of privacy, and ownership of their minds. New respondents were more worried about being a copy or a clone and mental abuse/torture.

The full list of attributes, their points, and placings are shown in Table 4.10. First place was again allocated three points per vote, second two points, and third one point.

**Table 4.10**

*Most Worrying Attributes of Mind Uploading*

Attribute	Number of points		Placing	
	Panel	New	Panel	New
Against religion/spiritual beliefs	0	15	13	9
Against natural laws	3	13	8	11
Just a copy or clone	5	30	6	2
Mental abuse/torture	6	36	4	1
Hacking/lack of privacy	13	22	1	5
Ownership of my mind	8	23	2	4
Corrupt/evil minds preserved	2	12	10	12
Life should be finite	6	21	4	6
No physical body	1	15	12	9

Unequitable access e.g., only rich and powerful	5	16	6	7
Life would lose its meaning	8	25	2	3
Impact on humanity as a species	0	16	13	7
Don't believe an uploaded mind would carry on living	0	3	13	14
We need sensory input and output	3	2	8	15
Hardware failure e.g., servers storing our data/minds	2	9	10	13

While participants in the pilot study were less favourable to mind uploading overall, some of the comments recorded on the website expressed the same thoughts, such as the desire to be there for loved ones after death and an interest in being able to continue to exist and evolve.

Some of the same concerns were also re-iterated, such as the risk of abuse and exploitation and violation of their privacy. Similarly, some felt mind uploading violated natural laws or religious/spiritual beliefs. The continuity and convergence of these themes across multiple sources indicates credibility via triangulation of both data and method (Johnson et al., 2020).

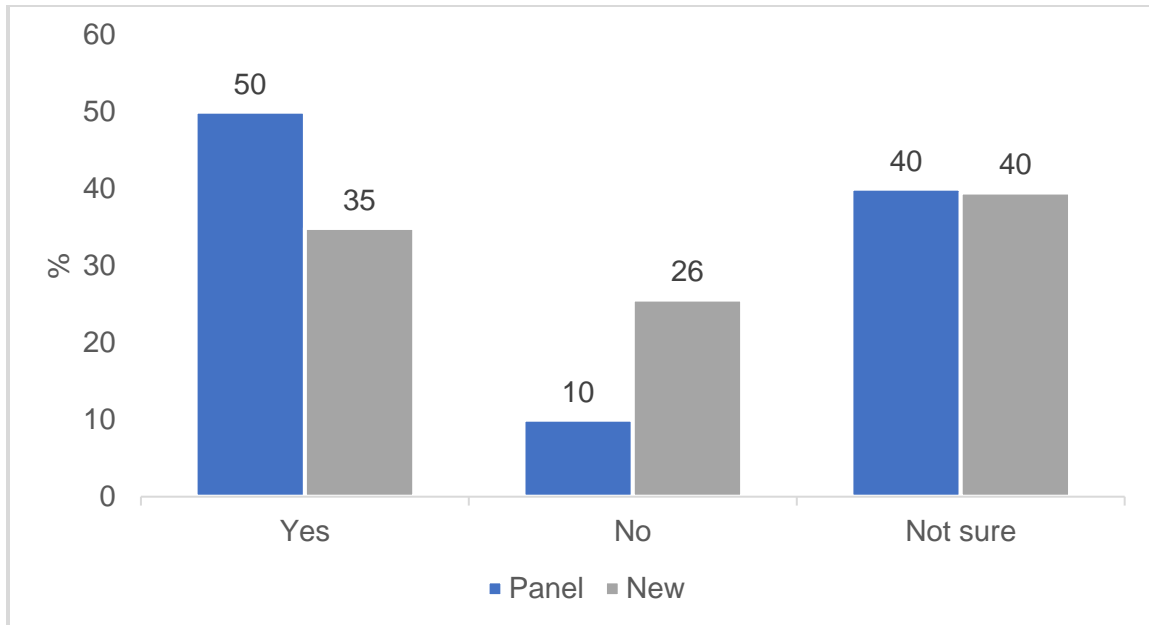
#### **4.5.14 Willingness to Mind Upload when Physical Body is Dying**

In the online pilot survey run in 2020, while just over a quarter would upload, almost twice as many would not. The website audience was more favourable, particularly the panel, where half would upload compared with over a third of new respondents.

However, as in the pilot, a sizeable proportion of both groups, particularly new respondents, were unsure which probably reflects the lack of knowledge and exposure to future technology.

**Figure 4.36**

*Willingness to Mind Upload*



The finding that most did not reject mind uploading outright may reflect our “pervasive struggle for existence and survival (self-preservation instinct)” (Nishanth & Jha, 2022), as well as our search for meaning (Steger et al., 2008).

#### **4.5.15 Change in Awareness**

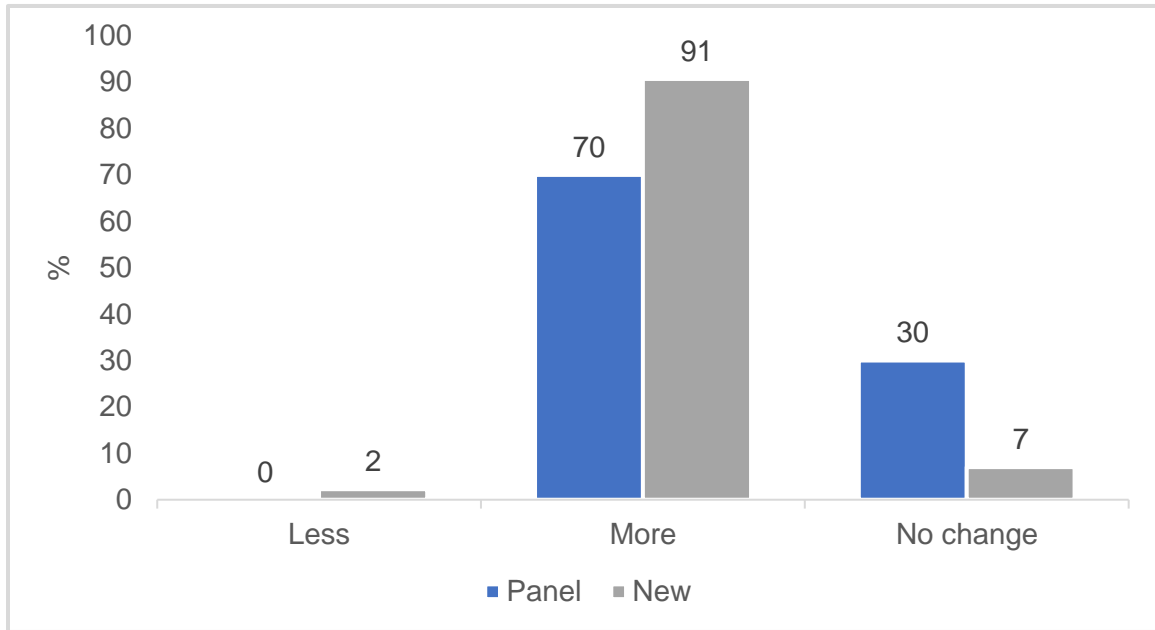
Since one of the aims of the website was to raise awareness and engagement with mind uploading, it was important to measure pre and post awareness.

Panellists have been involved since 2020, but even so, 70% claimed to be more aware after experiencing the website. Impact on the new respondents was

even more marked with almost all (91%) claiming to be more aware. This demonstrated that the method—a storytelling website—and the topic—mind uploading—have value when engaging with the public about neurotechnology.

**Figure 4.37**

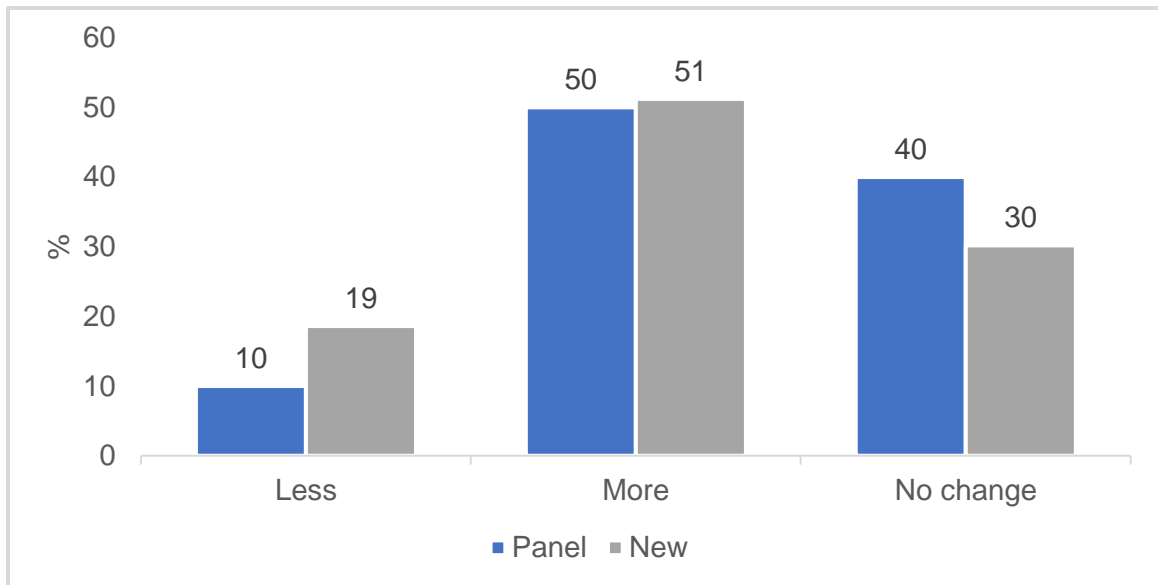
*Change in Awareness of Mind Uploading*



I was also interested in any change in favourability towards mind uploading when considered in the context of the character's stories. Close to half of both groups said they were more favourable to mind uploading, having experienced Nathan and Simon's stories; although, a significant minority felt no differently. A reduction in favourability was more prevalent among new respondents compared to panellists. This may have been due to their more limited exposure to the concept, which may have affected their attitudes in some way.

**Figure 4.38**

*Favourability towards Mind Uploading*



#### **4.5.16 Comparative Awareness and Favourability**

The pilot and the website both measured respondents' awareness of and favourability towards mind uploading. The question wording and response options were the same for the pilot and the website, but the pilot questionnaire described mind uploading as “converting a mind into digital data to allow it to be uploaded into an artificial carrier such as a supercomputer. This would allow you to live in a world of unbounded virtual experiences and effectively achieve cybernetic immortality.” The limitations of this wording have already been acknowledged. While the samples are independent and differ in size ( $n = 82$  pilot and ( $n = 53$  new participants) so care must be taken, the overview is interesting (see Table 4.11).

As shown in Table 4.11, the pilot sample and the new website participants had similar awareness of mind uploading, while the panel was more aware, which is as expected given their ongoing engagement with the topic. The panel was also

the most favourable towards the concept followed by new website participants, while the pilot sample was much less so. This may reflect differences in the sample.

NB: Net value is the combined percentage of those scoring 4 and 5 (Top 2 Box) minus the combined percentage of those scoring 1 or 2 (Bottom 2 Box).

**Table 4.11**

*Comparative Awareness of & Favourability Towards Mind Uploading*

Data Set	N =	Measure	Top 2 Box (%)	Bottom 2 Box (%)	Net (%)
Pilot	82	Awareness	28	54	-26
Website	10 (panel)	Awareness	60	10	50
Website	43 (new)	Awareness	23	49	-26
Pilot	82	Favourability	23	55	-32
Website	10 (panel)	Favourability	50	20	30
Website	43 (new)	Favourability	37	14	23

Note. Mind uploading defined (prompted) in Pilot.

Because of the obvious differences in favourability from the pilot in 2020 and the website data in 2023, I conducted a two-tailed independent samples t-test using summarised data of means, standard deviation (SD), and standard error mean (SEM) for the pilot sample ( $n = 82$ ) and the new website respondents ( $n = 43$ ). I excluded the panellists as the same size was too small ( $n = 10$ ).

The t-test compared favourability towards mind uploading in the pilot study and the website survey. There was a significant difference in favourability between the pilot group and the new respondents in the website survey. Table 4.12 shows the relevant data for the calculation.

**Table 4.12***Comparative Favourability Towards Mind Uploading (Means)*

Data Set	N =	Measure	Mean	SD	SEM
Pilot	82	Favourability*	2.48	1.32	0.146
Website	43 (new)	Favourability	3.21	0.83	0.127
p =	0.0013				

**4.5.17 Pre-Experience Exposure to Media**

Toward the end of the questionnaire, I asked if respondents had ever seen the drama Upload or played the game Soma. None of the 10 panellists had played Soma and only two (5%) of the naïve sample had. Exposure to Upload was slightly higher although only three (8%) of the new respondents and one (10%) of the panel had watched the show.

**4.5.18 Limitations**

The participants were predominantly recruited via Prolific. Prolific's database has considerable geographic reach, is well-populated, and offers many demographic filters. However, those who participated reflect the self-selection bias inherent in all research and may also demonstrate rapid response bias.

I carefully worded the mind uploading questions, and the questions in the second section on narrative engagement have been validated. However, there may have been issues in comprehension for those respondents for whom English is a second language. Having said this, the quantity and quality of verbatim comments indicate that this was not a substantive limitation.

Only 10 panellists experienced the website, which means that direct comparisons between them and the new sample must be treated with caution.

While the sample size ( $n = 43$ ) for the new panellists is powered correctly, there are some limitations in its composition, mainly in terms of age and ethnicity. The average age was 30 years. Hence, older individuals were underrepresented. In addition, most (61%) were white and although black participants were a significant minority, there was little participation from other ethnicities. There were also seven cases where employment status was missing. However, further funding is in place to enable a larger, more equal, diverse, and inclusive sample of 100.

The extended sample of 43 new respondents, who had not been primed by visiting the past and imagining the future, also demonstrated an ability to engage with and imagine the future world of mind uploading. A controlled study investigating the difference in contribution from participants with and without that additional engagement could be considered.

I was unable to obtain commentary from the designers of Soma on their rationale for including the questions on Simon's subjective experience. I was hoping to better understand why they had asked these questions and how they had decided on the response options. In the absence of this, my analysis of the three questions lacks context and deeper understanding.

The video clips depicting mind uploading covered several of the key themes, but they were not exhaustive or inclusive. There were noticeable differences in both the type of media: drama (Upload) vs. a game (Soma) and the perspective (observer (Upload) vs first person role play (Soma). However, the two media I chose were the “best fit” for the main topics of mind uploading. Although participants identified with both main characters, they were young, white males, so



lacking in diversity. This could be addressed in future work by allowing participants to contribute to and/or individualise the characters.

Overall, the design and flow of the website were favourably received although the embedded video clips were small rather than full screen. This did not limit response but has been addressed ahead of the next data collection phase.

I was cognizant of the participant burden associated with a lengthy questionnaire (be that online, face to face or telephone) and pre-tests had indicated the duration was approximately 60 minutes. However, this did not seem to be an issue since only a few partially completed the survey and several specifically requested a longer, more detailed narrative. On reflection, I would revisit the narrative experience section and specifically the questions on the capacity for imagination and discrete emotions.

Drawing on prior research and published literature as well as popular culture, I identified a selection of positive and negative attributes for mind uploading. I acknowledge that this list may not be exhaustive, but an analysis of other comments at the end of the website did not indicate any substantive missing areas. However, I will revisit and refine the attribute lists ahead of the next stage of data collection.

#### **4.6 Discussion**

The website data triangulated via different participants with the pilot and the two qualitative studies (study 1 and study 2) The continuity and convergence of these themes across multiple sources indicates credibility via triangulation of both data and method (Johnson et al., 2020).

Overall, the story and the execution of the website were effective. However, several participants thought greater interactivity would be an improvement. The website had a linear flow and showed a conventional narrative where I controlled how the story unfolded, which was primarily due to the budget I was working with. Ideally, a website with Interactive Storytelling (IS) would be the next iteration. This would have branching narratives such as those in RPGs where the player has control (or the illusion of control) over the path the story takes. Klimmt et al. (2012, p.189) defines this as a scenario where “the linearity of the narrative experience shifts toward a structure where fixed story elements predefined by the author can be arranged/rearranged and shaped continuously by the user.” This interactivity would be interesting to explore, although it potentially blurs the boundaries between a website and a game. As such it might detract from the novel method afforded by a storytelling website since games are well-researched.

The storytelling website enabled me to visualize and explore other elements of the upload experience such as embodiment and subjective experience. While respondents accepted the use of science and technology to develop themselves, they had limits. For example, most would want to be embodied rather than existing as an avatar, although the physical form would be influential. This desire for embodiment not only indicates the participant's desire for sensory and physical interaction but also reflects the prevalent view of experts that a brain and mind exist by experiencing the world around it.

Those working towards emulated or uploaded humans tend to consider robotic or virtual personas/avatars as options (Linssen & Lemmens, 2016;

McKeown & Lawrence, 2021). However, my research suggests that people would prefer a physical form rather than a virtual one, and given that embodiment in a robot is unappealing, hybrid and organic options should be considered.

There were some interesting results about willingness to survive as an “original” upload or a “copy.” The stimulus material and questions about subjective experience indicated that an original is “still you” and I have classified this as personal identity. This has been variously defined but I am referring to personal identity as “those properties I take to define me as a person or make me the person I am” (Olsen, 2023, section 8). What constitutes personal identity is challenging, but I am using a philosophical analysis by Chalmers (2010), which cites three main theories of personal identity: biological, psychological, and closest continuer. According to Cerullo (2015), who reviews these theories in the context of mind uploading, these can be summarised as follows:

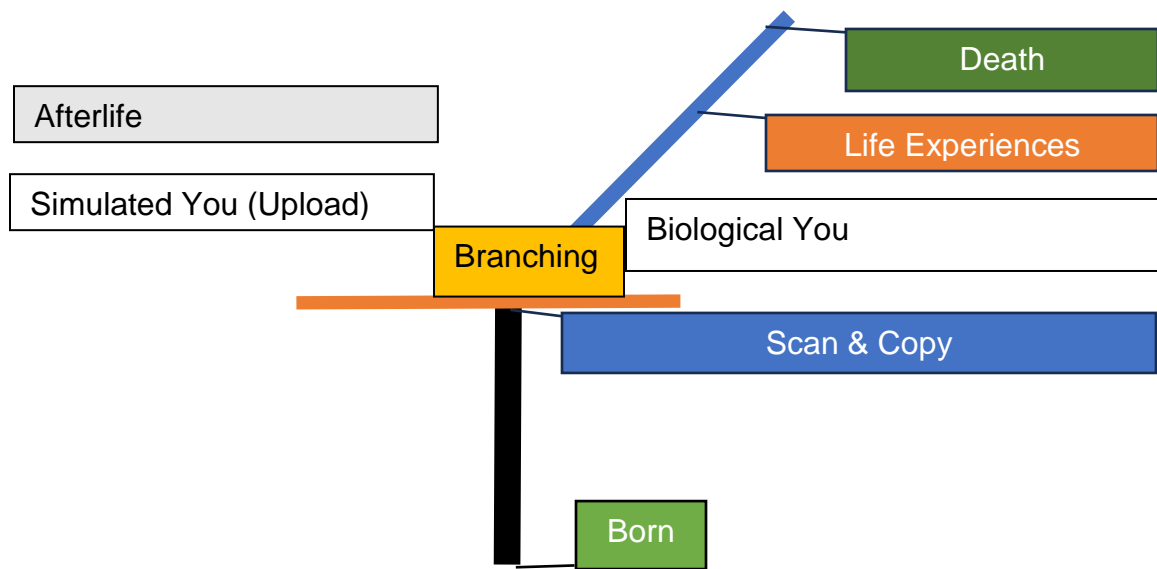
- Biological theory - the continuity of the physical brain is essential for identity and the continuity of consciousness.
- Psychological theory - psychological continuity is required to reserve identity.
- Closest continuer theory - consciousness will continue in whatever entity is most identical to the original.

Cerullo (2015) and others such as Brueckner (2005), Walker (2011), and Graziano (2019) expand upon the psychological theory and consider psychological branching identity as a means of allowing identity to continue in multiple selves. In mind uploading this would take the form of the “original” biological entity and immediately after “scan and copy” (the most likely route to whole brain emulation),

the simulated or copy. In his 2019 article, Graziano described this which I have represented:

**Figure 4.39**

*Branching Identity*



At the point of branching, then the original and the copy would be the same (both “you”). However, thereafter, different experiences would cause the copy or copies to diverge from the original you. My research was not designed to explore these thorny philosophical issues in depth, but it is interesting that over a third of participants would accept surviving as a copy.

Participants also tended to feel that they would still be able to find meaning in continued existence as an upload. This might be by seeing it as a new chapter in their life or as a new beginning. This may reflect our drive to find meaning in our existence and more specifically the meaning of our life (or afterlife) at a given moment Frankl (1985).

The uncertainty around an uploaded life made it both exciting and frightening and when given a choice between life extension and immortality, life extension was preferred. This option offered more control and certainty and allowed respondents to delay death but without the fear that life everlasting would be intolerable. The idea of life extension is not as farfetched as it might sound, with some experts believing “we may be at the threshold of a new ageing paradigm, one that replaces the generally accepted limits of human life” (Masci, 2013), and while these advances may not be imminent, the implications should be considered and planned for.

However to reiterate Laakasuo et al. (2018) - who cited Geraci, 2010 and Hughes, 2007 - “mind upload technology has obvious theological implications” and, for some, mind uploading in any context was morally and ethically repugnant. One potential reason for this is that mind uploading challenges the norms of life and death (Maciel & Pereira, 2013) and can be antagonistic to those with strongly held spiritual and religious beliefs. Future research could explore this in more detail and also how the concept of a digital afterlife may change how we perceive, define, and relate to religion (Steinhart, 2014).

Participants mainly perceived the benefits of mind uploading as it related to their survival; although, some considered the wider context and felt it might be more important to save humans as a species. However, this was a single question explored about Simon’s scenario. Hence, responses may reflect short term decision making in a specific context.

There is an opportunity to expand upon this and the other benefits that mind uploading may offer humanity, such as knowledge retention and a more “ethical” society. This would also contribute to existing data which showed that many Americans feared the impact of people living much longer due to the impact on society and resources. Participants also shared the view of some of the global sample in my research, in that such advances would only be available to the wealthy (Pew Research Center, 2013).

#### **4.7 Conclusions**

I invested considerable time reading and evaluating published literature and consulting with experts to find a way to bring a far-future concept such as mind uploading to life. Although the storytelling website was constrained by budget and time, it was well received by those who experienced it.

It enabled me to visualise and explore practical considerations such as a potential scan and upload process as well as more philosophical questions on what it means to be human. The website’s success as a method of facilitating narrative engagement is discussed in detail in Chapter 6, Science and Stories.

The other important benefit was that the website, together with a small grant from my funder, enabled additional data collection increasing the robustness of the data. Public research exploring mind uploading and neurotechnology is limited; hence, my work makes a substantial contribution.

## Chapter 5 Memories and Life Stories

### 5.1 Introduction

The expert definitions and categorisations of memory presented in Chapter 2 allowed me to frame the interviews with the public appropriately while Chapter 3 introduced memory as a use case. In this chapter, I discuss how individual memories enabled panellists to consider their past and their future ahead of the final study which explored a future of mind uploading. Corballis (2019, article 217, p.2) states that “we can travel mentally into a personal future as well as a personal past” and this mental time travel was an important premise in the study design.

Memory comprises one of many systems and functions of the brain, but it is a vast field, so I have focused on autobiographical memories and their contribution to experience and potential futures. According to Robinson (1976), autobiographical memory can be defined as a personal history of your past.

### 5.2 Data Set

The data set reported on in this chapter is from study 2 which comprised online longitudinal qualitative interviews (2 stages;  $n=12$ ). Participant demographics are recapped below. I have used absolutes due to the small qualitative sample.

- Seven males and five females.
- 10 out of 12 were white.
- Range of ages equally spread across age groups from 18–24 to 75–84 years (mean age = 47 years).

- Highest completed education: high school to a master's degree; although, the trend was an undergraduate degree or equivalent.
- Participants were employed full-time, part-time, or retired. One was unemployed and another a student.
- Five of the 12 lived in the UK. The remaining seven lived overseas, including Belgium, France, Greece, Portugal, and South Africa.
- Six gave their religion as Christian. Apart from one stating Judaism, the rest claimed no religion.

In verbatim quotes, panellists are identified by ID (e.g., xx).

### **5.3 Chapter Structure**

The chapter begins with a summary of public perceptions and how the themes identified compared with those cited by the experts in the e-Delphi study. Thereafter the chapter discusses specific aspects of memory and how participants recorded and revisited memories including the role technology played. The final sections explore memories as “use cases.”

### **5.4 Expert vs. Public Opinion**

Before I discuss public perceptions of memory and memories, it is relevant (Schulz et al., 2020) to consider both expert opinion and public understanding. According to a review of expert vs. lay public opinion across several fields including nanotechnology and biotechnology (Ho et al., 2011), the two audiences often differ. This was confirmed in my research, as there was limited overlap between the public and experts. The experts drew on scientific knowledge as demonstrated



by their frequent citing of published research while the public drew on their own experiences and beliefs.

The experts in Chapter 2 defined memory and mind and then discussed six central themes, and I have mirrored this structure when recording public perceptions. For ease of reference, the six themes are recapped below although two of them (Persistence and Neuroethics) did not feature in this part of the public research.

- Time (Memory and Technology)
- Persistence of Memory (Mental and Physical Change)
- Self/Individual vs Group/Collective Memories
- Accuracy of Memory
- Forgetting
- Neuroethics

#### ***5.4.1 Time and Memory***

Both audiences typically contextualised memories in the past. Experts and panellists acknowledged—albeit to varying degrees—that memories are a construction (or more precisely a reconstruction) of events and as such can vary. However, panellists' other comments were markedly different from the expert view. Experts focused on the classification of memories and the procedures involved, such as encoding, storage, and retrieval. In contrast, the public took a more people-centric view although this may have been influenced by the methodological emphasis on their own memories. For example, in study 2 both stages explored

their recollections of their memories and the memories they imagined they might make in the future.

Specifically, panellists talked about memories of past events experienced by themselves and other people. The most frequent association was an image or images which were also described as a “picture,” “film shot,” or “assemblage.” Although this was an open-ended question, the association with pictures may have been prompted by the pre-interview task of creating a memory board. There were no limitations or specifications; panellists could include whatever they wanted and use any media they wished although most used photos/pictures.

One of the key themes that emerged from the expert e-Delphi study (Chapter 2) was the temporal aspect of memory and that autobiographical memory comprises an individual’s personal history. The theme of time was also integral to the public’s understanding of memory since they thought of it as “things” or “experiences” they recalled and could relive and replay.

In Chapter 2, experts noted that we use past experiences to inform and predict future thoughts and behaviours, and one panellist took this one step further by saying he used memories to decide “how to prioritize my life, what are the meanings in my life. To have my daily activities produce memories in the making ... The thought that crosses my mind—what memories I want out of this one.” (9)

These results have interesting implications for memories being uploaded as part of mind and mind uploading. While a successful upload would include past experiences, a dynamic, evolving upload would continue to make new memories while a static “snapshot” would not. The desire to continue to “live” as an upload is

something that was depicted on the website through the stories of Nathan and Simon and was raised by participants in previous research.

#### **5.4.2 Self/Individual vs. Group/Collective Memories**

The experts discussed memories as a self-narrative and an “essential part of personal identity” but also in the context of a shared or collective experience. However, the public focused on the contribution memories made to their identity and reflected on how earlier events had shaped them. Examples of this included domestic violence and its impact on relationships and mental health as well as the effect of travel and experiencing different countries and cultures. These are shown in the following verbatims.

My memories make me who I am my body doesn't. (8)

They matter because they helped me keep notes of certain things that happened in my life, and sometimes they also help to shape or I'd like shape or give you an identity because for example, if you remember certain things that happened in your childhood, it can help you explain why you are the way you are today. (3)

The retention of personal identity is an important theme throughout. However, how an upload's continuation of public identity would be evaluated is complex and would likely include an individual's subjective assessment and other people's endorsement that the uploaded individual is perceived to be the same person.

#### **5.4.3 Accuracy of Memories**

Experts predominantly believed that memory is frequently both fallible and inaccurate due to the processes associated with memory retrieval. This view was shared by the public although they tended to attribute inaccuracy to personal and psychological factors. These included their own feelings and emotional

associations which might cause them to block out or edit traumatic incidents. However, some panellists acknowledged that they might also question their memories if other people had a different recollection of the shared events.

They (memories) may not always be accurate. They may not always be accurate because sometimes you can remember something happening in a certain way and I think it goes back to the part where our memories can block out the negative parts. (3)

They might not be actually what happened, or they might be something that was developed after it happened from recordings of what happened. For example, when other people are talking about it, uh, or are showing you pictures or video or whatever, you can start thinking that you remember it and yes, form memories, that might be ... not false, but an image of the recollections ... Maybe sometimes our memories get changed because of those narratives from other people. (7)

Mind uploading or being able to read and write memories to external storage or a new platform (as discussed with experts in Chapter 2) presents the opportunity to overcome the fallibility of memory. However, the implications are profound. These include the impact on our cognitive system such as data or cognitive overload which has been associated with several mental health issues (Matthes et al., 2020), which lead to problems such as anxiety, depression, and social fatigue (Guo et al., 2020; Primack et al., 2017).

#### **5.4.4 Forgetting**

When talking about forgetting, panellists tended to distinguish between short-term, day-to-day details, such as where they had put their phone, bag, or wallet and significant events or long-term memories. They acknowledged that lapses of memory were part of the ageing process with an individual describing her grandmother who “used to wear spectacles and put them on her forehead and couldn't remember where they were.”

Overall, there was consensus that forgetting serves a purpose, either as a way of moving past a traumatic event or to free up space so we can focus on current events rather than being bogged down in past data. Forgetting was described by a couple of panellists as having an adaptive purpose in allowing us to survive. In this sense, participants reflected the expert view (Chapter 2) that forgetting is an important function of the brain.

I think it's an adaptive purpose. Sometimes forgetting is the only way you can go through things. I'm going to give you an example. For example, when I started dating again um, after all these years with the same person and all, at the very beginning of dating. I wasn't very able to remember certain things that I used to do with my husband Mike, it looks as if I was substituting some of the joyful memories with him, yes with these new ones, with any partner, do you see what I mean? Super weird, but it's like I needed to forget that I had this amazing moment with my husband to be able to enjoy with this new partner. (10)

(If we didn't forget) we'd probably be insane. We would be full of contradictions. We wouldn't be able to progress in our lives. We would be stuck in the past. Stuck in situations - positive or negative, nostalgic or in limbo? And I think that if we perceive memory as a well-preserved memory as a stock of attention we would be without the focus. Distracted constantly and full of contradiction. (9)

Forgetting the upsetting things has a purpose because your mind doesn't want you to dwell on that because it's gonna damage you in some way. (14)

Theoretically, if there were no limits on uploaded data storage or cognitive capacity, we could store all past events and experiences. However, some kind of selective filter or “blocker” might be required so we could choose to ignore past trauma. An alternative is the capacity that one participant mentioned namely, to reflect and “recode” negative memories to more positive ones. The following sections discuss additional facets of memory that were included in the research with the public.

## 5.5 Retention, Recall, and Retrieving Memories

During the interview, panellists and I discussed what caused some memories to be retained better than others and what affected recall and retrieval. Some individuals felt that frequently recalling or reliving an event was part of what ensured it became a lasting memory; although, others remarked that what you remembered wasn't always predictable or easy to explain. Memories were said to have a strong emotional component and the panellist's recognition of the emotional component is in line with expert consensus that "emotional events are often more frequently and more vividly remembered than their neutral counterparts" (Kensinger & Ford, 2020, p251).

Panellists differed on whether they felt they recalled more positive or negative events while the literature strongly supports the view that negative events are better recalled and can be more vividly remembered. A review by Baumeister et al. (2001) entitled "Bad Is Stronger than Good," neatly encapsulates this. This difference may be down to the small qualitative sample in my research. Nevertheless, most panellists actively tried to remember the good moments rather than dwell on the bad, and several specifically stated that they blocked out or repressed trauma—such as domestic violence—either consciously or unconsciously.

I think I recall more of the good stuff. More of the good stuff and the bad stuff. ... I do remember some things more than others. Sometimes I feel like my long-term memory is better than my short-term memory. Yeah, like sometimes I don't know where I put my bag or my wallet or my phone, but I remember what happened 30 years ago. Like so yes I do remember I remember significant things more than just smaller things. (11)

I think with me I remember the good and the bad. Sometimes I tried to block out the bad, especially if I found it to be very traumatic. For example,

the stuff with the domestic violence issues, days where I really tried to block that out, but I know that with people, especially when they speak of like childhood traumas and all of that, they say that when people grow up they tend to block out all of that. I don't know if it's the mind's way of reacting or like protecting you from the trauma. (3)

Our senses are known to play a key role in evoking autobiographical memories with the sight and smell of lilies and the sight, smell, and taste of marmalade being cited by panellists. The triggering of vivid and emotionally charged autobiographical memories by sensory input is often referred to as the “Proust Phenomenon” after Marcel Proust, who described how eating a madeleine cake transported him back to childhood (Smith, 2016). Smell and taste are known to be among the most potent triggers (Green et al., 2023) with several cognitive processes influencing our perceptions and responses to smell and flavour particularly learning and memory (White et al., 2020).

The hippocampus, which is key to autobiographical memory, is activated by sensory input (Simon et al., 2006), and the amygdala and insular cortex—which are linked to learning and (emotional) memory—are involved in sensory memory formation and retrieval (Miranda, 2012; Royet et al., 2000).

The role of sensory information and the implications of this being lacking in an uploaded human is an important consideration and relates to the concepts of brain-centeredness vs embodiment discussed in Chapter 1. One theoretical option is a simulated environment (Sandberg, 2008) that recreates these sensations while another is a real environment that an embodied upload could sense.

## 5.6 Recording, Revisiting Memories, and the role of Technology

There were several ways the panellists recorded memories such as writing, drawing, or doodling in diaries or journals, taking photos, and in one case creating and sharing his personal story with an online community during the pandemic.

When panellists talked about revisiting memories, they mainly referenced photos—typically physical photos rather than digital ones. This seemed to be related to the fact that panellists were more likely to look further back in time when digital photography was less prevalent. The frequency with which they looked back at photos varied from monthly to a few times a year to only rarely. Individuals used this as a way of keeping “people’s spirits alive” or just to remember the moment.

I do sit back and look through stuff, especially my physical photos because they are the ones that are from a long time ago. The photos that we have on our phones. Yes, they could be two or three years old, but for example, I'll be missing my grandmother, so I'll just go through one of my batches of old photos that I have and I'll just look at her and my Grandfather when they were young or even when she was like alive but younger and just reminisce about those days even old houses, we have a photo and I just remember like the fun memories ahead of like going to visit her how I'd look forward to going there so I do it. It's not something. I do like every day but probably a month doesn't go by without me looking at some sort of like a physical photo that's like from back in the day. Just to revisit my memories and to keep people's spirits alive or just memories alive. (3)

The concept of being able to choose to save, restore, edit, or even delete memories interested panellists and they could imagine several ways that this functionality might be useful. The main reason was to preserve valuable memories, but they could also see the benefit in being able to revisit memories, either to consider events from a different perspective or to speak or act in a different way to the original. These memory processes would theoretically amend or augment the mind itself allowing an uploaded mind greater flexibility and functionality.



While the experts tended to reference smartphones as ways to search and offload information, panellists focused on the way smartphones and devices have revolutionised the way we capture and share memories. This was partly because smartphones/devices are ubiquitous but also due to the capability to take a photo and share it immediately via messaging or social media platforms. One individual observed that technology allows you to interact with media, revisit it, edit it, and move from witnessing and capturing an event to authoring it into a story you can share.

While this was a functionality that many used, panellists were also well aware of the potential risks of others being able to access their content on social media and share it. Such privacy and security breaches became even more pertinent when considering mind uploading.

A few also commented that people recorded everything, which was not only “intrusive” but also “disturbs or distracts from actual living.” Two panellists gave examples both involving car accidents. In one, passing drivers were taking photos of a recent crash and in the other, a panellist’s friend had had an accident that was recorded and posted to social media. Their friend's son had seen the post and been worried until he spoke to his mother and found out no one had been hurt.

It depends. Many people maybe would like to erase some memories. Maybe they will repeat the same memory if it is very good and get addicted to it like I forget everything else and then repeat this memory. So they can feel the same good things, Or if they lose someone, of course, they will keep those memories forever to remember him. But yeah, I think many people would if they had the chance erase some of their bad memories mostly. (6)

I think it would be nice if you could hold onto them (memories) in an organized way, if you know what I mean, like if you could

compartmentalize them and be like OK. When I was 17 and then go back and you access those you know, and I think that would be nice (11)

Now what I do is I either keep some notes on my phone or I take videos, especially if it's like events or when I'm out with things like that, then I make sure we capture them on like phones. We take videos, we take pictures and now because we should be smarter we make sure they are uploaded on some cloud, so they don't disappear and we're able to hold on to them forever. (3)

Being able to restore, retrieve and recreate memories through an augmented mind was seen as a way to overcome the frailties of memory and ensure that memories were not lost due to ageing and cognitive decline or impairment.

Having discussed various facets of memory, I will share and discuss a couple of examples of the memory boards that panellists created—both their past experiences and their possible futures.

## **5.7 Past Memories**

### **5.7.1 Interview Method**

My chosen interview style was to let each panellist freely narrate the story as depicted by their memory board with questions being carefully framed and introduced. This technique—photo elicitation—is often used for memory research (Harper, 2002). I wrote a discussion guide for both stages (see Appendix C and Appendix D) but this was used as an aide-memoire not prescriptively. The richness of the interview data included here is a response to my actively listening and responding at the moment as the participants told their narratives.

Each story was personalised, highly individual, and placed in different cultural contexts. As well as many positive moments, there were negative memories and several trusted me sufficiently to share traumatic incidents of

domestic violence and sexual abuse. Due to the length and detail of the recollections, I have only included two memory boards and the accompanying narrative in the body of the thesis. Other examples are available in Appendix I. I selected the two shown here as they best illustrated the richness and complexity of participant's life stories.

### 5.7.1.1 Example 1 – Panellist 'R' (3)



So, when I was thinking about it because I had asked if there's a certain theme that I should follow and you said no and the memories that I've put here are both good and bad, but they've impacted my life in a certain way. So, I thought like I need to just mention them.

So I'm gonna start right here in the corner. That's a picture of the nursery school. I think in the UK, you call it a nursery school; we call it a creche, I'm from South Africa by the way. This is the nursery school that I went to

and why I felt like I should put it there as a memorable moment. It's because it's one of the first instances where I started socialising with people, the way I was exposed to other children, exposed to other people with different personalities and this is one of my first memories of like socialising and looking forward to being with other people and discovering what type of a person I am. Am I a shy child? Am I an extroverted child? Am I an introvert? So that's why it's there because it's one of my fondest memories. Going to nursery school, getting to socialize, and finding out things about myself from like an early age.

And then the second one. I'm not sure if it's clear, there is a picture of a woman who is hiding and there's a man with a fist there. This one represents the first time I experienced domestic violence at home. So this one it's not so much of a good memory. However, it was one of the first ways that made me view like relationships with males in a certain way. And it is also influenced the way I am today when it comes to entering a relationship with a male. Anything like that because in the back of my mind I still have that trauma of experiencing the domestic violence at home.

And then the third one is a picture of a mother and a child. We have a franchise here called Spur... Every kid we'd always have birthdays at Spur and that was like one of my favourite times. ... That's why I used to love looking forward to birthdays because I knew that we would get to go and get balloons, eat, and go on the swings and all of that. So that's also another thing that I have as a memorable moment. A nice picture because then you also got a cake, and they would sing for you. And if it was your birthday, you got like ice cream for free as a dessert. So that was always something to look forward to as a child, definitely.

And then the one underneath that. That's the divorce one because once again, like I said, I don't know if I should follow good memories or bad or whatever so there's a mix. That is of the divorce with my parents—they finally got divorced in I think 2014 if I'm not mistaken after years of separation, yeah, that also it was a bad memory for me, but at the same time it made sense because now they get along more than they did before. When they were together they were not the best of friends but now they get along really, really well ... That's the thing with my parents, so it wasn't really a great memory for me. But now that I see that they can actually get along better now that they are divorced and whatever. I guess in some ways it become a good memory.

And then the next one over. Here is a picture of the beach because I remember we used to go on family vacation a lot and most of the time we always went to a coastal city. So I think that's why I just love being at the beach. It's very peaceful whenever I'm there. I just go around to clear my mind. I love being there. That is good for my sinuses is so that's another memory that I have.

And then this one is one of the South African passports. I've got some family in Botswana, so I'd always travelled as a young kid with my grandmother, and I think also it's one of the reasons that has influenced why I'm able to get along with people from different places because my family is also from like different places, so that's a memory that today has influenced me in the sense that I'm able to appreciate people no matter where they are from. You know, I see them as equals I see them as human beings because of the fact that as a kid I got to travel and experience something that was different from South Africa.

OK, and then the one over here. These are like dresses. We had something at the end of high school. It was called a matric dance. OK in the US they call it prom it's very similar to prom. So this for a girl like this is the next best thing to your wedding because you look forward to this from like when you are entering high school you already thinking of I can't wait till I'm done. My matric dance and all of that. So that was one of my best nights. It was one of the fun-est nights. I was able to close another chapter of my life, which was high school. So that's why I put it here. Also, as a very memorable moment in my life. Because you can only ever have a matric dance once.

And then the second last one. It's a coffin. Which, uh, symbolizes the passing of my grandmother, the same grandmother that I used to travel with to go to Botswana. And yeah, she passed away from cancer. Everything was so sudden. Losing someone that's prominent in your life. I feel like somehow loss will change your life in some way or another, so even me, it's just affected my, life and my way of thinking in one way or another. So that's the second last one.

And then the final one, shows people graduating, graduate students, that also symbolizes my graduation. That was one of my proudest moments because I was able to work hard, and I was able to do everything on time and I was like you know what? Now I'm jumping into the next phase of my life.

### 5.7.1.2 Example 2 – Panellist ‘S’ (10)



Starting ... from the silence is violence. So when I was young, when I was a child I suffered from domestic violence, my dad was quite a violent man towards my mum and I learnt not to react to it, my mum's instructions were to ... to hide somewhere like ... and so... Yeah, I never reacted much when I was a kid. But then I would speak to my mum ... It was a very difficult period of my life because I experienced violence at home, but also violence at school. I was feeling a lot because of my weight so ... if I if I have to go back and see or recall memories from my childhood, I actually don't have many memories of good times in my childhood. Most of my memories are very sad or very frightening because of violence, both at home and at school, and also because I couldn't speak about it, or I couldn't defend myself much it was even worse, so that's why I took that that picture there.

And then if you see the pictures that are below there is a woman covering the face and woman next to a tree she is sitting somewhere and in those circumstance I think of the consequences of violence because I struggled with some mental health challenges throughout the years, sometimes I get very stressed sometimes, um I'm very scared so ... it's difficult in life for me to cope and to accept everything that I've lived in one part. In another part, I think that I've learned a lot ... from those experiences. Also, I pretended not to say much to keep silent. I also learned to give people a lot, to be very attentive to ... what other people might need or want and to act accordingly ... And so I'm fighting back in that sense...But I am

learning to control from my own feelings and more connected to what other people need and want and that's one part of my life.

Then you can see some pictures of a lot of a ton of papers, so a lot of papers like a bundle of papers and this girl, her computer staring at the computer or staring at her laptop like concentrating (5). These pictures represent my work and I have been a university professor and a researcher. Right now I'm trying to finish a PhD in Psychology. So this represents the workload. But also another coping mechanism for me throughout the years. I was a straight A student but never caused any issues at home, but I was very focused on achieving goals from doing things right, so I'm quite connected to my work. I really like what I do. I enjoy it very much and I also struggle sometimes because I gotta do well. But I do a lot and sometimes I don't know how to stop. How to stop and rest and think about myself or what I need. Yeah stress and a lot of work is part of my life. So that's why I wanted to represent that. Because it's something that has been with me since I can remember like study and achieving and reading and research forever. So that's another important aspect.

The road that is, on the bottom of the board. Like the open road with its very interesting background lighting and perspective you know, but at the same time, there's nothing there, just you know, just fields and in the clouds. Actually, I normally see my life like I'm in the middle of the road. I'm going somewhere, but I'm really not sure where. I think that this has also been a crucial aspect of my life. I feel that I have a mission, but there is something that I feel that I want to accomplish, but I'm still not sure what it is, and I'm just trying to continue and walk the road and see what will come afterwards.

So yeah, then have pictures of America and couple's therapy. That's also very another important memory of my life. I'm recently divorced. This happened in 2020. We got divorced in 2020. No, actually we were separated in 2020 and divorced this year ... and I met my husband at university when I was 19, I'm 35 now so that at university I was super young and I was very, very happy that I met someone that I could share my life and my studies with and at that point he was kind of my saviour like he was the first person that showed me love and care in a good way, yes, you know, without being violent, controlling, or difficult. He was a very a very a very good man. So we were together for eight years, so when I was 26-27 he proposed so we were married when I was young. Yeah, but he was my first everything, my first boyfriend. The first guy I had sex with, and it was quite a discovery in my life with him so. We had some interesting times as a couple But then I decided to come to Belgium to ... and he wasn't very much into it. He liked our life as it was. So he promised he would come and meet me after some months and then it didn't happen, and we started fighting we started having a lot of differences in what we

wanted for our life. So in the end we decided to end the relationship and we also struggled through because of COVID-19. We couldn't see each other; we were in different countries. There were so many restrictions and that at the end we decided to part ways. So we tried a bit of couples therapy, it didn't work at all it was horrible ... So yeah, it was horrible, and then we parted ways and I'm still struggling today to put myself out there again, but it's been quite a journey that of marriage and separation.



Then this picture for women and sport ... Yes, and I think that over the years we (female friends) have developed a very close relationship with each other, with struggles and some of the same things instead of that making us far away it has brought us closer, so we are quite close, even though we're in different countries. We are very close, and I cherish that a lot. So and yeah, and also I want to change ... sisterhood, sorority being there for each other, yes, you know. ... I don't know how to explain it. Now that I'm older I can look at my life from a different perspective. But now that I am, I failed myself in different ways because when I was younger I was just achieving a lot. Now that I failed in different ways in relationships and in my work and in different ways. I can identify with their struggles. I think that I'm in a position where I can offer them support a lot of support the way they need me to.

I also put in a picture of people having coffee and then a muffin. I really like that a lot like having these conversations over coffee. With friends or with my sisters or with anybody who needs somebody to hear them, anybody that looks like they are struggling. All the things that I enjoy the most in life, you know to sit in a coffee shop with a friend and have long



conversations about everything and nothing at the same time. I think some of those conversations have been lifesavers definitely.

And then the right part of the of the board has made to do with what helped me overall. Like doing a PhD in a different country ... my failed marriage. Struggling with feeling not good enough for the PhD and that so what has helped me first is nature and being around it. Autumn is my favourite season so walks in the wood. Looking at the autumn leaves you know that that has been a lifesaver for me. Like walks in the park... Also exercising, I try to work out four or five times a week. When I have time I do Pilates at home and sometimes I go for a run. So that's super helpful to distribute stress and connect with my body again. To do with being a team with your body and exercising some form of control controlled, movement and breathing so that helps me a lot to identify where I'm too tense or if there is some spot in my body that doesn't feel very well that day. So I try to be very connected with what I need that day in terms of exercise.

Journaling is helping me a lot. So we have some pictures down there like journaling for me, it's mandatory. Every day, I try to write something even if just it's a small paragraph. To just put all my thoughts out so they just so I don't lose any of those things But also when I feel grateful about something else. Yes, I'm actually thinking of starting a blog and just using some of journal entries for life lessons on this kind of thing.

And coffee. I have to have coffee. Coffee is a must, like twice or three times a day, because otherwise I cannot function. Sometimes when I'm working I grab my laptop and I sit in a coffee shop now that we can, have coffee and write some pages and then come home. But that also helps a lot to go through this because if I had to stay at home like 24/7 and would be crazy.

And also, baking has helped me a lot and I actually know how to cook. but I was never into baking would try to say things, but they would never grow like they should. Yeah, yeah it was very bad. But now I try new recipes and I'm super into baking right now, now I make the best brownies ever...I make brownies with framboise, the fruit you can see there, the red one, raspberries. I do make brownies with raspberries, and they are insanely good.

And then finally there is that picture, that is purple ... I don't know how to explain - so I was also into some coaching training, trying to understand more about the spirituality. And this has also been an important part of my discovery, you know... I mean I don't practise this kind of I'm not a healer in that sense. But I like to read a bit about these things and try to understand. You know the circle is like, the colour of, your chakra, and it is profound and it's there because, for me, that's also important. You know whenever you're feeling this way depressed or unloved or down, and even

though you try to explain, explain yourself, you work with your irrational thoughts, and you read so you calm down but nothing like works. And you realise that there is a more profound suffering that has to do with something more spiritual. It's mainly those are, I think the main memories or the main aspects that can describe what my life has been so far.

## **5.8 Categorisation and Contribution of Memories**

### **5.8.1 Summary of Memory Boards**

These two panellists included a wide range of life experiences both good and bad. Both participants had been through divorces and experienced domestic violence. To varying degrees, these incidents affected their relationships, friendships, and mental health. However, the two individuals had vastly different recollections of school, one enjoying the social aspects and the other being bullied by her peers. Higher education featured in both accounts, one was finishing her PhD (she has since been granted a doctorate) and the other was embarking on a Masters. Both were well-travelled and enjoyed experiencing new places.

### **5.8.2 Method**

The free-form recollections gave me insight into individual memories and life experiences and for analysis I chose a narrative-based approach to reflect the fact that this stage of the research focused on people's life stories (Bruner, 1990; McAdams et al., 2006). The storytelling thread runs through the research binding it together and culminating with a website that tells the stories of two new individuals who experience mind uploading as part of their life (and afterlife) stories.

More specifically, I decided to use the coding categories described by Thomsen (2009, p448), who devised this analysis method "to investigate which components of autobiographical memory are utilised in the telling of the life story."

This reflects the view that the life story is based on autobiographical memory and these memories are hierarchically organised (Bluck & Habermas, 2000; Conway, 2005). While some aspects of the interview method (differ as discussed later in this section), the objective of coding or classifying the participant's life story was the same as Thomsen's original work. See Table 5.1 for a list of codes and definitions.

Thomsen (2009) drew upon multiple studies in this field to devise coding categories that reflected commonly agreed upon types of autobiographical memory. These included "lifetime periods" and "mini narratives", "specific memories", "categoric memories", and "facts". Thomsen also looked at extended narrative segments and described them as "chapters" in the life story (Pillemer et al., 1991; Thomsen & Berntsen, 2008). Thomsen subsequently added other categories such as "reflections", "evaluations", "life lessons", "inferences about personality", and "meta-communication." Thomsen's (2009) paper was the first to provide empirical evidence that autobiographical memories are organised in extended blocks of time or chapters.

**Table 5.1***Life Story Coding*

<b>Code</b>	<b>Definition</b>
Chapters	Parts of the life story that take place over a period of over 24 hours and more typically months to years. It is the period that defines a chapter and distinguishes it from a categoric memory. Includes lifetime periods such as a marriage and mini narratives (e.g., a two-week holiday). Chapters are typically about the participant's life story but can be about other people
Chapters about other people	
Specific memories	Describe events lasting 24 hours or less
Categoric memories	Repeated routines or similar activities with no reference to a given day
Facts	Contain general information without reference to time.
Inferences about personality	General statements about personality traits, roles, and interests.
Life lessons	General statements about life or moral rules
Evaluations	Evaluations by the participant of some aspect of the story. These can be either positive or negative.
Reflections	Participants explain reasons for decisions, choices, and general reflections about life but without an emotional tone.
Meta communication	Participants reflecting on the process for example "maybe I mentioned this."

In my research, panellists chose key moments in their lives to date and represented them in different ways, mainly pictorially. As with Thomsen's (2009) study, participants had complete freedom in their choice of memories and were encouraged to tell me their stories in their own words. Unlike Thomsen's research, I did ask questions during the interview, but these were carefully considered so that I did not divert or influence the narrative. There were differences in the sample

since Thomsen's sample comprised 30 elderly women (mean age 79 years), while those in my research comprised seven male participants and five females with a mean age of 47 years.

### **5.8.3 Life Story Analysis**

The analysis of memories is frequently inductive (Keightley, 2010) and I followed this principle. However, my analysis is intended to illustrate differences in memory composition rather than a robust analysis of components since I have relatively little experience with this analysis, and as Thomsen herself observes, the coding scheme is "very complex, containing many conceptually related categories" (Thomsen, 2009, p451).

In all cases, personal, autobiographical memories played a clear role in the development of a life story; however, individuals placed different reliance on chapters for structure. Thomsen found that her evidence supported other studies (Barsalou, 1988; Conway, 2005; Neisser, 1986; Thomsen, 2009; Thomsen & Berntsen, 2008), which suggest that personal chapters "are a central and distinct part of autobiographical memory" and influence the structure and organisation of a life story by summarising extended periods (Thomsen, 2009, p.447). This structure helps the participant tell a coherent life story (Thomsen, 2009). Chapters about others were cited much less: approximately a third.

Overall, panellists replicated Thomsen's findings that evaluating memories formed a prominent part of their recollection. Previously, participants had differing views on whether they recalled positive or negative memories better. However, they stated that they tried to remember the good aspects and their actual

evaluations were more often positive rather than negative. Overall, all categories apart from meta-communication were represented.

## **5.9 Planning for the Future**

Before discussing hopes and plans, I asked participants to what extent they considered the future. The majority did and tried to plan for it, although others were less proactive. A few specifically said that the pandemic had changed how they approach the future by encouraging them to live in the present moment and experience it fully.

Nevertheless, most could visualise an alternate future one where they lived in a different place, had chosen to continue to study or study a different subject, and one person felt they would be a different person if they hadn't experienced a controlling, abusive relationship since that had made them stronger and more independent.

I mean longer term. I've always had plans that I want to have. They are still obviously there, but now I don't really put as much pressure on myself with regards to making sure I get there because I'm like, yes, have the plans like I'm always on working on achieving those long-term goals or whatever, but don't put too much pressure on yourself. I would say I would never really celebrate my new movements because as soon as I've done something I would choose something I would immediately be like. OK, what's next on the list? ... Now I'm like when you achieve something, take time to just rest, relax, enjoy it being the now, and then once you've done all of that, you can move on and say OK, so what's next and what's next and what's next? (3)

I don't have a particular path for the future. But a lot of people, depending on their age, have quite a culturally determined trajectory, you grow up, you find somebody. You have a partnership, you get married. You may or may not have kids. You buy your first house. There are these sorts of steps that are quite often expected, and I never had that vision. I rejected that path. Yes, I found it quite self-limiting, I never had such expectations on my own. These might have been expectations by my family and by others, not by me. I keep all parts open before making up my mind, which



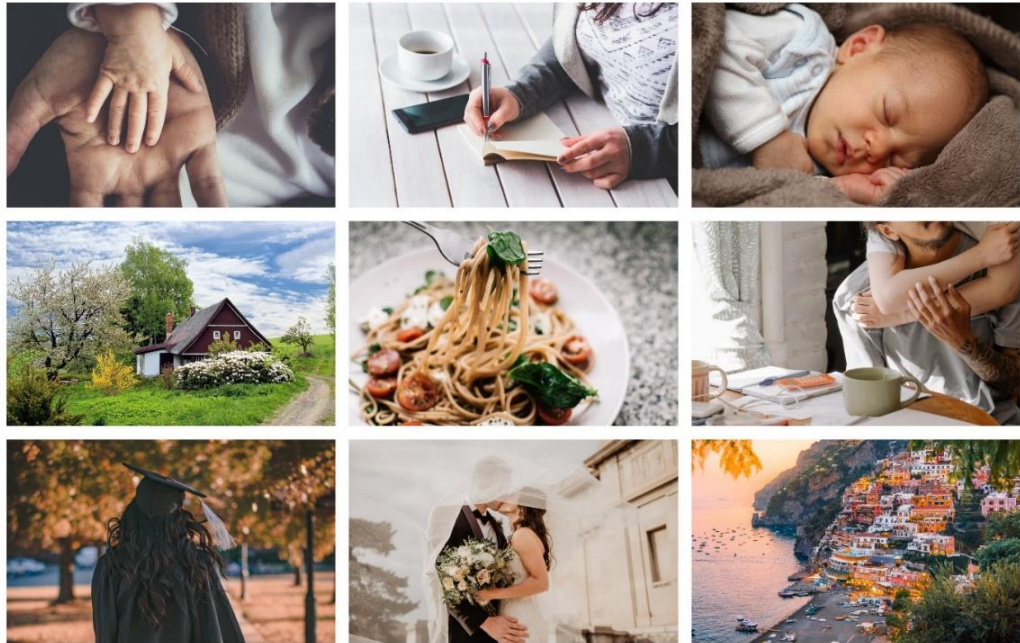
And then also just health also just mental health as well which is why I put a monk. Meditating, hopefully continuing with that. For the far, far distant future and also physical health as well. It's difficult to put physical health first when you're a mom like it's been so difficult. I used to be so healthy and so fit, but now not as much and so just appreciating my body and what it's done and all of that. And then I think again I just wanna have a beach house. I wanna look out and see the beach. Yeah, I don't know how far in the future that will be, but that's another goal for the future as well. And like I said, humanitarian work and working for the UN. Yeah, that's pretty much all the things that I put on there.

(So what does traveling give you do you think?) 2That's a good question. I think I just love that like it just feeds my curiosity. It just gives me that you know. When the first time that I was on an airplane that excitement, it fulfills that I've done it. You know what I mean? Like there's very few goals where you actually feel like you've worked hard for it, and you can just breathe and enjoy it. So it gives you that kind of feeling of exploration of possibility it gives me hope that even though life can be difficult, it can be better. So I think that's what it is. Just that thrill of that's what I get just that possibility, hope. Yeah, and I don't do expensive traveling at all like we always stay in the cheapest places and the cheapest food. And so for me it's not even about like the luxury of it, it's just about the feeling of a different place and a different culture.

Uhm and (travelling) alone I want to try that as well. I have a family and I love my family, but I'm an introvert and they know when they need to leave me alone. That that's one of the goals as well. Just to travel alone and Uhm, get that time too. So I can introspect I think. I've done it once. I went to New York by myself, and it was a good experience like it was really nice. People are nice. They gave me directions and everything but on the way back it took me three days to get back home. So that was when I wished that I had my husband or my children with me. But other than that, that was the only time that I travelled alone, and it was a nice experience. (Travel with your children as opposed to just you and your husband?). I love that they (kids) feel what I feel like. Just that excitement of being a new place. Experiencing new things. But I think it goes. You know, it's two ways as well because I love that they get that experience. But I'm the mom, so I have to pack for everyone I have to make sure I know what everyone's eating so I don't really fully enjoy the experience because I'm always thinking about others eating. Are they full? Are they hungry? Are they happy? Are they protected? We can go to the beach, but I can't really enjoy it because I have to make sure they don't go too deep. So it's such a like it's such a yeah it's a lot. But I do enjoy it because I love how you know we look back and talk about it. Oh, we went here, and we did this and just those experiences that we create together outside of our home life is just nice.



### 5.10.2 Example 2 – Panellist ‘S’ (10)



Well actually since our last conversation I met someone. Yes, I met someone, and I've started a new relationship, so I'm quite thrilled about the whole thing. I was in a very difficult relationship last year and I ended things before the end of the year, and I wasn't really into going back to a (dating) app super soon. But I just started talking to two guys you know. Just out of curiosity, like I had no intention of starting to date again whatsoever, but. Uh, I think that having no expectations actually made things very fluid and easy between me and this, and this guy. His name is Steven and actually, after speaking with him for some days we just decided to go on a on a first date and it was super fun and super awesome. How can I say it like it felt so natural? You know, just talking to him and the attraction and the good vibes and we're kind of similar in in many ways. And we have a like a clear vision for ourselves and what we want. I don't know how to explain it. It was like a magical connection kind of thing ... So I've been actually thinking about the future with this person. And we've spoken a bit about it like I'm 36. He's 40, yeah. And we have no time to waste. We're grownups so even though we are experiencing this crazy love as if we were 16 at the same time, we're not too carried away, like we're trying to keep things realistic too. But for example, I've already spent a weekend at his place, and it was amazing. Like we have the same cleaning standards, which is very important ... I'm not romantic myself and I've been through rough experiences through marriage and divorce issues with my own parents, a violent home and this and that. So it's not easy for me to trust, but with this guy, I'm exploring, you know, the side that I didn't know why I had. You know, he tells me that when we're together and when we're experiencing things that I look like a like a little girl who is just

in awe. Discovering things you know happy, like exploring, discovering and I'm like OK, this is new for me, you know right? So you can imagine that I picture myself you know, having all his baby. So uhm, you'll see that its mainly things related to him, you'll see it's a smaller board, but I think that it pictures well what I'm what I'm going through now, let's see.

So OK, so travelling, definitely, He's been two different parts of Europe and Asia, but he hasn't been to America at all. Actually, I've been to Europe and America a lot, but not so much in Asia. So I think that we have a lot of places that we could go and discover together. And of course, I want to show him around South America as much as I can because I have family and friends there that I would like to meet and to see so that that would be super super amazing. And he seems like the type of guy who who's chilled also while travelling like he's a bit like me like he likes to do some planning, but not that much planning that the whole thing becomes rigid, yes, but not too spontaneous, but then you have no place to sleep at night. That's so that that's already a lot though, and he seems to enjoy like culture and some bit of museums. He's a bit of a foodie so it's not only just you know, just make walks in nature and adventure but also you know stuff in the city, and you know just go to a nice coffee shop for brunch you know or to just walk around the city and explore the city. So that's something I like. So I'm looking forward to start travelling with him as soon as we can.

You'll also see that in my memory boards, I have like a little picture of food, so food plays a massive role in my life. So if I can if I can eat well with this guy, I'm going to be so pleased and so happy.

So you will see a baby there in the board a baby. Yes, my future baby. There is a picture of a marriage too. There is a picture of my kind of dream house. You know, it's a small house, you know in a rural area yeah like not too far from the city, but with a nice garden and uh and some nature around. Yes, something I would really enjoy.

And then there's also another picture where with this girl who's writing something in a notebook. So I told you that journaling is quite massive for me, it's brought me so much healing but I'm thinking of writing in a more serious way. Like maybe writing a book or something like that, uhm? Definitely not related to my thesis or, uh, you know, to my dissertation or anything I'm doing. I think that I've quite an interesting life story and lots of knowledge you know. Maybe putting that in, uh, you know, putting all that, all that knowledge and all that healing in a book. For me it makes sense. And it's something that I would like to just donate to the world, you know, like so that's also in my plans at some point. UM, writing a book.

### 5.11 Using the Past to Predict the Future

The two examples I have shared can be seen as the mechanism of using the past to predict the future.

The first ('R') envisaged a multifaceted future, and some of her key goals were physical and mental health, giving something back via humanitarian work and travel—both with her family and alone—since she felt they both gave her different experiences. Her early travel experiences and her own family may have shaped her connectedness to her family and appreciation of different cultures, people, and places.

In contrast S's life story had changed significantly from when we first spoke since she had ended a difficult relationship and got divorced. However, while she hadn't been actively looking for a new partner, she had met someone and was excited and hopeful that they might build a future together. In this instance the past had influenced what she was looking for in a partner and her plans included them travelling together, as it was something they both enjoyed and hopefully a home and a baby. She was also drawing on her journaling as a route to writing a book to share her life experiences and lessons.<sup>6</sup>

Both these and the other memories and predictions that participants shared with me eloquently demonstrated how we can mentally to mentally time travel (Tulving, 2002) or take ourselves from the present to the past or future (Michaelian, 2016). This skill was crucial, given that future research with participants required

---

<sup>6</sup> Sadly, the relationship has since ended, so the predicted future looks different.

them to project far into the future and imagine a world where mind uploading existed.

Thematic analysis of the remaining interviews indicated that many simply wanted a future where they were happy, healthy, and able to spend time with friends and family while a few were hoping to meet their life partner and settle down and have children.

I think for me my main thing is just to be happy to be healthy to be with my family and to make a difference in the world. I think those are the most like in everything that I do. I just wanna be happy and healthy and make a difference and also just to have my family be happy as well I think. (3)

A couple of the younger participants were finishing their studies and looking to start a career or to gain a postgraduate qualification. Travelling was another popular goal regardless of age.

I mean I have a dream house ... When I have my own money that I will make for my job. I want a small house ... I will have my things. I will cook I will relax all this stuff ... I think I prefer minimalism. So I don't want many things to get chaotic and forget that I have many things ... Maybe I like the colour black but with a twist of colour, yes. So maybe black, littered with colourful seats or colourful paintings, something like that. I want a garden. So I have plans. Maybe I will grow my own food, something like that. And of course, I will want them to have near my house, many opportunities so that. The city that I will choose to have to house my heart, to build my house, it has to have many opportunities like jobs and things to do, maybe theatre. (What else are you hoping for?) For a family, I don't know yet because I'm very young. I'm young, so I haven't thought about it—children. I don't know if I can do it, when you do it, you never go back ... You have forever. Yes, so I will do it when I am very ready and be sure that I can do it. Yes, definitely. Partner? I wouldn't have a problem, but he has the same mentality as me, so he wants to travel. We can do many things together. (6)

## **5.12 Reflection on the Interviews**

As mentioned previously one of my objectives in these interviews was to build trust and rapport with my 12 panellists ahead of the journey into future worlds.

It was therefore important that I reflected on how well I met these objectives and what I had learned from the extended engagement experience. To enable this, I re-read interview transcripts for both stages. I also re-watched key moments in the interview videos to assess disclosure and how individuals engaged with me and the topics. My conclusions were as follows:

- Panellist's interactions with me were open, honest, and trusting as shown by the detailed and varied memories they shared. Although many memories recalled happy times, several participants told of traumatic incidents in their past such as violence and abuse. I was authentic and open, shared memories of my own where appropriate, and showed sympathy and empathy without judgment and participants responded to this.
- Participants committed to the research and felt that their contribution was important and valued. At appropriate points, I shared updates on my research as well as the progress towards whole brain emulation and mind uploading and several panellists commented on how informative and interesting they had found the experience.
- The method (individual interviews) gave panellists the confidence to share personal and sensitive information in a "safe space." The relaxed, personalised nature of the interview allowed them to contribute fully and made it an enjoyable experience rather than interviewing by rote based on a structured questionnaire.

The purpose of these investigations was to answer the constituent RQ focussing on how the public describes and recalls their past and imagines their future and this was achieved.

### 5.13 Discussion

This concluded the second stage of qualitative research with a panel of 12. I gained valuable insights into how nonexperts described and defined memories and how autobiographical events and experiences had shaped them as individuals. As well as revisiting an individual's past, we also looked to their possible futures.

This exercise in “mental time travel” prepared participants for future research journeying far into the future where memory and mind can be augmented and even uploaded. While this ability has been known for almost 40 years (Tulving, 1985), in the last twenty years neurological evidence has confirmed that the mental activity of remembering personal events and imagining future events involves many of the same physical structures (Andonovski, 2022).

The “core” network centres on the medial temporal lobes which include the hippocampus, amygdala, and para-hippocampal regions. Neuroimaging studies confirm that these areas are consistently involved in both remembering and imagining events (Addis, 2018, 2020; Benoit & Schacter, 2015; Campbell et al., 2018; Hodgetts et al., 2016; Jacques et al., 2018; Schacter et al., 2012). People with episodic amnesia selectively retain semantic but not episodic components of autobiographical memory and clinical studies have shown that these individuals find it hard to imagine novel events and scenarios (Hassabis & Maguire, 2007; Rosenbaum et al., 2009; Stanley B. Klein et al., 2002).

This evidence confirms that the (potentially unique) ability of humans to mentally reconstruct past events and imagine future scenarios is physically

represented in the brain. This and other empirical data that demonstrate a physical representation of mental activity or state go some way to supporting the concept of functionalism which underpins whole brain emulation and mind uploading.

#### **5.14 Conclusions**

The extended interaction over these two stages of research, (which included the optional engagement tasks with AI apps and BCIs and culminated with the storytelling website), provided anecdotal and empirical evidence of the willingness of the public to engage with scientific research. It demonstrates that listening to and engaging with the public contributes both to our understanding of their perceptions and allows them to have a voice.

In Chapter 6 we turn to another facet of human nature: stories and storytelling. As Lewis and Hildebrandt (2019, p3) state “story and storytelling run deep and wide through the human experience, explaining much of who we have been, who we are, and who we may become.” This exploration is framed by the stories of two individuals who have been mind uploaded, thus answering the RQ that specifically asks, “How does the public respond to and experience future stories of mind uploading”?

## **Chapter 6 Science and Stories**

### **6.1 Introduction**

Chapter 5 discussed autobiographical memories and how these contributed to personal histories and life stories, which answered the RQ on how people remember their past and imagine their future. This was a use case for exploring the subsequent RQ—how the public responds to and experiences future stories of mind uploading.

This chapter gives an overview of how stories and storytelling have evolved and their significance to humanity. It then evaluates the performance of the website as an evidence-based data collection tool and a narrative method for engaging the public with science. The website was specifically designed to bring the concept of mind uploading to life through the stories and experiences of the characters depicted in it.

### **6.2 Role of Storytelling**

This section outlines how the mechanics of storytelling have evolved over human history and briefly discusses the significance of stories and their ability to engage and communicate science to the public (Dahlstrom, 2014). A detailed discussion surrounding my choice of storytelling as a method was included in Chapter 3.

Telling stories or listening to them, be they fact or fiction, is an inherent human characteristic. Through stories, we share our lives and our cultural identity, strengthen social bonds and impart and gain knowledge (Mendoza, 2015; Richardson et al., 2018). However, how we tell or receive stories has changed



dramatically since the days we first communicated. First, this was via cave drawings. Then stories were passed on from one generation to another orally before the written word and pictures became prevalent. Nowadays, digital innovation, such as the internet and social media platforms, means that we can quickly and easily create new friendship bonds as well as share and receive information with shared stories reaching millions of people every day (Page, 2018). Not only has digital storytelling—defined as the use of “digital tools and media to develop, create, enhance, and share stories” (Couros et al., 2013, p546) risen in popularity (Lewis & Hildebrandt, 2019), it has also provided a platform for exploring potential digital futures such as an uploaded brain and mind.

Creating an engaging and thought-provoking narrative was a crucial component of my research since I needed to take participants on a journey to the future world of mind uploading, evoking both cognitive and emotional responses (Richardson et al., 2018). Both aims were achieved as demonstrated by the results discussed in section 6.14.

### **6.3 Definition of a Story or Narrative**

Before diving deeper, I need to clarify terminology. There are conflicting opinions about whether a narrative and a story are the same or different entities. Those who distinguish between the two describe the narrative as the “overall phenomenon” mediated or narrated by the teller and comprising a number or a “system” of stories (Chatman, 1980). However, in this research investigation, I am following the work of several researchers who have produced work on narrative transportation (Green, 2004, 2007, 2008; M. C. Green, 2021; Green & Brock, 2000,

2002; Green et al., 2012; Green & Jenkins, 2014; Ryan, 2007). Green, in particular, is highly influential and integral to my research because she pioneered work in this field and is an active contributor. Green uses the terms “narrative” and “story” interchangeably across her considerable body of work and Dillon & Craig, 2021 also observed that the two terms are not consistently distinguished in either fact or fiction. Therefore, in my work, narrative and story are synonymous and I use both interchangeably.

Despite some variability in the exact wording, there is a central triumvirate of constituents that most researchers agree on. These are “temporality,” so events occur and unfold over time, “causality” (cause and effect), and the experience of those “characters” involved. More precisely, Herman (2009, p.73) claims narrative represents “a structured time-course of particularized events that introduces conflict (disruption or disequilibrium) into a story world ... conveying what it’s like to live through that disruption.” Dahlstrom (2014) simplified this definition and Green cited it in a 2021 podcast stating that “narratives follow a particular structure that describes the cause-and-effect relationships between events that take place over a particular period that impact particular characters.” These concepts are discussed in more detail in the context of narrative structure in the next section (6.4).

#### **6.4 Composition and Analysis of Media (Upload and Soma)**

The website—Afterlives—was designed to tell a story and allow participants to better imagine and reflect on the fictional world of mind uploading. However, practicalities—such as the amount of time I could reasonably expect participants

to spend online and also limitations of the available media—meant that Afterlives was not designed to deliver a complete story for either of the two main characters.

However, given that storytelling was a key aim of the website, I have evaluated it against established narrative principles which allowed me to reflect on how to improve the website. When analysing, I focused on the video clips illustrating key moments in the character's stories since while they are just a small segment of the whole drama (Upload) and game (Soma), they represent the story arc experienced by participants.

The Afterlives website depicted the stories of Nathan and Simon, who are the main characters. The condition of temporality is met in both Upload and Soma as events unfold over time. Both stories are set in the future; 2033 in Upload and further ahead in 2104 for Soma although the back story for the latter starts in 2015. Both stories also have causality. In Nathan's case, one example is his decision to finish with his girlfriend, Ingrid. However, Ingrid is the account holder at Lakeview and, hence, controls Nathan's access to services. Once she stops funding his afterlife, he is downgraded to part of the hotel where data use is capped at 2GB a month. Once the individual has reached this limit they are "frozen" until the next data cycle.

In the game, Soma, causality is more subtle and complex, with an emphasis on moral and ethical choices that shape the player's experience rather than the structure of the game. In Soma, the mind uploading process copies rather than transfers the mind. Hence, there can be multiple versions of the main character Simon. At one point, Simon's mind is copied into a new body since his old body is

dying. However, that means there are two Simons (both with uploaded minds) as the previous one is still alive. Simon has to decide whether or not to “kill” the other Simon. While this choice doesn’t affect anything in the actual gameplay, it has (internal) consequences in terms of how the player feels about the decision.

Both stories fulfil the three central criteria of characters experiencing temporality and causality. However, they do so in very different ways, thus demonstrating the flexibility and freedom that allows for the boundless creativity of stories. These story attributes are important in conveying the complex aspects of mind uploading narrative.

Characterisation brings the hypothetical concept of mind uploading to life through Nathan and Simon. It helps the viewer/participant consider the situations the characters experience, which are often specific to mind uploading: for example, multiple copies of Simon. Through Simon, I was also able to explore participants’ responses to embodiment and compare and contrast the acceptability of digital avatars vs. robot bodies. Both themes—clones and embodiment—are important ones.

Participants used science fiction such as *The Matrix* and *The Simpsons* to inform their perceptions of mind uploading. However, the examples they cited did not cover the key themes of mind uploading and the impact was somewhat limited since they were purely for entertainment. To truly understand the public’s perception of mind uploading, I needed them to engage with the characters’ stories.

Temporality is a complex topic and hypothetical technologies like mind uploading represent future innovations in neurotechnology. To truly understand the public's perception of mind uploading, I had to transport them to a future world. Temporality also allowed me to contextualise the implications of mind uploading for our current trajectory of life and death. Mind uploading potentially offers life extension and/or immortality, which are both emotive and controversial subjects but highly topical. To give just one example, a group of researchers at the University of California recently demonstrated proof of concept in using "synthetic biology to reprogram the cellular ageing process" (Zhou et al., 2023, p381).

Causality relates to the potential implications of mind uploading both for individuals and for humanity. As emphasised throughout, the ethical considerations of such future neurotechnology are multifaceted and include equality, diversity, privacy, and security. The narrative I shared with participants supports comprehension of this complex landscape.

## **6.5 Analysis of Narrative Structure in Upload and Soma**

Aristotle first described the three-act structure in the context of poetry and drama (Arnold & Eddy, 2007; Ip, 2011) This model has been widely adopted in multiple types of media including drama, films, and games (Soares de Lima et al., 2019). There is also a five-act format which includes two additional sub-acts within the second act, but I felt the concise, three-act approach was more appropriate for my short story.

The three acts are typically referred to as "set-up," "confrontation," and the "resolution." The setup introduces the main character(s) and their world(s). It also

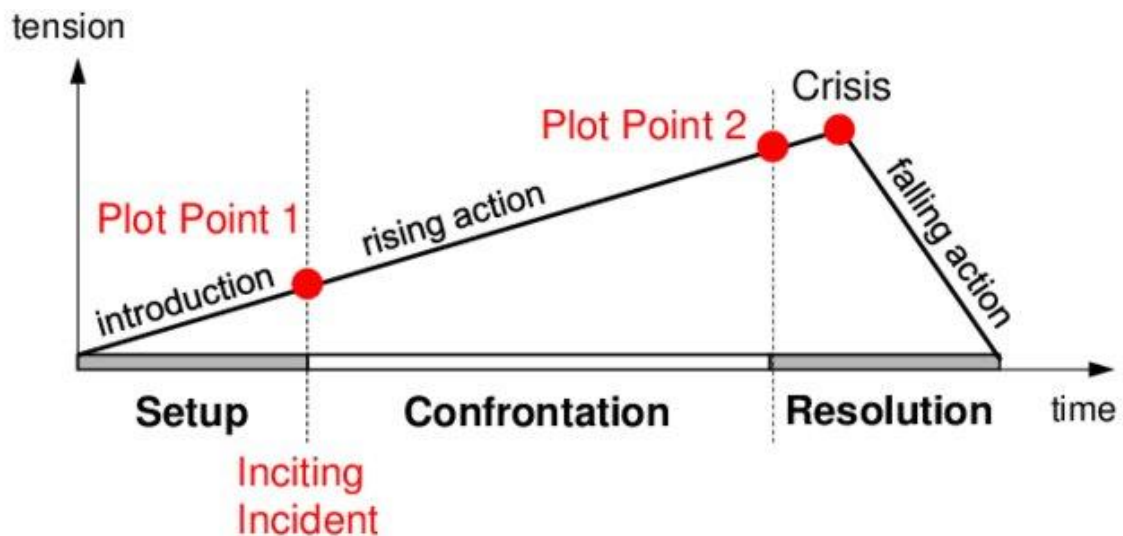
reveals what the main character needs or wants to do and what is potentially standing in their way. Critically, this first act also asks the big dramatic question. For example, in *The Eternal Sunshine of the Spotless Mind* (Gondry, 2004), the question is “What would happen if you could erase all the memories you had of a person you wanted to forget?” The first act also shows the “Inciting incident,” which is the disruption that upends the character’s world or the event that sets the main character on the narrative journey. Towards the end of Act 1, plot point 1 signals the transition to Act 2 where the character tries to achieve their goal.

In Act 2 (the confrontation), the character faces multiple challenges and obstacles and, typically, as the stakes increase, the obstacles become higher and harder. In this section, there is typically a turning point (plot point 2) with an uncertain outcome—the main character could win or lose, and the action peaks at the climax ahead of the final act.

In the final act (resolution), the story concludes. The ending shows the fate of the main character—how their world has changed, how they have changed since the start of the story, and, critically, if they answered the big question and achieved the original goal. This arc is visualised in Figure 6.1 taken from Soares de Lima et al. (2019)

**Figure 6.1**

*Three-Act Story Arc*



When creating the website, I carefully considered which media to include and endeavoured to portray the topics in a balanced way. This was not always possible given that I was working with existing media. For example, Nathan's and Simons' scans and uploads are handled differently in Upload and Soma. However, I kept additional narration to a minimum, and it was written from the perspective of an objective third party.

I had some understanding of the elements of storytelling from my interest in the arts, and this encouraged me to use narrative as a method for research and engagement as evidenced in HCI (Tanenbaum, 2014). My understanding evolved further when I collaborated with The British Science Association, which provides resources and training for scientists to become better storytellers.

Given that the website method focuses on storytelling, I felt it important to reflect on overlaying the three-act structure onto the abridged story for Nathan

(Upload) and Simon (Soma). Several researchers, including Mark Blythe in his conference paper “Research Fiction: Storytelling, Plot and Design,” (2017) and Hrastinski & Jandrić (2023), emphasise how an awareness of literary plots allows us to improve the fictional stories we tell as part of our research. This exercise, together with comments from participants, enabled me to identify limitations and potential improvements. For reference, I have shown the website information available to the participants at each stage or act.

### **6.5.1 Act 1 Set-up**

#### Narrative

The story you are about to engage with—*Afterlives*—asks you to assume a world far in the future where we have developed the technology to upload our minds. In the future, this is an established process, and several companies host different uploaded worlds. However, not everyone wants to or can afford to upload, and the experience can vary. Some uploads - like Nathan who you will meet - continue to live on in virtual worlds as avatars that co-exist with the real world of living beings. Other uploads—like Simon—either exist as avatars or—in some scenes—have been downloaded so they continue to exist in physical form in the real world. Nathan and Simon's experiences are revealed through video clips and a walk-through of gameplay and narrated by an objective third person.

Characters: So, let's meet two individuals who have chosen to upload—Nathan and Simon—and follow their uploading journeys. The back story on each:

Nathan is a software developer, aged 27 at the time of death from a punctured lung in a car accident. He is uploaded to Lakeview, from Horizon, which is a virtual world populated by uploads who exist as life-like avatars.

Simon works in a bookstore and initially had his brain scanned as part of a recovery effort after he was involved in a car crash. Simon's existence as an upload spans several worlds, including an underwater facility on Earth: the only place to have survived a meteor collision. There are references to the ARK, a virtual reality containing human brain scans which when launched into space would safeguard the last humans. Catherine, who features in some segments, is a brain scan of a Computer Scientist who was working on the ARK.



Nathan was scanned and uploaded when he was close to death following a car accident. This short clip shows how the process was for Nathan.  
(video clip)

And this is Nathan's uploading to the virtual world of Lakeview.

Nathan wakes up to start his first day as an upload in Lakeview.

That was Nathan's initial upload experience. Let's meet Simon and compare his experience.

This brief back story on each character was all that participants were told at the start of the story. I took this decision, having considered participant burden and engagement since the website also collected data on several mind uploading themes and included multiple questions on narrative experience.

The following analysis compares the story elements shown on Afterlives with a traditional narrative arc. In the Discussion (section 6.21), I reflect on how well the story performed and discuss planned improvements to the website.

### **6.5.2 Analysis of Website Story vs. Three-Act Story Arc**

The questionnaire in Appendix G shows the story flow and questions in Word and the website links are given again:

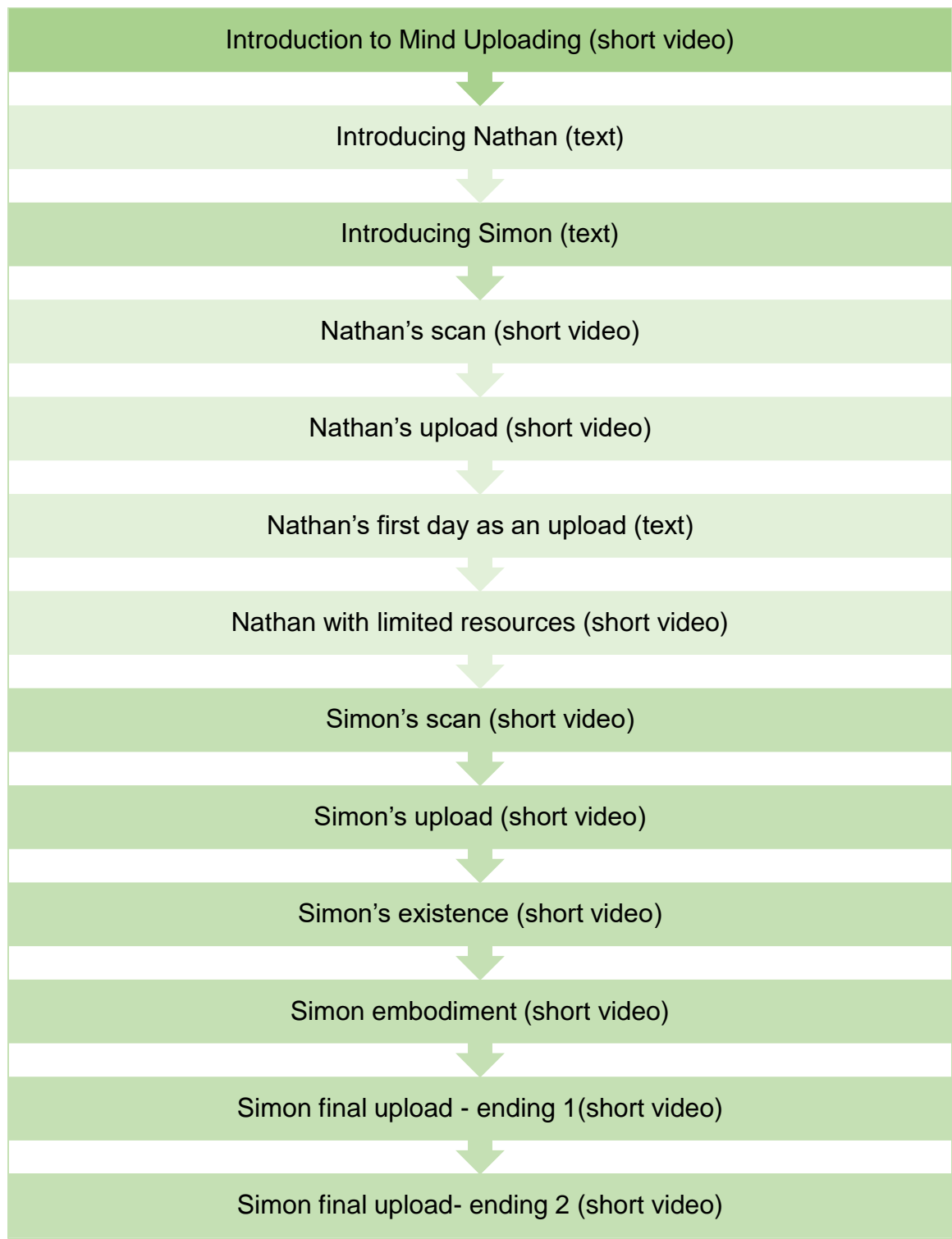
**Link to main website - Afterlives**

**Link to website preview**

However, for ease of reference, I have summarised the story flow below and indicated if the information was provided in text or video format.

**Figure 6.2**

*Narrative Flow*



## Figure 6.3

### *Narrative Structure of Website*

#### Act 1 - Set up

##### Introduce characters:

Both main characters are only given a brief back story; although, aspects of their personality are revealed in the video clips.

##### Introduce the character's worlds:

This refers to Nathan's and Simon's afterlives; although, brief scenes from their lives are included in the setup.

Nathan's uploaded world (Lakeview) is shown including his room, the view from the window, the hotel, and his customer support "angel," Nora, who is his link to the real world. Nathan is also shown living on a budget floor at Lakeview.

Simon's world is shown via the initial setting for the brain scan and his upload to a facility filled with machines and body suits.

##### Character's aim/dramatic question:

Simon has a clear objective—to help Catherine launch the ARK and save humanity—this can be deduced from the clips.

Nathan's objectives are less apparent, but they include investigating his missing memories from the so-called "accident" that caused his death. Another objective is to launch his free digital afterlife programme: Beyond. These aspects are not included on the website.

##### Inciting incident:

Both Nathan and Simon's worlds are disrupted when they are uploaded. However, the incident that sets them on their narrative journey is different.

In Soma, Simon's main objective of helping Catherine launch the ARK is clear from the videos although the backstory to this is not shown.

Nathan is alerted to the suspicious circumstances of the car crash both by one of his neighbours early in Season 1 (episode 2) and subsequently by Nora when she realises his missing memories have been deleted but neither of these incidents is included.

##### Plot point 1 - The character tries to achieve a goal

This point signals the transition to Act 2 where the character tries to achieve their goal. Because of the narrative structure, it is difficult to pinpoint this in either Upload or Soma.

#### **Act 2 - Confrontation**

The character faces multiple challenges and obstacles:

Simon faces multiple challenges as he tries to process aspects of his new existence, such as the fact he is no longer human, and he has multiple copies since the system duplicates rather than transfers his mind. These were shown, albeit briefly.

Nathan's challenges are varied and include restoring his missing memories and hacking into the servers to prevent Horizon (who runs Lakeview) from instigating a programme called

Mind Frisk, which will access and share residents' thoughts. These elements are not shown on the website.

Plot point 2 - Uncertain outcome:

This is typically a climactic scenario where the main character could win or lose. In *Soma*, this is not easy to identify. It could be the point where Simon first realises his mind is copied, not transferred, and he has to decide whether or not to kill a previous version of himself. However, while this is shown on the website, it was not climactic.

In *Upload*, it could be at the end of Season 2 where Nathan chooses to be downloaded into a clone body. The season ended on a cliffhanger with Nathan's nose bleeding, which is a sign of a failing download. Clips from Season 2 were not included in the story.

Simon's afterlife in *Soma* is darker and more disorientating since the game requires Simon to solve puzzles and avoid predators in several different settings. His main contact is with Catherine, who is herself a brain scan.

Act 3 - Resolution

While Nathan and Simon's stories have a beginning and a middle, neither has an ending. Nathan's fate is not resolved either in the video clips or the series itself since Season 3 is streaming as I write.

*Soma* includes two alternate endings for Simon. The endings play on the concept that rather than transferring his mind, Simon is copied, so multiple versions are possible. The first finale shows Simon (version 3) left alone in the dark in an abyss while the latest copy (version 4) safely makes it to a spaceship (the ARK). The alternative shows Simon (v4) on the ARK and reunited with Catherine. The end shot is the ARK leaving the planet and disappearing into the blackness of space.

## 6.6 Narrative in Different Media

Given I used a TV drama and a game as stimulus material, I explored how the concept of a narrative is perceived across different media. Both Green and Dahlstrom support the premise that narrative "is independent of content and so narratives can be present within almost any communication activity or media platform" (Dahlstrom, 2014, p.13614.) According to this definition, storytelling can occur in multiple media ,such as books, movies, TV dramas like *Upload* and the more recent innovation of computer games like *Soma*.

As computer games have evolved and become more widely played, there is a widespread acceptance that games have a fundamental ability to depict narrative (Wesp, 2014). This was not always the case since, traditionally, the academic study of games fell into two opposing categories: ludology, which focuses on the study of games as play and game activities and narratology which studies video games as stories (Ang, 2006). An in-depth review of these approaches is outside scope, but I follow narratological principles by evaluating *Soma* and *Upload* in terms of “what” is a narrative and “how” is it created (Fludernik & Pirlet, 2012). Subsequent work such as the use of narrative fiction and specifically science fiction to facilitate public research and engagement would increase my academic contribution to this area and this is discussed in the final chapter.

It should be noted that not all games have a “narrative design” (Ryan, 2006), and *Soma* is unusual. As the co-founder of Frictional Games stated in a 2013 blog post, “Every part of the experience is directly connected to the story” (Gripp, 2013). When I chose *Soma* as a means of bringing the future world of mind uploading to life, I did so because it was thematically rich, including many of the key topics—such as consciousness, personal identity, and subjective experience—that had been important to the participants in my prior research. At the time, I was unaware *Soma* had won many accolades and an award in 2015 for best story and writing of the decade in a game.

I now introduce measures of narrative effectiveness and discuss how well the storytelling website *Afterlives* meets them.

## **6.7 Evaluation of Storytelling Website**

Chapter 4 reported on public attitudes to mind uploading using data collected by the storytelling website. However, it was important to understand how effective the storytelling website was as a method for exploring future scenarios as this approach has not been widely researched.

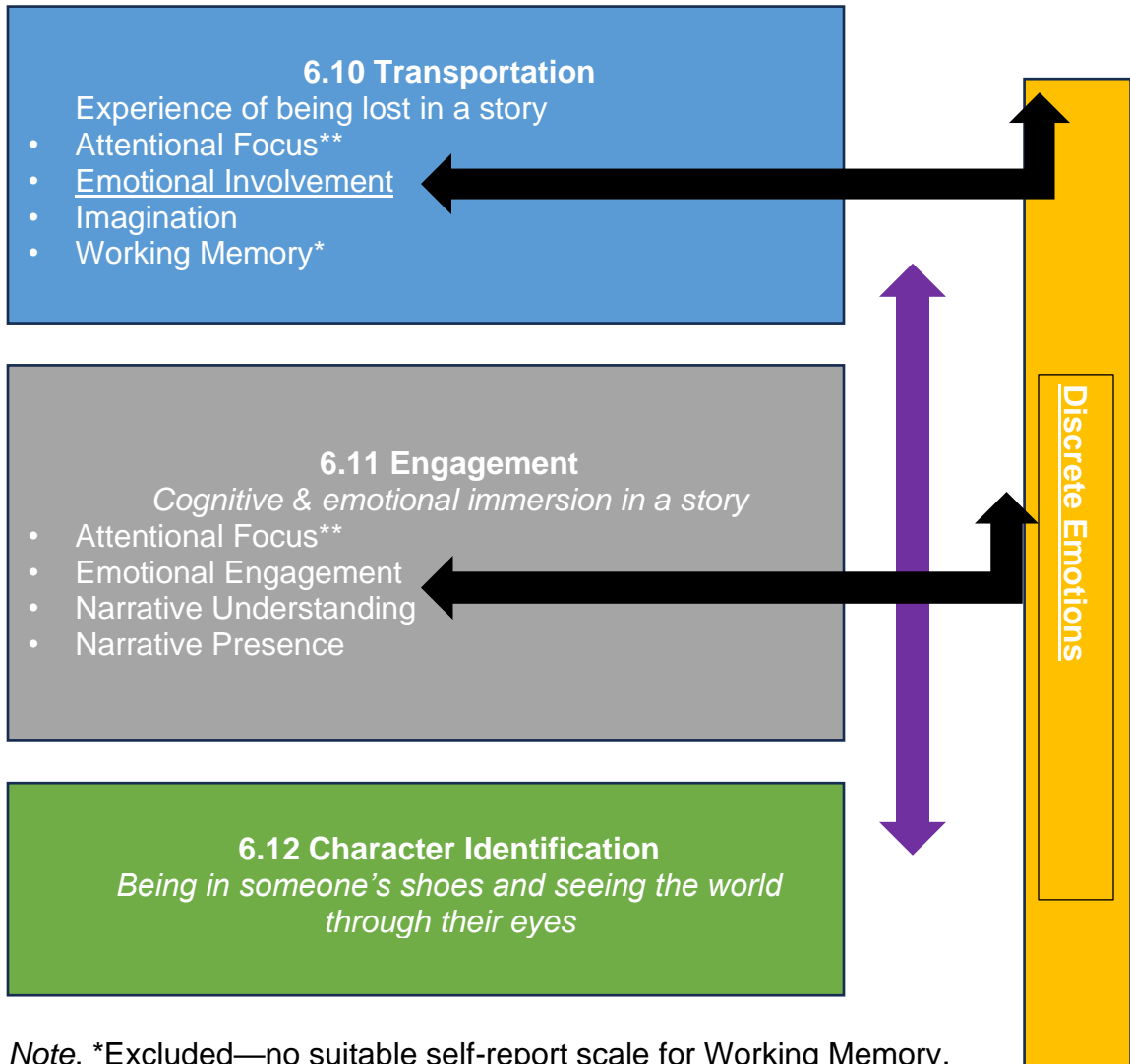
In this instance, “effectiveness” for the website was defined as its ability to tell the story of the two main characters in a way that encouraged participants to experience and reflect on the concept of mind uploading.

First, I consider the potential methods of measurement namely subjective self-report vs. objective, physiological methods. I then discuss the different elements of narrative experience, namely narrative transportation (transportation), narrative engagement (engagement), and character identification, and the scales used to measure them. These constructs are unique but inter-related. Thereafter in section 6.14 I discuss how the website performed against narrative measures.

## **6.8 The Concept of Narrative Experience**

There are three high-level concepts linked to the narrative experience, and I assessed how well the website performed on each. This is a complex topic, so I have visualised it below (Figure 6.4). The diagram provides a brief definition of the main concepts and shows their key attributes. I have colour-coded throughout to signpost the route.

**Fig 6.4 Components of Narrative Experience**



Note. \*Excluded—no suitable self-report scale for Working Memory.

\*\*Attentional focus and an emotional component feature in both transportation and narrative engagement.

## 6.9 Methods of Measurement

Transportation, engagement, and character identification are typically measured via self-report immediately after the narrative experience. However, transportation, identification, and engagement are dynamic processes, changing

throughout a narrative and hence a single retrospective assessment may not capture the full picture (van Krieken et al., 2017).

The narrative evaluation questions for transportation (being lost in a story), engagement (cognitive and emotional immersion), and character identification as well as nested concepts such as attentional focus were shown immediately after participants had experienced Simon and Nathan's stories. In addition, all the scales used are well established and validated. Nevertheless, my research shares the same limitation as many studies in this field: namely, that the questions were asked about a previous experience and hence biases in recall and response are possible (Appel et al., 2015).

Direct measurements such as brain activity, heart rate, electrodermal activity/galvanic skin response, and temperature would overcome these limitations and, in conjunction with self-report, would provide a more comprehensive assessment. This would also add to existing knowledge of the relationship between them since I could only find two papers (Richardson et al., 2018, 2020) that studied how physiological measures are related to narrative transportation by measuring participant responses in real-time. Richardson (2020, article 11298) used wrist sensors to measure heart rate, electrodermal activity, and body temperature and reported higher and more variable heart rates, greater electrodermal activity, and higher body temperatures.

Such objective measures have several advantages over subjective self-reporting where biases, such as social desirability and acquiescent responding (Paulhus, 1991), can occur. As one might expect, social desirability is responding



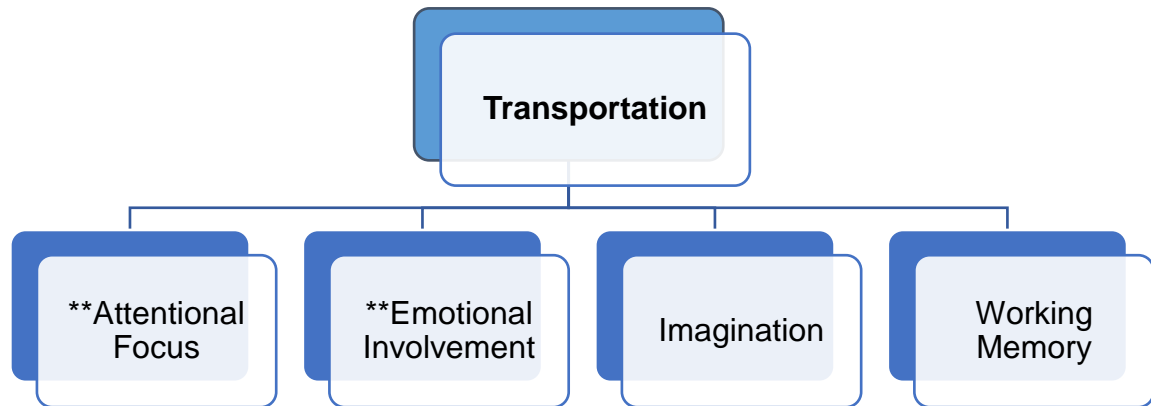
in a way perceived as desirable by others and acquiescent responding is a preference for the positive elements of a scale regardless of the items (Weijters et al., 2013). Furthermore, many of the constructs in transportation occur outside of an individual's awareness, making it difficult to measure them using self-report methods (Moyer-Gusé, 2008).

The website was not identified as a potential method until I had researched it thoroughly. Designing and building it also took time, thus precluding analysis which went beyond the integrated self-report questions. Furthermore, both my panellists and new participants were widely geographically dispersed and were experiencing the website in their own homes. Such environments make obtaining accurate physiological readings difficult.

## 6.10 Transportation

**Figure 6.5**

*Elements of Transportation*



*Note.* \*\*Attentional focus and an emotional component are a component of both transportation and narrative engagement and are discussed in this section on transportation.

The most widely known and adopted construct in this field is (narrative) transportation. While it is not the only way of evaluating an individual's media experience, transportation is focused on narrative or stories. Hence, I prioritised it over other related concepts such as flow and immersion. A full review of all the related concepts in HCI would be sizeable and as such is outside of scope.

Green and Brock (2000) pioneered the concept of transportation and research continues to evolve, particularly as we find new ways of telling stories such as through digital media. Transportation is something that we have all experienced, "the feeling of being lost in the world of a narrative, of being completely immersed in a story and leaving the real world behind" (Green, 2021, p.87).

The original transportation scale (TS) by Green and Brock (2000) comprised 15 items, 11 universal and four items to evaluate reactions to the main characters. The latter can be adjusted to reflect the number of protagonists. The items can be described by three factors: cognitive, emotional-affective, and visual imagery. This scale has been validated and is still widely used although research investigating its suitability across multi-media is limited (Jarrier et al., 2017).

In 2015, a short version of the transportation scale was created (Appel et al., 2015; M. C. Green, 2021) comprising six items representing the same three factors that was shown to be as sensitive as the original (Appel et al., 2015). Both versions of the scale use a seven-point scale that captures opinions about the story ranging from 1—not at all to 7—very much. For example, “While I was experiencing the story I could easily picture the events in it taking place.”

Transportation can occur across different media such as books, films, plays, virtual reality experiences, and factual and fictional narratives. Overall, there are many different ways to make a story transporting; for example, through the plot, characterisation, and/or visual elements or a combination of these. As Green herself observed (2021, p.96), “There are many different pathways to transportation” but it works best when stories “show, not tell.” I tried to adhere to this principle in the website narrative by telling the story predominantly through embedded video clips rather than text.

As shown in Figure 6.5, transportation involves several cognitive processes. These include attentional focus, emotional “involvement,” imagination, and working memory (Busselle & Bilandzic, 2009; Green, 2008; Green & Brock, 2002).

A recent literature review (Gordon et al., 2018) confirmed that these cognitive elements are all important for transportation. More specifically, transportation requires high attention and high working memory, and both are required to create an emotional response. (I tackle emotional components subsequently).

A good imagination is important to enable an individual to lose track of reality and immerse themselves in a narrative. Furthermore and of particular relevance to my research, imagination helps us envision our “future selves,” (Wilson & Gilbert, 2005; Zabelina & Condon, 2020) and future worlds such as those depicted in *Upload* and *Soma* (Moore & Milkoreit, 2020; Mullally & Maguire, 2014; Stoetzler & Yuval-Davis, 2002).

I identified and implemented self-report questionnaires for three of the four elements that are important for transportation (attentional focus, emotional “response,” and imagination). The questionnaires for attentional focus and emotional “response” also relate to those aspects in narrative engagement.

However, I have been unable to identify a suitable self-reported instrument for working memory. This is the part of short-term memory concerned with immediate conscious perceptual and linguistic processing (Diamond, 2013). In narrative, it is the activity that is required to attribute meaning to and develop an interpretation of a story (Gordon et al., 2018). The Working Memory Questionnaire (WMQ Vallat-Azouvi et al., 2012) is self-report and has good validity but measures aspects of daily life, which is not appropriate for a task that actively seeks to

transport participants into imaginary worlds. Hence, working memory is excluded from this study; although, I may be able to identify a proxy measure in future work.

### **6.10.1 Attentional Focus**

The American Psychological Association's Dictionary of Psychology (APA, 2023) defines attentional focus as "the focus of an individual's attention at a particular moment" and notes this focus may be internal or external. More specifically, in narrative, attentional focus can be described as focusing attention into a narrative world and disengaging attention from the physical environment (Bezdek & Gerrig, 2017, p.60).

Attentional focus was represented in the original transportation scale (Green & Brock, 2000). However, it was subsequently refined and represented as one of the four dimensions in Busselle & Bilandzic's (2009) narrative engagement scale, which used the original theoretical construct of attention-distraction.

Hence, in my research, attentional focus was captured using the 2009 scale of Narrative Engagement (Busselle & Bilandzic). This instrument has been validated and also shown to be related to physiological measures such as skin conductance (Sukalla et al., 2016).

There is debate about the accuracy of self-reporting attention, but Bezdek and Gerrig (2017) report empirical evidence—using audio probes and button presses while participants were watching narratives—suggesting that self-reports on attention-related items of the transportation scale can accurately capture the extent of decreased attention to non-narrative stimuli. This provides some evidence that participants can make accurate judgments about their overall levels

of attentional engagement. Hence, this method could be incorporated into future studies measuring attentional focus when participants are engaged with the website.

### **6.10.2 Emotional Components**

As Figure 6.4 illustrates, emotion is a component in both narrative transportation and narrative engagement. Emotion was considered and captured in two different ways on the website. The first was a measure of emotional involvement/engagement with the narrative and the second was the discrete emotions experienced by the participant. However, this is a complex area, so let me clarify how emotion fits within my research.

Transportation includes an emotional (affective) component which is variously described as “involvement,” “response,” or “reaction.” The emotional aspect of transportation was captured via a single item on both the original scale and the short version (“the narrative affected me emotionally”) scored using a seven-point scale which captures opinions about the story ranging from 1—not at all to 7—very much.

However, as Green herself noted, transportation is highly correlated with engagement so to avoid duplication, the emotional effect was measured using the narrative engagement scale developed by (Busselle & Bilandzic, 2009). This investigated the reader/viewer’s empathy and sympathy (for the characters) and the extent to which the narrative affected the participant emotionally - via three items. Hence, emotional engagement encompassed the extent to which the reader/viewer “mirrored” the emotions depicted by a key character (Cohen, 2001)

as well as the reader/viewer's emotional response. The latter may or may not be the same as the emotion represented by the character. For example, you can sympathise with someone without empathising with them. Hamby's research into this area (Hamby et al., 2023) supports the premise that readers/viewers consider the situation from both the perspective of the character and their reaction to it.

To drill down into the specific emotions that affected the participant emotionally. I also included the Discrete Emotions Questionnaire (DEQ) from Harmon-Jones et al. (2016), which as the name suggests, considers each emotion as a distinct entity. It comprises 32 items classified into eight subscales (anger, disgust, fear, anxiety, sadness, desire, relaxation, happiness). As such it measures a broad range of psychologically defined "basic" and "important" emotions, such as anger, disgust, fear, sadness, happiness, anxiety, desire, and relaxation (Ekman, 1992; Izard, 1991; Shaver et al., 1987). The scale consists of a seven-point Likert scale which runs from 1—"not at all" to 7—"an extreme amount."

This scale has been validated and has several features that make it suitable for my study. First, as its name suggests it is sensitive to discrete emotions. Second, it captures dynamic emotions. Third, it uses language that non-experts use and understand, and fourth, only the relevant subscales can be used which limits participant fatigue (Harmon-Jones et al., 2016). I was mindful of this and only included those emotions that had been identified and mentioned by participants in prior studies. Hence items classified as desire, relaxation, disgust, and anger were not included, while sadness, happiness, fear, and anxiety were incorporated.

### **6.10.3 Imagination**

Imagination can be described as a creative ability to form images, ideas, and sensations in the mind that helps make knowledge applicable for problem-solving, integrating experience, and learning (Egan, 1992). In 2020, Zabelina & Condon published the Four-Factor Imagination Scale (FFIS), which took a different perspective on the definition and assessment of imagination. Prior measures, such as those by Jankowska & Karwowski (2015) and Marks (1973), tended to approach, and hence measure imagination through mental imagery or as part of a measure of creativity. In contrast, Zabelina & Condon (2020) proposed that imagination is a more complex cognitive construct that occurs independently of creativity and intelligence. The four-factor model measures individual differences in frequency, complexity, emotional valence, and directedness of imagination using a six-point Likert scale from 1—very inaccurate to 6—very accurate. The four components are defined below:

- Frequency – the amount of time spent in an imaginative state.
- Complexity – also described as vividness – how specific or detailed someone's imagination tends to be.
- Emotional valence – the extent to which one's imaginings are largely positive or negative.
- Directedness – the degree to which imaginings are goal or outcome-orientated.

The four factors show high overall internal and factor-specific consistency and predict creative behaviours, art appreciation, and openness to experience,

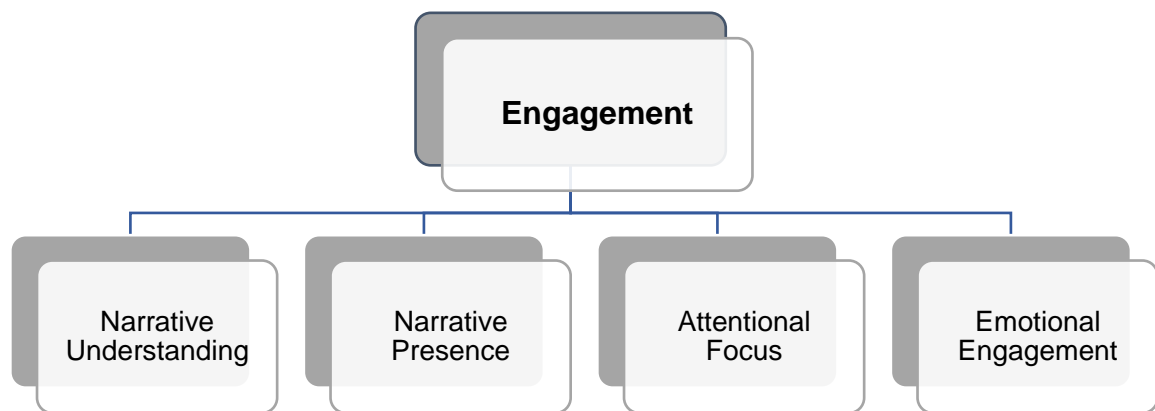


indicating solid convergent validity. Since none of the four factors correlate highly with intellect or with measures of cognitive ability, the researchers conclude the FFIS scale has discriminant validity. Neuroimaging evidence supports the concept that imagination is multi-faceted involving many connected cognitive processes with different regions and networks of the brain being flexibly involved (Beaty et al., 2018; Jung et al., 2016). Hence it seemed feasible that imagination is indeed a complex construct and should be evaluated as such in my research<sup>7</sup>.

### 6.11 Narrative Engagement

**Figure 6.6**

*Elements of Engagement*



Green & Brock’s original Transportation scale is still widely used but as mentioned previously, it has been refined to consider narrative engagement (Busselle & Bilandzic, 2009; Tal-Or & Cohen, 2010). While engagement is highly correlated with transportation, engagement focuses on specific dimensions of the narrative experience (Green, 2021; Tal-Or & Cohen, 2016). As shown above (Figure 6.6) these are narrative understanding, narrative presence, attentional focus, and

---

<sup>7</sup> However, my subsequent reflection on the data captured for each participant’s level of imagination queries the contribution the FFIS made to my research.

emotional engagement (The latter two have been discussed under the heading of Transportation; section 6.10).

The relevant items for narrative engagement were derived from other scales and refined by Busselle and Bilandzic (2009). The original scales were:

- Identification (Cohen, 2001)
- Transportation (Green & Brock, 2000)
- Narrative presence (Kim & Biocca, 1997)
- Narrative involvement (Appel et al., 2002)

The resulting engagement scale (Busselle & Bilandzic, 2009) comprised 12 items divided into four subscales with three questions relating to each using a seven-point Likert scale from 1—strongly disagree to 7—strongly agree. Half of the questions were reverse scored. The items on emotional engagement investigate empathy and sympathy (for the characters) but also the extent to which the narrative affected the participant emotionally. The scale is complementary to existing scales, pointing to the interplay between different aspects. For example, emotional engagement may underlie identification with characters and difficulty in narrative understanding may undermine transportation.

Using the narrative engagement scale for the story of future worlds and technologies also evaluated the scale using “more fantastic content,” an application that the researchers themselves identified (Busselle & Bilandzic, 2009) and does not seem to have been addressed. Narrative understanding and

narrative presence are summarised below. Attentional focus and emotional “engagement” were covered under Transportation in section 6.10.

### **6.11.1 Narrative Understanding**

Although we can intuit what narrative understanding is, it is difficult to find a standardised definition. I am using a summary based on Busselle and Bilandzic (2009). This views narrative understanding as occurring when readers or viewers follow the plot, (and) understand the motivations and actions of characters. This understanding is integral to storytelling since, as Barwell states, there is a premise “that narratives involve a distinctive understanding of the events they are about. The key to this understanding lies in the nature of storytelling and stories.” (Barwell, 2009, p49). Without an understanding of the story its ability to transport and engage would be lost. The website narrative unfolded through short video clips supported only by a brief backstory for each character hence the need to evaluate how well participants comprehended the narrative.

### **6.11.2 Narrative Presence**

This can be conceptualised as the psychological experience of being in a non-physical or virtual world. It refers to the reader or viewer being present in the narrative rather than the actual world (Busselle & Bilandzic, 2009).

Presence can encompass feelings of participation, embodiment, or disembodied observation. It can be demonstrated in multi-media experiences involving fiction readers, movie audiences, or videogame players (Gerrig, 1993). Busselle & Bilandzic (2009, p.341) consider that narrative presence involves losing awareness of self and surroundings and the “sensation of entering another space

and time.” The latter comes from the reader/viewer constructing another “story” world. This concept is closely entwined with being transported by a story.

### **6.12 Character Identification**

The last of the three key concepts is character identification, which can be thought of as “being in someone’s shoes and seeing the world through their eyes” (Livingstone, 1998 as cited by Cohen, 2001, p.250). It occurs when readers can experience the narrative through the perspective of a story character (Green, 2021; Green & Jenkins, 2014). There are multiple paths to allow audiences to connect with characters including representative characters either in terms of demographics such as age, race or gender, or values and priorities (Green, 2021). Given the timeframe and budget available, I had to use existing media, and I was conscious that my two main characters—Nathan and Simon—were stereotypical, white males in their late twenties. However, I included an open-ended question to enable participant commentary.

A validated self-report measure of identification evaluated does not seem to exist (Tal-Or & Cohen, 2016). Hence, like many others, including Busselle & Bilandzic (2009), Chung & Slater (2013), De Graaf (2014), Moyer-Gusé (2008), Shen & Seung (2018) and Tal-Or & Cohen (2010), I used the five identification items from Tal-Or & Cohen’s scale (2010). These are rated on a seven-point Likert scale from 1—strongly disagree to 7—strongly agree.

### **6.13 Rating Scales used on the Website**

Table 6.1 summarises the scales I embedded on the website to measure the key concepts. I ensured the wording reflected the context of the questions for

example “experiencing the story.” Any refinements to each scale are also noted in Table 6.1. The questionnaires are including as part of the website questionnaire in Appendix G.

**Table 6.1**

*Summary of Rating Scales*

<b>Construct</b>	<b>Scale</b>	<b>Rating</b>
Transportation (Green & Brock, 2000)	Unipolar Likert  Only endpoints labelled  Extent agree with  statements	1 – not at all to 7 - very much
Engagement (Busselle & Bilandzic, 2009)	Bipolar Likert  Only endpoints labelled  Extent disagree or agree  with the statement	1 – strongly disagree 7 – strongly agree
Attentional Focus (Busselle & Bilandzic, 2009)	Bipolar Likert  Only endpoints labelled  Extent disagree or agree  with the statement	1 – strongly disagree 7 – strongly agree
Discrete Emotions (Harmon-Jones et al., 2016)	Unipolar Likert  Only endpoints labelled  Extent           experienced  emotion described	1 – not at all 7 – an extreme amount

---

Imagination Zabelina & Condon, 2020)	Bipolar Likert  All points labelled  Extent statement accurate	1- very inaccurate 6 – very accurate
Character Identification (Tal- Or & Cohen, 2010)	Bipolar Likert  Only endpoints labelled  Extent disagree or agree  with the statement	1 – strongly disagree 7 – strongly agree

---

When reporting on transportation. I excluded the statements relating to the participant having “a vivid mental image” of the character for two reasons. First, unlike a spoken or written story where the participant had to imagine the main characters, the video clips from Upload clearly show Nathan and Nora, so these questions were superfluous. Second, I did not collect data on Simon from Soma since the footage shows the game from his perspective as a player, he only appears briefly in a robot body.

## **6.14 Evaluation of Storytelling Website on Key Dimensions**

### **6.14.1 Analyses**

When reporting I sought to place the data in context by referencing pre-existing narrative research. However, I was unable to source “normative” databases for any of the concepts in either the specific media used or across multimedia. There does not appear to be any agreed definition of what a “high value” (median or mean) might be. Hence, I used my judgement and experience

when interpreting the data which may be fallible although there do seem to be clear trends.

[Emotional effect is captured in Transportation, Engagement, and in the context of Discrete Emotions hence in addition to scale-specific analyses there is an overview in section 6.14.7].<sup>8</sup>

#### **6.14.2 Data Sets for Public Research**

- There are two independent groups: the panel/panellists ( $n = 10$ ) and new respondents ( $n = 43$ ).
- I use “participants” to indicate all; “panellists” refers to the individuals who continued to engage ( $n = 10$ ), and “new respondents” relates to the 43 individuals who experienced the website without any prior engagement.
- For coherence, I report the findings from both groups under the same headings wherever possible.
- However, I have tabled the data separately due to the different sample sizes and differing exposure to mind uploading as a concept.
- Where appropriate, I have highlighted similarities and differences between the two groups with the caveat that these are descriptive indicators rather than robust statistical differences, given the small sample of panellists ( $n = 10$ ).

---

<sup>8</sup> The emotional valence items in the imagination battery relate to an individual's positivity or negativity, for example when imagining their future rather than their reaction to the narrative. On reflection these items were extraneous and will be excluded from future versions of the website.

- For ease of comparison, I have shown percentages for both groups, although with the warning that the sample size for the panel is small ( $n=10$ ).

### 6.14.3 Transportation

The transportation scale ran from 1—“not at all” to 7—“very much,” so a higher score indicated greater transportation. The data indicated that respondents were transported with median scores typically exceeding four or five out of seven. Scores for the two reverse-scored items indicated new respondents were less likely to be “distracted” than panellists, which may have been influenced by the novelty of the topic.

Across the board, there was most agreement with the statement, “I wanted to learn how the story ended,” a sentiment that was reflected in spontaneous comments about the website experience. This positive response to the narrative has informed reflections on how to develop the website for future studies as reflected upon in the Discussion (section 6.21).

**Table 6.2**

*Scores for Transportation*

Transportation Statements	Panel ( $n = 10$ )			New Respondents ( $n = 43$ )		
	Median	Mean	S.D.	Median	Mean	S.D.
<b>Cognitive:</b> While was experiencing the story, I could easily picture the events in it taking place.	6.00	5.20	1.69	6.00	5.58	1.40
I could picture myself in the scenes	4.50	4.20	2.04	6.00	5.37	1.60



---

described in the story.						
I was mentally involved in the story while experiencing it.	5.00	4.80	1.99	6.00	5.86	1.25
<b>General:</b> While I was experiencing the story, I thought about the events occurring in the room I was in. (R)	3.00	3.20	2.15	4.00	4.19	2.21
I wanted to learn how the story ended.	6.50	5.70	2.00	7.00	6.42	0.76
I found myself thinking of ways the story could have turned out differently	5.00	4.30	2.21	6.00	5.53	1.45
<b>Emotional:</b> After the story ended, I found it easy to put it out of my mind. (R)	4.00	3.70	1.90	5.00	4.35	1.72

---

#### **6.14.4 Discrete Emotions**

The Discrete Emotions Scale (DEQ) by (Harmon-Jones et al., 2016) asked participants to indicate the extent to which they experience certain key emotions while engaging with the story. It used a seven-point Likert scale from 1—“not at all” to 7—“an extreme amount,” so a higher score indicates a more extreme emotion. As mentioned, I only included salient emotions, and these are shown in Table 6.3 alongside the relevant sub-scales. Apart from “enjoyment,” new respondents scored higher throughout indicating more “extreme” emotions than the panel. However, both audiences agreed that “liking,” “worry,” and “anxiety” were the discrete emotions they felt most strongly. This supports other positive

scores and comments about the website experience as well as indicating some success in conveying the more concerning aspects of mind uploading.

**Table 6.3**

*Discrete Emotions*

Discrete Emotions Statements	Panel (n = 10)			New Respondents (n = 43)		
	Median	Mean	S.D.	Median	Mean	S.D.
<b>Happiness:</b> Happy	3.50	3.40	1.71	5.00	4.37	1.48
Satisfaction	2.00	2.90	2.18	4.00	3.81	1.72
Enjoyment	4.50	4.10	1.79	4.00	4.42	1.74
Liking	4.50	4.10	1.91	5.00	4.30	1.78
<b>Anxiety:</b> Dread	2.00	2.50	1.71	4.00	3.70	1.78
Anxiety	4.00	3.70	1.77	5.00	4.26	1.93
Nervous	3.00	3.20	1.75	5.00	4.16	1.90
Worry	4.50	3.70	2.06	5.00	4.21	1.78
<b>Sadness:</b> Sad	4.00	3.60	1.90	4.00	4.02	1.73
Grief	1.50	2.30	2.00	3.00	3.23	1.74
Empty	1.50	2.10	1.60	3.00	3.23	1.65
<b>Fear:</b> Terror	1.00	2.70	2.31	3.00	3.16	1.56
Lonely	1.00	2.10	1.60	4.00	3.56	1.70
Scared	3.50	3.00	1.83	4.00	3.74	1.73
Panic	2.50	2.50	1.27	3.00	3.21	1.88
Fear	3.50	3.10	1.79	4.00	3.95	1.81

**6.14.5 Imagination**

This scale included measures of an individual's frequency, complexity, emotional valence, and directedness towards a goal. The Likert scale was a six-

point variant where 1 was “very inaccurate,” 6 was “very accurate,” and five of the items in the complexity sub-scale were reverse scored. New respondents scored higher than panellists on slightly more items indicating that the statements were more relevant for them. Both audiences gave the highest scores to the “complexity” sub-section which comprised statements that described their inner world as less detailed and/or less complex than other people’s. This is likely to be based on supposition rather than fact unless participants are privy to other’s imaginings. While the high “complexity” scores indicate participants felt they were less able to imagine in detail or imagine new, future scenarios, this was not supported by the other levels of narrative experience.

**Table 6.4**

*Imagination*

Imagination Statements	Panel (n = 10)			New Respondents (n = 43)		
	Median	Mean	S.D.	Median	Mean	S.D.
<b>Frequency:</b>	3.50	3.40	1.65	4.00	3.77	1.56
I am lost in my imagination most of the time.						
I find myself lost in my imagination very frequently.	3.50	3.40	1.51	4.00	3.91	1.65
I find myself daydreaming often.	4.50	3.90	1.60	4.00	4.21	1.32
I spend much of my time daydreaming.	2.50	3.30	1.77	3.00	3.35	1.53
I get lost in my fantasies.	3.50	3.40	1.65	4.00	3.60	1.51

---

I get lost in thoughts that aren't related to what's going on around me.	5.00	4.30	1.49	4.00	4.14	1.54
Sometimes it is as though I wake up from daydreaming.	3.00	3.10	1.85	4.00	3.40	1.48
My mind wanders in unpredictable ways.	3.50	3.60	1.65	4.00	3.65	1.53
I often fantasize about impossible things.	4.00	3.90	1.60	5.00	4.42	1.48
<b>Emotional Valence:</b> Imagining my future makes me feel blue.	3.00	3.00	1.76	3.00	2.98	1.61
I become depressed when imagining my future.	3.50	3.00	1.70	2.00	2.53	1.59
Imagining things in the future makes me fearful.	3.00	3.20	1.75	2.00	2.84	1.73
The things I imagine make me sad.	3.00	3.00	1.56	2.00	2.44	1.3
My fantasies lead to negative emotions.	2.50	2.40	0.97	2.00	2.26	1.45
I visualize negative outcomes for the future of the world.	3.50	2.90	1.73	3.00	2.79	1.64
My daydreams are unpleasant.	2.00	2.00	1.25	2.00	2.09	1.19

---

---

<b>Complexity:</b> My fantasies are less detailed than most peoples'. (R)	5.00	4.80	0.63	5.00	4.33	1.52
Most people seem to have more complex imaginations than me. (R)	5.00	4.50	1.08	5.00	4.44	1.53
My imaginings are not very complex. (R)	5.00	4.80	0.79	5.00	4.30	1.57
My fantasies do not involve many details. (R)	5.00	4.50	1.27	5.00	4.55	1.44
I have difficulty picturing the details of a situation I have not previously experienced. (R)	5.00	4.70	1.42	5.00	4.33	1.44
<b>Directedness:</b> My daydreams have a clear goal.	3.50	3.40	1.51	4.00	4.07	1.32
My daydreams are directed toward a specific outcome.	4.00	4.00	1.41	4.00	4.30	1.36
My fantasies are quite purposeful.	3.50	3.60	1.27	5.00	4.14	1.3
There is a purpose for my fantasies.	4.00	3.60	1.27	4.00	4.37	1.16
When I imagine my future, I like to plan its details.	4.00	3.90	1.20	5.00	4.37	1.4

---

### 6.14.6 Scores for Engagement

Engagement comprised narrative understanding, narrative presence, attentional focus, and emotional engagement. The scale ran from 1—“strongly disagree”—to 7—“strongly agree”—so a higher score indicated greater agreement. The first six items were reverse scored. I considered asking participants to score each character, but given the brevity of the narrative, I decided against it. Hence, participants gave a single score for narrative engagement.

Overall, the narrative engaged participants with median scores of four and above for all but two items for panellists. On all but three of the twelve items, naïve respondents scored higher than panellists.

**Table 6.5**

*Engagement*

Narrative Engagement Statements	Panel ( <i>n</i> = 10)			New Respondents ( <i>n</i> = 43)		
	Median	Mean	S.D.	Median	Mean	S.D.
<b>Narrative Understanding:</b> At points, I had a hard time making sense of what was going on in the story. ( <i>R</i> )	3.00	3.60	1.84	4.00	4.42	1.67
My understanding of the characters is unclear. ( <i>R</i> )	5.50	5.10	1.45	6.00	5.07	1.60
I had a hard time recognizing the thread of the story. ( <i>R</i> )	6.00	5.20	1.62	6.00	5.37	1.50

---

<b>Attentional Focus:</b> I found my mind wandering while experiencing the story. ( <i>R</i> )	5.00	4.70	2.16	6.00	5.30	1.80
While experiencing the story, I found myself thinking about other things. ( <i>R</i> )	6.50	5.60	1.90	6.00	5.51	1.70
I had a hard time keeping my mind on the story. ( <i>R</i> )	6.50	5.70	2.00	6.00	5.79	1.58
<b>Narrative Presence:</b> During the story, my body was in the room, but my mind was inside the world created by the story.	4.00	3.80	2.49	5.00	4.91	1.72
The story created a new world, and then that world suddenly disappeared when the story ended.	5.00	3.90	2.38	5.00	4.53	1.58
At times during the story, the story world was closer to me than the real world.	4.50	3.60	2.17	4.00	4.16	1.59
<b>Emotional Engagement:</b> The story affected me emotionally.	3.50	3.60	2.01	4.00	3.86	1.57
During the story, when the main character succeeded, I felt happy, and when they suffered in some way, I felt sad.	4.00	3.70	2.31	5.00	4.91	1.70
I felt sorry for some of the characters in the story.	5.00	4.60	2.01	6.00	5.42	1.68

---

The two lowest scores for panellists indicated they had some difficulty making sense of the story and also that it lacked emotional effect. While the story engaged participants, it was not truly immersive in that they were observing rather than interacting and shaping the narrative. Other factors such as multiple video clips rather than a seamless narrative and a limited backstory and exposure to the characters may also have limited the story's emotional effect.

### **Table 6.6**

#### *Website Back Story for Nathan and Simon*

So, let's meet two individuals who have chosen to upload—Nathan and Simon—and follow their uploading journeys. The back story on each:

Nathan is a software developer, aged 27 at the time of death from a punctured lung in a car accident. He is uploaded to Lakeview, from Horizon, which is a virtual world populated by uploads who exist as life-like avatars.

Simon works in a bookstore and initially had his brain scanned as part of a recovery effort after he was involved in a car crash. Simon's existence as an upload spans several worlds including an underwater facility on Earth—the only place to have survived a meteor collision. There are references to the ARK, a virtual reality containing human brain scans which when launched into space would safeguard the last humans. Catherine, who features in some segments, is a brain scan of a Computer Scientist who was working on the ARK.

#### **6.14.7 Summary of Emotional Effect**

At this point, it is relevant to assess the emotional affective aspect measured in the transportation scale against emotional engagement from narrative engagement and the discrete emotions participants experienced.

There was the strongest agreement with the statement that participants “felt sorry” for some of the characters, presumably Nathan and Simon since they were



the only ones who featured significantly. In terms of the discrete emotions experienced the most common were “liking,” “worry,” and “anxiety.”

However, the median scores indicated that participants found it fairly easy to put the story out of their mind while the scores for emotional engagement showed that the story did not affect participants emotionally although there was some mirroring of the characters' emotions particularly from new respondents.

#### **6.14.8 Character Identification**

The questions relating to identification with the character were asked for both Nathan and Simon. The identification scale ran from 1—“strongly disagree” to 7—“strongly agree” and, hence, a higher score indicated greater agreement.

The data indicated that respondents identified with both characters with median scores from both groups of four and above. There was a tendency for the new respondents to identify more strongly with Nathan and Simon than the panellists.

A minority commented on the reasons for not identifying fully with the characters and some threads span both characters such as insufficient characterisation and a limited backstory or context to the character's choices. It was only in a couple of cases that participants only felt unable to identify with the characters because of demographics such as age, gender, culture, and race. Individuals described Nathan as “naïve” and seeming to upload for “personal gratification.” A few found Simon’s story harder to understand or the first-person gameplay dehumanised him and made the story less realistic. Individuals commented that Nathan’s life was too “sanitized,” whereas Simon’s situation and

emotions were rawer, and that he seemed more conscious and aware: for example, of the ethical issues involved in mind uploading.

**Table 6.7**

*Character Identification – Nathan and Simon*

Identification Statements	Panel (n = 10)			New Respondents (n = 43)		
	Median	Mean	S.D.	Median	Mean	S.D.
I think I understand Nathan well.	5.00	4.30	1.77	5.00	5.26	1.27
I think I understand Simon well.	5.00	4.30	1.77	5.00	4.74	1.58
I understood the events in the story the way Nathan understood them.	4.50	4.00	1.70	5.00	5.02	1.21
I understood the events in the story the way Simon understood them.	4.50	4.00	1.70	5.00	4.81	1.64
While viewing, I felt like Nathan felt.	4.00	3.70	2.16	5.00	4.88	1.45
While viewing, I felt like Simon felt.	4.00	3.70	2.16	5.00	4.77	1.67
During viewing, I could really “get inside” Nathan’s head.	4.00	4.00	2.00	5.00	4.88	1.31
During viewing, I could really “get inside” Simon’s head.	4.00	4.00	2.00	5.00	4.58	1.74
I tend to understand why Nathan did what he did.	5.00	5.00	2.69	5.00	5.30	1.32

---

I tend to understand why Simon did what he did.	5.00	4.50	2.07	5.00	4.79	1.68
---	------	------	------	------	------	------

---

Given the limitations of the media, participants identified well with Nathan and Simon. Verbatim quotes illustrate both the downsides and the positives of the approach. Please note that participants are identified by ID (e.g., xx).

The experience is clear, sadness is sadness, feelings feel the same, but you never know, I feel there was insufficient characterisation. (6)

It felt somewhat unrealistic. It probably didn't help that I have watched Upload so know the wider context. I also felt Nathan seemed to be very unlike me and it seemed like a distorted version of reality that lacked nuance. For comparison, it reminded me of the TV series Friends which is in no way representative of a group of "friends" in their mid to late 20s/early 30s living in NY. Everything is too sanitised, and Nathan does not appear to be dying when uploaded. I wish I had more information about the decision to be uploaded - did he make the decision himself or his family after the car accident? What choices has he been offered? What terms of agreements before giving consent? (8)

I found it easier to identify with Simon as the emotions expressed seemed rawer, but perhaps that is because it is an RPG format as opposed to a comedy sci-fi series. The storyline emphasises the tech part of the uploading process, shows not once the face or full body of Simon uses the voice in all scenes, and touches upon the materiality of uploaded Simon in arms and hands - looking like VR or AR or a combination of the two. The effect is rather claustrophobic and the emotions, in my view, are feeling trapped in a digital world as a mind with some consciousness, neither dead nor alive, in the sense we know it in real life. This makes it very unappealing, like the worst possible scenario in a world where uploading is a possibility. I did identify with him. (8)

I think because it was presented in a game view whereas the other video with Nathan was truer to life. (45)

The first story (Nathan's) was shallower so I could understand it from the given videos. The second one feels like there is a whole story missing for me. (32)

Because I didn't actually see Simon only saw what he would see, it was difficult for me to identify with him. Made him seem less human to me.

Looked like a game rather than reality so more difficult for me to relate to him. (56)

### **6.15 Overall Reaction to the Narrative**

Toward the end of the survey, I gave participants the option to offer improvements to the narrative itself. There were some suggestions, but overall, comments confirmed that the storytelling approach was effective. Improvements included some areas that have already been discussed, such as a longer, more integrated narrative and more background to the characters and their story. There was also interest in knowing more about how Nathan and Simon's stories as uploads unfolded. However, others praised the fact that the narratives were an effective method of "painting a picture," enabling them to experience and reflect on the implications of a future where mind uploading exists. The following quotations illustrate these opinions:

Both stories made me ponder over the concept, feel what's at stake, and form an opinion or feel more comfortable developing an argument in favour or against. Picking two different storylines was also very helpful to see more schools of imaginative thought. Well done! (9)

It was interesting. You could maybe try to create your own videos rather than using a TV show and game. (25)

It paints the picture, but you can make it more real. (28)

The story is very interesting and mind-blowing, I wanted to see how it all ended and I wish it was longer. (38)

Maybe giving us links to other parts of the story if we wanted—I was invested! (45)

I think the story is well put together and with a lot of detail so I would add interaction with other people who uploaded. (52)

More realism, less fantasy-related realities, the first video footage is a better example of reality where if you have the money you get the better

experiences, where the computer game scenarios with multiple mind upload abilities tend to detract from the overall core of the program. (57)

It was thought-provoking and for me opens a whole world of debate. I enjoyed it as it is. (59)

### **6.16 Reaction to the Website Design**

Participants were also asked how, if at all, the website could be improved. The majority praised rather than suggested finding the website appealing, user-friendly, and easy to navigate. While a few would have preferred a different colour palette, most improvements involved making the video clips bigger or full screen and one person suggested accessibility features such as an option to change the font size. However, overall reactions were positive, as shown below:

The website is user-friendly and easy to navigate. I did not experience any difficulties. (27)

The website is beautiful and easy to navigate, there is nothing to change at all. (38)

The website is good also. Just the videos, I wasn't able to put in full screen, but I was able to see it well anyway. (47)

Video pop-ups should be bigger and allow using full screen for a more immersive experience. (52)

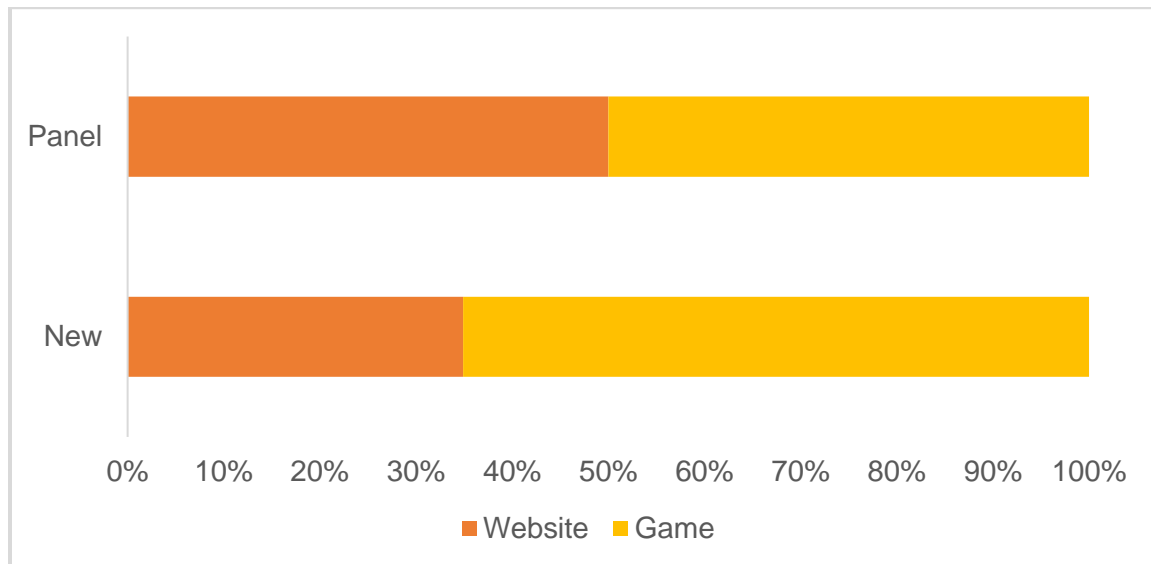
It was easy to use and navigate, therefore I wouldn't make any changes. (3)

### **6.17 Future Developments**

Participants were asked if they felt the narrative would be more engaging as a storytelling website or a game. As Figure 56 shows, while the panel was split equally, almost two-thirds of new participants voted for a game.

**Figure 6.7**

*Preference for Storytelling Website vs. Game*



### **6.18 Participant’s Final Comments**

Many people had no other comments to make although several took the time to say how “interesting,” “enjoyable,” and “thought-provoking” the experience had been. Two new respondents suggested using video clips from Netflix’s *Altered Carbon*, as this also tackles a future world where a person’s memories and consciousness are stored on a device that can be transferred to new bodies.

### **6.19 Quality Assessment**

I knew from my prior research and anecdotal feedback that mind uploading sparked interest and a willingness to engage. This is new data since the two published papers on mind uploading did not qualitatively assess these aspects. However, I was conscious of the potential impact of asking participants, particularly new ones who had no loyalty to the project, to commit to approximately 60 minutes online. Known issues with long online surveys include lower response rate, partial

completions, or attrition and poorer quality of responses (Deutskens et al., 2004; Galesic & Bosnjak, 2009).

However, these issues were thankfully not evident in my study. New participants were recruited via Prolific, and the uptake or response rate did not appear to be an issue. Only five individuals “returned” the study on Prolific which could have been for several reasons including technical difficulties (although individuals would typically contact me first to see if I could resolve the issue), partial completions, or a withdrawal of consent. In addition, the quality of open-ended responses throughout was high, which indicates that interest was maintained. The quality of open-ended responses was qualitatively assessed from the level of detail provided as well as its salience to the question. Future work will consider quantifying this element to aid study replication.

## **6.20 Limitations**

On review and reflection, I have identified several limitations some of which I can address for the next version of the website and future research. I did not capture prior familiarity with *Upload* and *Soma* during recruitment; although, I did collect this information towards the end of the website. In retrospect, this could have introduced bias since it is well documented that exposure to a stimulus causes familiarity which leads to favourability, the mere exposure effect as meta-analysed by Bornstein (1989). While this was not an issue, as only two of the 53 participants had played *Soma* and four had seen *Upload*, I will add a screening questionnaire for the next phase of data collection.

Using objective measures such as recording physiological responses alongside subjective self-reporting would contribute to data on the accuracy of self-reporting. Future studies could potentially integrate both subjective and objective data; although, this would require careful consideration of the ethics including participant burden, intrusion, and collecting and storing sensitive personal data.

The small sample size and particularly the size of subgroups affected the statistical analyses. However, the next data collection will increase the sample size by  $n = 100$  which will bring the total sample to  $n = 153$ .

The website was shown to be an effective data collection tool and method of narrative transportation and engagement. However, on reflection, the story could be strengthened to increase emotional engagement and emotional impact. The quantity of data on narrative experience could also be refined and reduced. Website amendments, both to the narrative and the questionnaires, are discussed subsequently.

## **6.21 Discussion**

The storytelling website was designed as a data collection tool and novel method. Overall, it fulfilled both objectives, as shown by the detailed data on mind uploading themes and consistently high scores for transportation, narrative engagement, and identification with the characters. Participants were interested and invested enough to want to know more about the character's backgrounds and uploaded lives as well as additional detail about mind uploading. While additional content would increase the duration of the website experience, I could offset the



potential participant burden by collecting less data on the participant's narrative experience, particularly discrete emotions, and imagination.

### **6.21.1 Narrative Experience Assessment**

Emotion was measured in three ways: (a) as an item in transportation, (b) in emotional engagement (a sub-scale of narrative engagement), and (c) using discrete emotions. The transportation measure and the emotional engagement sub-scale both captured valuable data on emotional effect and empathy and sympathy for the characters.

Assessing an individual's imaginative capability via the Four-Factor Imagination Scale (FFIS) was not a direct measure of the website's effectiveness so from that perspective its contribution is debatable. However, I could investigate using the FFIS as a screening tool which tailors the website experience to an individual's imaginative capacity—this would require additional funding and resources.

### **6.21.2 Mind Uploading Stimulus Material**

The other amendments concern the mind uploading section, both in terms of stimulus material and questions. Where feasible I have tried to amend the website story, so it more closely follows the traditional three-act story arc. A specification for each act follows. The third column ("How") considers possible methods.

#### **Table 6.8**

*Narrative Arc*

---

**Act 1 Set-Up** *Introduce characters and character's worlds (before uploading and once uploaded)*

---

What	Why	How
Additional context and insight into characters in life and afterlife	Greater identification and empathy with characters	Footage of Nathan and Simon in the real world and their interactions with other people  Participants contributing to the development of existing characters e.g., contributing to existing personas, personalising characters  Empathy mapping to ascertain areas of strength and weakness

*Character's aim/dramatic question*

---

What	Why	How
Clarify Nathan's goals as an upload	Relevant to key concerns e.g. equitable access missing, corrupted, or deleted memories/data.	Footage from Upload

*Inciting Incident*

What	Why	How
Show for Nathan & Simon	Emphasises disruption to character's worlds	Footage from Upload & Soma

---

**Act 2 Confrontation** *The character faces multiple challenges and obstacles*

---

What	Why	How
Show Nathan's challenges	Relevant to mind uploading concerns e.g., missing	Footage from Upload

---

		memories, mind privacy	
<b>Act 3 Resolution</b>	<b>What</b>	<b>Why</b>	<b>How</b>
	Resolve Nathan's story	To provide a conclusion	Footage from Upload S3 Participants choose/vote on the ending
	Explore Simon's ending	To provide additional data on perceived outcomes of mind uploading	Participants choose/vote for 1 of the 2 endings in Soma

The detail underpinning the summary in Table 6.8 is in Appendix J.

## 6.22 Conclusions

The positive results clearly show that the website was an effective method for conveying the mind uploading narrative and a novel data collection tool. Future iterations will develop the method for example by strengthening empathy and emotional impact as outlined in the Discussion. I will also assess other areas where the website could be made more interactive through, for example, branching narratives where participant's decisions affect the story.

The website was the final study in my PhD, but I have funding for an additional data collection phase. This is timetabled for early 2024 and will research an additional 100 participants to achieve a larger more equal, diverse, and inclusive sample. It will include underrepresented or underserved publics with a range of backgrounds including minoritized ethnicities. This phase will use the existing website to allow for direct data comparisons. Thereafter, I plan to continue to research and engage with underrepresented or underserved publics to increase

their awareness and interest in science. British Science Week and The British Science Festival are initiatives that I will continue to contribute to.

My research highlights the importance of connecting the public with advances in neurotechnology. Other stakeholders, such as industry and policymakers, are working in this space, and the speed of development is such that there is a risk that new neurotechnology will be developed without considering the needs of society, both as individuals and a community or collective.

## Chapter 7 Discussion

This chapter concludes the thesis as follows. First, I provide an overview of current research before I consider the research gap and how my research addresses these questions. Finally, I acknowledge the limitations of my work and identify how to address these in future work.

### 7.1 Potential Impact of Neurotechnology

Mind uploading via whole brain emulation is one hypothetical future neurotechnology resulting from rapid developments in neuroscience, neurotechnology and AI. The potential impact of these advances and capabilities is far-reaching since neurotechnology is “poised to change the very essence of what it means to be human” (Hain et al., 2023, p.7) and has profound implications for human rights.

Neural data is a new domain of personal data described as “the ethical, legal, social, or natural principles of freedom or entitlement related to a person’s cerebral and mental domain” (Ienca, 2021, article 101258). These neurorights involve safeguarding not only our individual right to mental privacy, personal identity and agency but also ensuring fair and equitable access to neurotechnology throughout the population.

We are standing on the edge of a technological revolution, which coupled with promising medical research into longevity (Zhou et al., 2023) may profoundly alter what it means to be human. This dissertation takes a deep dive into this complex and important field and addresses a fundamental need to ensure responsible research and innovation (RRI) by early engagement with the public.

This focus on RRI aligns with the European Commission’s policy of RRI as “a strategy to align scientific and technological progress with socially desirable and acceptable ends.” (Ruiz-Mallén et al., 2021, p263.)

## **7.2 Research Considerations**

Expert audiences and policymakers are actively discussing the impact of this new technology. However, my cumulative learning from literature spanning neurotechnology and mind uploading echoes Burwell et al. (2017) namely, that our understanding of the public’s response is understudied.

Researchers working in this field (Funk et al., 2016; Laakasuo et al., 2018; Laakasuo et al., 2021; MacDuffie et al., 2022; Sample et al., 2020) emphasise the need to engage with the public as key stakeholders. My research has been driven by the importance of understanding public perceptions of advanced neurotechnology which could enhance human cognition beyond what might be considered “normal” or “natural” (Castelo et al., 2019; Erden & Brey 2023; Funk et al., 2016).

## **7.3 Scope of My Research**

My studies contribute new data to understudied areas and also demonstrate a deeper exploration and understanding of mind uploading. My RQs are reiterated in Figure 7.1.

**Figure 7.1**

*Research Questions and Chapters*

<b>How do the public feel about neurotechnology that may transform memory and mind and ultimately allow us to mind upload?</b>	
Chapter 2	<ul style="list-style-type: none"><li>• What consensus, if any, is there among experts on key concepts such as memory and mind?</li></ul>
Chapter 4	<ul style="list-style-type: none"><li>• How aware of these technologies are the public and how do they respond?</li><li>• How do public perceptions compare with an expert perspective?</li></ul>
Chapter 5	<ul style="list-style-type: none"><li>• How do the public describe, recall their own past and imagine their future?</li></ul>
Chapter 6	<ul style="list-style-type: none"><li>• How do the public respond to and experience future stories of mind uploading?</li></ul>

These RQs were explored through a complex multi-staged methodology. My research contributes new qualitative and quantitative data on mind uploading as well as a new method for researching and engaging the public via the storytelling website.

## **7.4 Key Results**

### **7.4.1 Expert Consensus on Key Concepts (e-Delphi study)**

This initial research established how multi-disciplinary experts defined memory and mind and their opinions on current and future technology. The e-Delphi study achieved its objective and ensured an expert perspective informed my research with the public. However, obtaining consensus on key definitions was

challenging likely because of the complexity of the topics and the multi-disciplinary sample.

A consensus definition of memory was broadly attained but expert commentary on the human mind reflected the ongoing debate on what constitutes a mind. When thinking of the relationship between brain, mind, and body, the experts surveyed tended towards materialism: namely, that “all entities and processes are composed of—or are reducible to—matter, material forces or physical processes” (Stack, 1998 in Routledge Encyclopaedia of Philosophy).

This replicates the assumptions of whole brain emulation and mind uploading that “the mind is viewed as an emergent property of the brain generated from and dependent upon neural activity, but nonetheless separate from it” (Voneida, 1998, p.1077). It may also support the view espoused by Sandberg (2008, p.5) that “WBE represents a formidable engineering and research problem, yet one which appears to have a well-defined goal and could, it would seem, be achieved by extrapolations of current technology.”

The weight of expert opinion was that the brain and mind are embodied and are integral and inseparable which reflects the body of scientific evidence (Fei, 2020). This challenges the assumptions for mind uploading which requires “brain-centeredness.” This states that in “order to produce accurate behaviour only the brain and some parts of the body need to be simulated, not the entire body” (Sandberg, 2008, p.15). I consider the theme of embodiment in more detail when discussing public research in section 7.4.3.



The e-Delphi study also contributed to scientific research on memory augmentation by introducing a scenario where we could hypothetically prevent memory degradation and/or store memories outside the biological brain. Expert commentary reinforced the importance of protecting neural data to safeguard individuals and to defend against a world that is highly likely to discriminate based on access to neurotechnology (Information Commissioner's Office, 2023).

#### ***7.4.2 How Public Perceptions compare with Experts***

My results provide new evidence to support the finding that experts, industry, and public audiences often diverge (Ho et al., 2011; MacDuffie et al., 2022). The experts had a wealth of published data to draw on whereas lay people more often drew on their own beliefs and experiences. The key differences in memory and mind were as follows:

- Experts considered memory and mind using empirical evidence while the public used a more personal lens. Both of these views are valid and point to the importance of considering the different levels of knowledge and priorities of all stakeholders so that their needs are met by future neurotechnology.
- Experts also used empirical evidence to classify memories and describe encoding, storage, and retrieval. The public was more likely to focus on how past experiences had influenced their identity. Both audiences acknowledged the fallibility of memory albeit for different reasons.
- Experts tended to accept a key assumption of whole brain emulation: namely, that the mind is an emergent property of the brain. In contrast the public tended

to ascribe metaphysical properties to the mind which has implications for how to frame whole brain emulation and mind uploading for different audiences.

In summary, my studies contribute new data on mind uploading to existing research on the differing beliefs that experts and the public have about a range of topics including the properties of memory (Simons & Chabris, 2011, 2012), genomic medicine (Sugawara et al., 2012), automated vehicles (Swain et al., 2023), and brain injury (Teresa L. Swift, 2001).

However, whatever their other differences, the ethics of neurotechnology or neurorights was a key theme for both expert and public audiences. They shared the same concerns that neural data is personal and sensitive, and its privacy and security are paramount. All could envisage scenarios where neural data could be misused and abused to the detriment of individuals. In addition, there were fears that unequal access to neurotechnology would create a greater divide between the privileged and disadvantaged. These concerns are evident in other research studies on neurotechnology (Funk et al., 2016; MacDuffie et al., 2022; Sample et al., 2020) and signpost the importance of a comprehensive understanding of the public response.

#### ***7.4.3 Public Awareness and Response to Mind Uploading***

As well as reporting on my studies, this section also considers additional research which would develop key themes. In particular, favourability towards mind uploading had increased significantly from 2020 to 2023. One factor could be the higher profile of neurotechnology and AI with scientific information available through open-access literature and widespread coverage in popular media.

Experience with AI, in particular, has likely increased due to transformative AI like ChatGPT.

Participants' theoretical willingness to upload if their physical body was dying also increased from 2020 to 2023. This, together with the increase in favourability towards the concept, may reflect an increased acceptance of neurotechnology even at the far end of the spectrum like mind uploading. However, I acknowledge that this may also reflect the participant profile in my research and potentially their access to new technology. My research makes a significant contribution to this understudied area and the next phase of data collection among underrepresented and underserved publics will expand the data set.

#### **7.4.3.1 Theology**

As Laakasuo et al. (2018) observed mind uploading with its promise of immortality has theological implications and my results contribute early qualitative data that religion, faith, and spirituality are influential. My findings are supported by previous studies on neurotechnology (Funk et al., 2016; Sample et al., 2020; Sattler & Pietralla, 2022; Wexler & Thibault, 2019) and may reflect a perception that enhancements rather than restoration are seen as “playing God.” There is, therefore, a clear opportunity to explore attitudes to mind uploading across different cultures and religions.

#### **7.4.3.2 Embodiment**

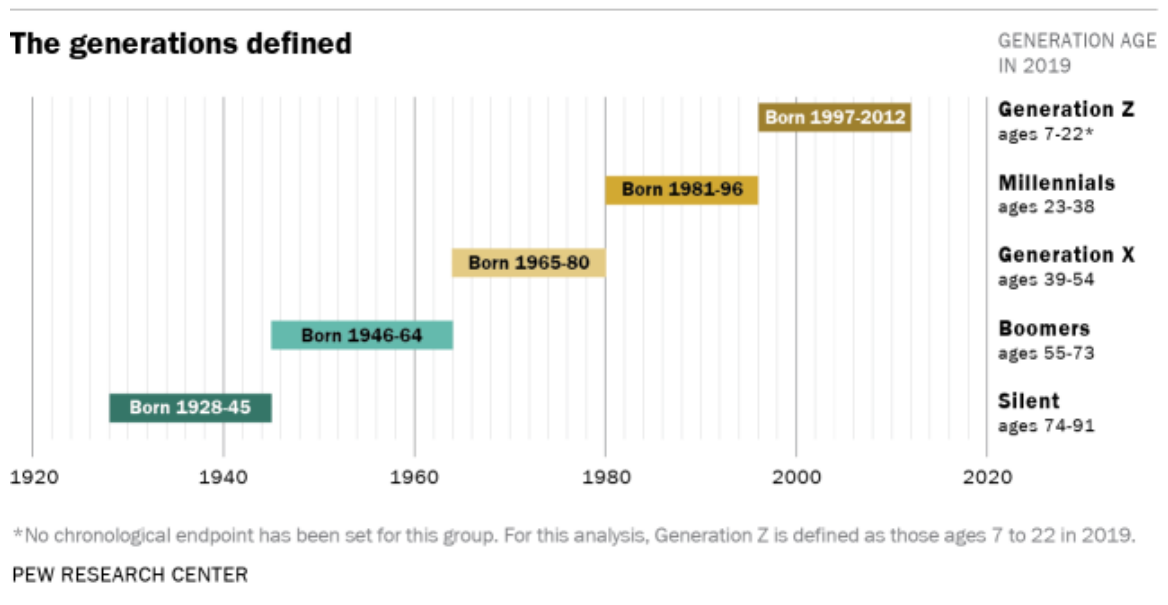
My research explored the acceptability of a range of options, including an avatar, a robot body, and another (unspecified) physical form. Participants preferred embodiment to existing as an avatar in a virtual world, which speaks to

the importance of being able to interact with others and the environment. It also supports the expert opinion that an emulated brain and mind would require some kind of body (Eth et al., 2013; Linssen & Lemmens, 2016; Sandberg, 2013). However, the option of a robot body, which has been proposed by experts, was unappealing and future research could explore physicality for example hybrid and organic forms in more depth.

Response to existing as an avatar in a virtual world may have been influenced by age of the sample since we know age (and social context) are influential in VR usage (more than 30% of Gen Z and Millennials have tried VR compared with 26% of Gen X and only 13% of Boomers; Dimock, 2019). The age of the participants was captured in age bands, so I cannot ascribe all website participants to Gen Z or Millennials. However, it appears that approximately a quarter could be Gen Z and around 40% Millennials. There is an opportunity to explore this further by sampling specifically in these age groups (see Figure 7.2).

## Figure 7.2

### Definition of Generations



### 7.4.3.3 Age

Age is also known to be relevant in technology acceptance. Several studies (Arras & Cerqui, 2005; Haslam et al., 2021; Sample et al., 2020; Sattler & Pietralla, 2022) have shown that younger individuals (not defined) are more likely to accept technologies that enhance cognitive abilities than older people. The sample was not designed to focus on age-related differences, but the average age of both the pilot and website participants was relatively young, around 30 years of age. This may have contributed to the acceptance of mind uploading. The effect of age could potentially be further investigated since additional data collection via the website is scheduled in early 2024, and this will include a higher proportion of older individuals.

#### **7.4.3.4 Sex.**

There was a higher proportion of females in the pilot, which may have influenced perceptions of risk with new technologies (Funk et al., 2016; Haslam et al., 2021; Sample et al., 2020; Sattler & Pietralla, 2022). This may reflect the finding that, as of 2017, women are still less positive towards technology than men as demonstrated by a meta-analysis, of empirical evidence over approximately 17 years (Cai et al., 2017). This gender gap could potentially be explored further since additional data collection via the website is scheduled for early 2024.

#### **7.4.4 *Public Recall of their Past, and Imagining Their Future***

Recalling, reflecting on, and sharing their life stories and hopes for the future engendered rapport and trust between me (the researcher) and panellists. It also strengthened their ongoing commitment to this longitudinal research and nearly all engaged with the final study. However, data from the new participants indicates that this commitment to extended engagement is not required for the website to be an effective data collection tool. My research was highly iterative, and the past and predicted memory interviews reflected this since study 2 was designed to address potential issues around the conceptualisation of the future. On reflection, this is best classified as a process that underpinned participants' response to mind uploading stories of the future.

#### **7.4.5 *Public Response to Future Stories of Mind Uploading***

I covered the contribution to understanding the public response to mind uploading as an exemplar of future neurotechnology in section 7.43. This section focuses on the methodological contribution of the storytelling website designed for

the final study although I acknowledge that I have only a limited understanding and that future interdisciplinary research such as in HCI would increase my contribution.

There is an immense body of work on storytelling and narrative both as a craft and a method but little on telling digital stories to conduct research into public opinions. There are open-access storytelling platforms such as threejs.org but these appear to primarily be used by individuals or organisations to provide information or market a brand. My research data on elements of narrative experience such as transportation, engagement, and character identification demonstrate that the website is a novel and effective story-telling method.

There are established methods to explore future technologies and worlds such as design fiction, speculative design, Contravision, and video games. However, the storytelling website is unique in that it bridges storytelling and speculative design and contributes a new data collection tool and a novel method for engaging the public with future technology. Future work developing the website could involve collaboration with experts in these fields.

## **7.5 Limitations**

Comparative data for public research on mind uploading is limited and hence, the theoretical foundation is undeveloped. However, the importance of public opinion is becoming more widely acknowledged and additional studies, including my own, will reflect this.

Overall, the complex, multi-staged study design achieved its objectives, but study 2 (longitudinal interviews) may have been superfluous since the website can

stand alone as an effective method and data collection tool for mind uploading. The interviews included established qualitative methods for researching memories and life stories, such as photo elicitation (Harper, 2002). However, the study design was focused on the process of extended engagement rather than as a method for memory research and as such there are limitations in my analysis.

The e-Delphi study method lacks a standardised definition of consensus for either quantitative research or qualitative work, which affects replicability and reproducibility. I chose experts from a variety of different but interrelated fields to reflect the topics of memory and mind. However, while this variety generated rich and complex data, it may have contributed to the difficulty in achieving consensus. In addition, the response rate was low which may have affected the validity of the responses.

My studies lacked a diverse and inclusive sample, most often excluding older people and minoritized ethnicities. The next stage of data collection ( $n = 100$ ) in 2024 will prioritise underrepresented and underserved publics, but additional studies are needed to study the impact of factors like age, sex, and religion/faith.

The global pandemic also impacted the methods I used. I had originally planned to conduct a mix of face-to-face and online research, but this had to be amended to online methods only. However, these restrictions will hopefully not exist for future research.



## **7.6 Future Research**

There is considerable scope for further research among the public, but I have focused on two potential routes which each explore a different perspective on researching mind uploading as an exemplar for future neurotechnology.

### ***7.6.1 Physiological Measures of Narrative Experience***

The website captured self-reported measurements of narrative experience that were initially conceived as a precursor to objective, physiological measures. This area is under-researched and additional data would contribute to an understanding of the relationship between the two methods.

I could extend the work conducted by Richardson et al. (2020) that measured brain activity, heart rate, electrodermal activity/galvanic skin response, and temperature. It is possible to limit the invasiveness of the techniques by not requiring real-time accuracy and avoiding the use of expensive, specialised equipment (Romine et al., 2020). Initial investigations indicate that measuring heart rate would be the best solution specifically using the optical heart rate sensor on smartwatches, which are widely adopted. Research has shown that the heart rate acquired from the smartwatch is reasonably accurate with a high degree of correlation to commonly used ECG and PPG devices (Phan et al., 2015).

### ***7.6.2 Design Fiction & Science Fiction***

Design fiction is a recognised method in HCI (Blythe, 2017; Coulton et al., 2018; Lindley, 2015; Lindley & Coulton, 2015; Lindley & Potts, 2014). The website is not strictly speaking “design” fiction since it focuses on the fictional future rather than design, but it shares the same objective of allowing the public to explore and

reflect on potential futures. There are also parallels in the creation of imaginary scenarios, worlds, and characters with which audiences become closely identified (Coulton et al., 2016; Coulton et al., 2018; Jordan & Silva, 2021).

While design fiction may have more academic credibility than science fiction my research confirms that science fiction “shapes the understanding of the public on things like artificial intelligence and biotechnology” Barr Kirtley (2018). Science fiction also provided visual use cases for the final stage of my research with the public and helped “expose important ethical questions and dilemmas” (Jordan & Silva, 2021, p.8).

The use of science fiction as a research space is currently underexplored, but academics with expertise in science fiction for education and research are interested in my work and there is already early dialogue about research collaboration. Initial research indicates this route offers the opportunity to continue to explore novel methods as well as engage the public.

## **7.7 Personal Reflection**

The programme of research described here has led me to revisit and reflect on my own views on mind uploading potentially via WBE from a preserved brain. I believe WBE is an achievable albeit ambitious goal and ‘the mind is what the brain does’ (Minsky, 1987) and that aspects such as subjective experience are a result of neural activity. To me this in no way detracts from the wondrous capabilities of a human brain and mind. I think that that an emulated brain and mind would need a physical form and sensory input to function effectively and in common with most participants I would prefer a physical body to an avatar. Although Simon’s rusty

robot body in Soma is unappealing, I would happily exist as a high-tech robot with enhanced capabilities if that overcame the trials of an ageing body! The concept of mind uploading is fascinating but my work has highlighted the ethical challenges and the risks inherent in accessing such highly personal and sensitive neural data. In particular it is hard to envisage how ethical frameworks would be regulated globally and how we will ensure fair and equitable access to such technology.

## **7.8 Concluding Statements**

The expert study highlighted the complexity of neurotechnology and the rapid advances in these domains, especially when partnered with AI. While these developments have immense potential, they come with considerable ethical challenges.

My work exploring public understanding of neurotechnology - including future developments such as mind uploading - contributes new knowledge and signposts future work in these domains. It also speaks to the importance of responsible research and innovations in the context of research policy (Weinberger et al., 2021, p.3) which recommend “societal participation at the early stage of envisioning research questions, technologies, and futures”

My programme of studies demonstrate how RRI can be embedded into the research pathway and contributes to the objective that neurotechnology is ethically developed and adopted inclusively thus “forging a new social contract between society and technoscience” (Flink & Kaldewey, 2018, p.19)

My research makes a significant contribution to an understudied field by providing new empirical data on mind uploading from both an expert and lay public

perspective. At the heart of my studies is an innovative story telling website which is an accessible global resource for public engagement and research. This addresses a clear need by allowing the public to contribute to on-going debates on innovations in neurotechnology and related fields such as digital technology and AI.

## REFERENCES

- Addis, D. R. (2018). Are episodic memories special? On the sameness of remembered and imagined event simulation. *Journal of the Royal Society of New Zealand*, 48(2–3), 64–88.  
<https://doi.org/10.1080/03036758.2018.1439071>
- Addis, D. R. (2020). Mental time travel? A neurocognitive model of event simulation. *Review of Philosophy and Psychology*, 11(2), 233–259.  
<https://doi.org/10.1007/s13164-020-00470-0>
- Adnan, Y., & Daud, M. (2010). Factors influencing office building occupation decision by tenants in Kuala Lumpur City Centre – a Delphi study. *Journal of Design and the Built Environment*, 6(1)
- Agar, J. (2020). What is technology? *Annals of Science*, 77(3), 377–382.  
<https://doi.org/10.1080/00033790.2019.1672788>
- Agar, N. (2016). 184 Enhancement, mind-uploading, and personal identity. In S. Clarke, J. Savulescu, T. Coady, A. Giubilini, & S. Sanyal (Eds.), *The ethics of human enhancement: Understanding the debate*. Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780198754855.003.0013>
- Allen Institute for Brain Science (<https://alleninstitute.org/>)
- Anderson, C. (2010). Presenting and Evaluating Qualitative Research. *American Journal of Pharmaceutical Education*, 74(8).  
<https://doi.org/10.5688/aj7408141>
- Anderson, B.(Director). (2014). *The Simpsons* [Television series]. Fox.
- Andonovski, N. (2022). Episodic representation: A mental models account. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.899371>
- Ang, C. S. (2006). Rules, gameplay, and narratives in video games. *Simulation & Gaming*, 37(3), 306–325. <https://doi.org/10.1177/1046878105285604>
- Anguera, M. T., Blanco-Villaseñor, A., Losada, J. L., Sánchez-Algarra, P., & Onwuegbuzie, A. J. (2018). Revisiting the difference between mixed methods and multimethods: Is it all in the name? *Quality & Quantity*, 52(6), 2757–2770. <https://doi.org/10.1007/s11135-018-0700-2>
- Appel, M., Gnambs, T., Richter, T., & Green, M. C. (2015). The transportation scale–Short form (TS–SF). *Media Psychology*, 18(2), 243–266.  
<https://doi.org/10.1080/15213269.2014.987400>

- Appel, M., Koch, E., Schreier, M., & Groeben, N. (2002). Aspekte des leserlebens: Skalenentwicklung. *Zeitschrift für Medienpsychologie*, 14(4), 149–154. <https://doi.org/10.1026/1617-6383.14.4.149>
- Armstrong, J. & Brooker, C. (Writers) & Welsh, B.(Director). (2011 December 18). The Entire History of You (Season 1 Episode 3). [TV Series episode]. In C. Brooker, A. Jones (Executive Producers), Black Mirror ITA. Zeppotron, Channel 4 Television Corporation, Babieka
- Arnold, B., & Eddy, B. (2007). *Exploring visual storytelling*. Cengage Learning.
- Arras, K. O., & Cerqui, D. (2005). *Do we want to share our lives and bodies with robots? A 2000-people survey*. <http://hdl.handle.net/20.500.11850/82619>
- Ashton, R. H. (1986). Combining the judgments of experts: How many and which ones? *Organizational Behavior and Human Decision Processes*, 38(3), 405–414. [https://doi.org/10.1016/0749-5978\(86\)90009-9](https://doi.org/10.1016/0749-5978(86)90009-9).
- Aybek, E., & Toraman, C. (2022). How many response categories are sufficient for Likert-type scales? An empirical study based on the item response theory. *International Journal of Assessment and Evaluation*, 9(X), 534–547. <https://doi.org/10.21449/ijate.1132931>
- Baird, A. (2019). A reflection on the complexity of the self in severe dementia. *Cogent Psychology*, 6(1), Article 1574055. <https://doi.org/10.1080/23311908.2019.1574055>
- Bardecki, M. J. (1984). Participants' response to the Delphi method: An attitudinal perspective. *Technological Forecasting and Social Change*, 25(3), 281–292. [https://doi.org/10.1016/0040-1625\(84\)90006-4](https://doi.org/10.1016/0040-1625(84)90006-4)
- Barnett, S. F. H., & Goult, B. T. (2022). The MeshCODE to scale—Visualising synaptic binary information. *Frontiers in Cellular Neuroscience*, 16. <https://doi.org/10.3389/fncel.2022.1014629>
- Barrett, D., & Heale, R. (2020). What are Delphi studies? *Evidence Based Nursing*, 23(3), 68–69. <https://doi.org/10.1136/ebnurs-2020-103303>
- Barr Kirtley, D. (Host. (2018-present). Yuval Noah Narai Interview [Audio podcast]. <https://youtu.be/XRgrvIVbOGw?si=j4BQKs7vwHdMQ1Vo>
- Barsalou, L. W. (1988). The content and organization of autobiographical memories. In E. Winograd & U. Neisser (Eds.), *Remembering reconsidered: Ecological and traditional approaches to the study of memory* (pp. 193-243). Cambridge University Press. <https://doi.org/DOI:10.1017/CBO9780511664014.009>

- Barwell, I. (2009). Understanding narratives and narrative understanding. *The Journal of Aesthetics and Art Criticism*, 67(1), 49–59.  
<http://www.jstor.org/stable/40206389>
- Batty, E. (2020). Sorry to say goodbye: The dilemmas of letting go in longitudinal research. *Qualitative Research*, 20(6), 784–799.  
<https://doi.org/10.1177/1468794120905737>
- Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. *Review of General Psychology*, 5(4), 323–370.  
<https://doi.org/10.1037/1089-2680.5.4.3>
- Beaty, R. E., Chen, Q., Christensen, A. P., Qiu, J., Silvia, P. J., & Schacter, D. L. (2018). Brain networks of the imaginative mind: Dynamic functional connectivity of default and cognitive control networks relates to openness to experience. *Human Brain Mapping*, 39(2), 811–821.  
<https://doi.org/https://doi.org/10.1002/hbm.23884>
- Bell, A. J. W. (1981). *The hitchhikers guide to the galaxy* [Television series]. British Broadcasting Corporation (BBC).
- Benbasat, I. (2010). HCI research: Future challenges and directions. *AIS Transactions on Human-Computer Interaction*, 2(2), 16-21.  
<https://aisel.aisnet.org/thci/vol2/iss2/1>
- Benoit, R. G., & Schacter, D. L. (2015). Specifying the core network supporting episodic simulation and episodic memory by activation likelihood estimation. *Neuropsychologia*, 75, 450–457.  
<https://doi.org/10.1016/j.neuropsychologia.2015.06.034>
- Berecz, J. (1976). Toward a monistic philosophy of man. *Andrews University Seminary Studies*, 14(2), 279–288.  
<https://digitalcommons.andrews.edu/auss/vol14/iss2/11>
- Bezdek, M. A., & Gerrig, R. J. (2017). When narrative transportation narrows attention: Changes in attentional focus during suspenseful film viewing. *Media Psychology*, 20(1), 60–89.  
<https://doi.org/10.1080/15213269.2015.1121830>
- Bishop, F. L. (2015). Using mixed methods research designs in health psychology: An illustrated discussion from a pragmatist perspective. *British Journal of Health Psychology*, 20(1), 5–20.  
<https://doi.org/https://doi.org/10.1111/bjhp.12122>
- Bjerke, I. E., Øvsthus, M., Papp, E. A., Yates, S. C., Silvestri, L., Fiorilli, J., Pennartz, C. M. A., Pavone, F. S., Puchades, M. A., Leergaard, T. B., & Bjaalie, J. G. (2018). Data integration through brain atlasing: Human Brain

- Project tools and strategies. *European Psychiatry*, 50, 70–76.  
<https://doi.org/https://doi.org/10.1016/j.eurpsy.2018.02.004>
- Bluck, S., & Habermas, T. (2000). The life story schema. *Motivation and Emotion*, 24, 121–147. <https://doi.org/10.1023/A:1005615331901>
- Blue Brain Project (<https://www.epfl.ch/research/domains/bluebrain/>)
- Blythe, M. (2017). *Research fiction: Storytelling, plot and design*. Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (pp. 5400–5411). Denver, Colorado, USA.  
<https://doi.org/10.1145/3025453.3026023>
- Boccia, M., Teghil, A., & Guariglia, C. (2019). Looking into recent and remote past: Meta-analytic evidence for cortical re-organization of episodic autobiographical memories. *Neuroscience & Biobehavioral Reviews*, 107, 84–95. <https://doi.org/10.1016/j.neubiorev.2019.09.003>
- Bolger, F., & Wright, G. (1994). The quality of expert probability judgement: Issues and analysis. *Expert Systems*, 11(3), 149–158.  
<https://doi.org/10.1111/j.1468-0394.1994.tb00321.x>
- Bornstein, R. F. (1989). Exposure and affect: Overview and meta-analysis of research, 1968–1987. *Psychological Bulletin*, 106(2), 265–289.  
<https://doi.org/10.1037/0033-2909.106.2.265>
- Bostrom, N. (2003). Astronomical waste: The opportunity cost of delayed technological development. *Utilitas*, 15(3), 308–314. <https://doi.org/10.1017/S0953820800004076/>
- Bostrom, N., & Sandberg, A. (2008). Whole brain emulation: A roadmap. *Lancet Univ.*
- Boulkedid, R., Abdoul, H., Loustau, M., Sibony, O., & Alberti, C. (2011). Using and reporting the Delphi method for selecting healthcare quality indicators: A systematic review. *PLOS ONE*, 6(6), Article e20476. <https://doi.org/10.1371/journal.pone.0020476>
- Bowling, A. (2014). *Research methods in health: investigating health and health services*. McGraw-Hill Education (UK).
- BRAIN Initiative (<https://braininitiative.nih.gov/>)
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.  
<https://doi.org/10.1191/1478088706qp063oa>



- Brewer, J., & Hunter, A. (2006). *Foundations of multimethod research: Synthesizing styles*. Sage.
- Brod, S., & Gais, S. (2020). Memory engrams in the neocortex. *The Neuroscientist*, 27(4), 427–444. <https://doi.org/10.1177/1073858420941528>
- Brown, A., Kouri, N., & Hirst, W. (2012). Memory's malleability: Its role in shaping collective memory and social identity. *Frontiers in Psychology*, 3. <https://doi.org/10.3389/fpsyg.2012.00257>
- Brueckner, A. (2005). Branching in the psychological approach to personal identity. *Analysis*, 65(4), 294–301. <http://www.jstor.org/stable/3329083>
- Bruner, J. S. (1990). *Acts of meaning: Four lectures on mind and culture* (Vol. 3). Harvard University Press.
- Brunyé, T. T., Ditman, T., Mahoney, C. R., Augustyn, J. S., & Taylor, H. A. (2009). When you and I share perspectives: pronouns modulate perspective taking during narrative comprehension. *Psychological Science*, 20(1), 27–32. <https://doi.org/10.1111/j.1467-9280.2008.02249.x>
- Bryman, A. (1988). *Quantity and Quality in Social Research* (1st ed.). Routledge. <https://doi.org/10.4324/9780203410028>
- Buben, A. (2022). Do immortals need an eject button? Sartre and the importance of always having an exit. *European Journal of Philosophy*, 30(3), 1135–1146. <https://doi.org/https://doi.org/10.1111/ejop.12718>
- Burwell, S., Sample, M., & Racine, E. (2017). Ethical aspects of brain computer interfaces: A scoping review. *BMC medical ethics*, 18(1), 1–11. <https://doi.org/10.1186/s12910-017-0220-y>
- Busselle, R., & Bilandzic, H. (2009). Measuring narrative engagement. *Media Psychology*, 12(4), 321–347. <https://doi.org/10.1080/15213260903287259>
- Butlin, P., Long, R., Elmoznino, E., Bengio, Y., Birch, J., Constant, A., Deane, G., Fleming, S. M., Frith, C., & Ji, X. (2023). Consciousness in artificial intelligence: Insights from the science of consciousness. *arXiv preprint arXiv:2308.08708*.
- Buzsáki, G. (2019). *The brain from inside out*. Oxford University Press.
- Cai, Z., Fan, X., & Du, J. (2017). Gender and attitudes toward technology use: A meta-analysis. *Computers & Education*, 105, 1–13. <https://doi.org/10.1016/j.compedu.2016.11.003>

- Calman, L., Brunton, L., & Molassiotis, A. (2013). Developing longitudinal qualitative designs: Lessons learned and recommendations for health services research. *BMC Medical Research Methodology*, 13(1), 14. <https://doi.org/10.1186/1471-2288-13-14>
- Cambridge Dictionary. (2023). Transhumanism. <https://dictionary.cambridge.org/dictionary/english/transhumanism>
- Cameron, J. (2009). *Avatar* [Film]. 20th Century Fox
- Campbell, K. L., Madore, K. P., Benoit, R. G., Thakral, P. P., & Schacter, D. L. (2018). Increased hippocampus to ventromedial prefrontal connectivity during the construction of episodic future events. *Hippocampus*, 28(2), 76–80. <https://doi.org/10.1002/hipo.22812>
- Cantone, D. (2022). The simulated body: A Preliminary investigation into the relationship between neuroscientific studies, phenomenology and virtual reality. *Foundations of Science*. <https://doi.org/10.1007/s10699-022-09849-x>
- Cappuccio, M. L. (2017). Mind-upload. The ultimate challenge to the embodied mind theory. *Phenomenology and the Cognitive Sciences*, 16(3), 425–448. <https://doi.org/10.1007/s11097-016-9464-0>
- Caramel Column Inc. (2018). *Alter ego*. In (Version 3.6.11) [App].
- Caroline Tynan, A., & Drayton, J. L. (1988). Conducting focus groups — A guide for first-time users. *Marketing Intelligence & Planning*, 6(1), 5–9. <https://doi.org/10.1108/eb045757>
- Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum*, 41(5), 545–547. <https://doi.org/10.1188/14.Onf.545-547>
- Castelo, N., Schmitt, B., & Sarvary, M. (2019). Human or robot? Consumer responses to radical cognitive enhancement products. *Journal of the Association for Consumer Research*, 4(3), 217–230. <https://doi.org/10.1086/703462>
- Cellan Jones, S., & Shindler, N. (Executive Producers). (2019). *Years and Years* [Television Series]. Red Production Company.
- Cerullo, M. A. (2015). Uploading and branching identity. *Minds and Machines*, 25(1), 17–36. <https://doi.org/10.1007/s11023-014-9352-8>
- Chalmers, D. J. (1995). Facing up to the problem of consciousness. *Journal of Consciousness Studies*, 2(3), 200–219. <https://doi.org/10.1093>

- Chalmers, D. J. (2010). *The singularity: A philosophical analysis*.  
<http://consc.net/papers/singularity.pdf>
- Chalmers, D. J. (2014). Uploading: A philosophical analysis. In R. Blackford & D. Broderick (Eds.), *Intelligence unbound* (pp. 102–118). John Wiley & Sons. <https://doi.org/10.1002/9781118736302.ch6>
- Chalmers, I. (1999). People are “participants” in research. Further suggestions for other terms to describe “participants” are needed. *British Medical Journal*, 318(7191), 1141a. <https://doi.org/10.1136/bmj.318.7191.1141a>
- Chatman, S. (1980). *Story and Discourse: Narrative Structure in Fiction and Film*. Cornell University Press. <https://doi.org/doi:10.1515/9781501741616>
- Chung, A. H., & Slater, M. D. (2013). Reducing stigma and out-group distinctions through perspective-taking in narratives. *Journal of Communication*, 63(5), 894–911. <https://doi.org/10.1111/jcom.12050>
- Clarke, A. C. (1955). *The City and the Stars*.(New Ed).Gateway
- Cohen, B. A. (2017). How should novelty be valued in science? *eLife*, 6, Article e28699. <https://doi.org/10.7554/eLife.28699>
- Cohen, J. (1992). Statistical power analysis. *Current Directions in Psychological Science*, 1(3), 98–101. <https://doi.org/10.1111/1467-8721.ep10768783>
- Cohen, J. (2001). Defining identification: A theoretical look at the identification of audiences with media characters. *Mass Communication and Society*, 4(3), 245–264. [https://doi.org/10.1207/S15327825MCS0403\\_01](https://doi.org/10.1207/S15327825MCS0403_01)
- Coman, A., Brown, A. D., Koppel, J., & Hirst, W. (2009). Collective memory from a psychological perspective. *International Journal of Politics, Culture, and Society*, 22(2), 125–141. <http://www.jstor.org/stable/40608220>
- Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language*, 53(4), 594–628. <https://doi.org/https://doi.org/10.1016/j.jml.2005.08.005>
- Cookson, C. (2023, July 12). AI-driven neurotechnology ‘on steroids’ needs regulation, says UNESCO. *The Financial Times*, Neurotechnology. <https://www.ft.com/content/48afd321-5323-449c-aacf-7562f38b2799>
- Corballis, M. C. (2019). Language, memory, and mental time travel: An evolutionary perspective. *Frontiers in Human Neuroscience*, 13. <https://doi.org/10.3389/fnhum.2019.00217>
- Coulton, P., Burnett, D. J., & Gradinar, A. (2016). *Games as speculative design: Allowing players to consider alternate presents and plausible futures*. Design Research Society Conference. 27–30 June 2016. Brighton, UK.

- Coulton, P., Lindley, J., & Cooper, R. (2018). *The little book of design fiction for the internet of things*. Lancaster University
- Couper, M. R. (1984). The Delphi technique: Characteristics and sequence model. *ANS Advances in Nursing Science*, 7(1), 72–77. <https://doi.org/10.1097/00012272-198410000-00008>
- Couros, A., Montgomery, K., Tupper, J., Hildebrandt, K., Naytowhow, J., & Lewis, P. J. (2013). Storying treaties and the treaty relationship: Enhancing treaty education through digital storytelling. *International Review of Qualitative Research*, 6(4), 544–558. <https://doi.org/10.1525/irqr.2013.6.4.544>
- Creswell, J. W., Ebersohn, L., Eloff, I., Ferreira, R., Ivankova, N. V., Jansen, J. D., Nieuwenhuis, J., Pietersen, J., Plano Clark, V., & Van der Westhuizen, C. (2016). *First steps in research*. Pretoria: Van Schaik Publishers.
- Crick, Francis, and Christof Koch. "Towards a Neurobiological Theory of Consciousness." *Seminars in the Neurosciences* 2, (1990): 263-275. Article. 13 Images.. *Seminars in the Neurosciences*
- Cuc, A., Koppel, J., & Hirst, W. (2007). Silence Is not golden: A case for socially shared retrieval-induced forgetting. *Psychological Science*, 18(8), 727–733. <https://doi.org/10.1111/j.1467-9280.2007.01967.x>
- Cuc, A., Ozuru, Y., Manier, D., & Hirst, W. (2006). On the formation of collective memories: The role of a dominant narrator. *Memory & Cognition*, 34(4), 752–762. <https://doi.org/10.3758/BF03193423>
- Cuhls, K., Giessen, A., & Toivanen, H. (2015). *Models of horizon scanning - How to integrate horizon scanning into European research and innovation policies*. <https://doi.org/10.13140/RG.2.1.1938.7766>
- Custer, R. L., Scarcella, J. A., & Stewart, B. R. (1999). The modified Delphi technique - A rotational modification. *Journal of Vocational and Technical Education*, 15(2), 50-58. <https://doi.org/10.21061/jcte.v15i2.702>
- Cutcliffe, J. R. (2003). . Reconsidering Reflexivity: Introducing the Case for Intellectual Entrepreneurship. *Qualitative Health Research*, 13(1), 136-148 <https://doi.org/10.1177/1049732302239416>
- Cutcliffe, J. R., & McKenna, H. P. (1999). Establishing the credibility of qualitative research findings: the plot thickens. *Journal of Advanced Nursing*, 30, 374-380. <https://doi.org/10.1046/j.1365-2648.1999.01090.x>
- Dahlstrom, M. F. (2014). Using narratives and storytelling to communicate science with nonexpert audiences. *Proceedings of the National Academy of Sciences*, 111(supplement\_4), 13614–13620. <https://doi.org/doi:10.1073/pnas.1320645111>

- Dalkey, N., & Helmer, O. (1963). An experimental application of the Delphi method to the use of experts. *Management Science*, 9(3), 458–467. <https://doi.org/10.1287/mnsc.9.3.458>
- Daniels, G., & Klein, H. (Executive Producers). (2020–present). *Upload* [Television series]. Deedle-Dee Productions
- Databasix (2024). <https://www.dbxuk.com/blog-2023/data-protection-laws-around-the-world>
- Davies, R. (2005-present). *Doctor Who* [Television series]. British Broadcasting Corporation (BBC)
- Davis, J. K. (2022). The desirability and morality of life extension. In C. S. Wareham (Ed.), *The Cambridge handbook of the ethics of ageing* (pp. 257–269). Cambridge University Press. <https://doi.org/10.1017/9781108861168.019>
- Day, J., & Bobeva, M. (2005). A generic toolkit for the successful management of Delphi studies. *Electronic Journal of Business Research Methods*, 3(2), 103–116. <https://api.semanticscholar.org/CorpusID:16382198>
- De Graaf, A. (2014). The effectiveness of adaptation of the protagonist in narrative impact: Similarity influences health beliefs through self-referencing. *Human Communication Research*, 40(1), 73–90. <https://doi.org/10.1111/hcre.12015>
- Dehaene, S., & Changeux, J.-P. (2011). Experimental and theoretical approaches to conscious processing. *Neuron*, 70(2), 200–227. <https://doi.org/https://doi.org/10.1016/j.neuron.2011.03.018>
- Denzin, N. K. (2009). *The research act: A theoretical introduction to sociological methods*. Routledge. <https://doi.org/https://doi.org/10.4324/9781315134543>
- Deutskens, E., de Ruyter, K., Wetzels, M., & Oosterveld, P. (2004). Response rate and response quality of internet-based surveys: An experimental study. *Marketing Letters*, 15(1), 21–36. <https://doi.org/10.1023/b:mark.0000021968.86465.00>
- Dewey, D., Kaplan, B. J., Crawford, S. G., & Wilson, B. N. (2002). Developmental coordination disorder: associated problems in attention, learning, and psychosocial adjustment. *Human movement science*, 21(5-6), 905–918. [https://doi.org/10.1016/s0167-9457\(02\)00163-x](https://doi.org/10.1016/s0167-9457(02)00163-x)
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64, 135–168. <https://doi.org/10.1146/annurev-psych-113011-143750>

- Diamond, I. R., Grant, R. C., Feldman, B. M., Pencharz, P. B., Ling, S. C., Moore, A. M., & Wales, P. W. (2014). Defining consensus: A systematic review recommends methodologic criteria for reporting Delphi studies. *Journal of Clinical Epidemiology*, *67*(4), 401–409. <https://doi.org/10.1016/j.jclinepi.2013.12.002>
- Diamond, N. B., Armson, M. J., & Levine, B. (2020). The truth is out there: Accuracy in recall of verifiable real-world events. *Psychological Science*, *31*(12), 1544–1556. <https://doi.org/10.1177/0956797620954812>
- Dickson-Swift, V., James, E. L., Kippen, S., & Liamputtong, P. (2006). Blurring boundaries in qualitative health research on sensitive topics. *Qualitative Health Research*, *16*(6), 853–871. <https://doi.org/10.1177/1049732306287526>
- Dillon, S., & Craig, C. (2021). *Story listening: Narrative evidence and public reasoning*. Routledge.
- Dimock, M. (2019 January 17). Defining generations: Where Millennials end and Generation Z begins. <https://www.pewresearch.org/short-reads/2019/01/17/where-millennials-end-and-generation-z-begins/>
- Dirckx, S. (2019). *Am I just my brain?* The Good Book Company. <https://books.google.co.uk/books?id=EQTPDwAAQBAJ>
- Doherty, S., & Nelson, R. (2010). Using projective techniques to tap into consumers' feelings, perceptions and attitudes ... Getting an honest opinion. *International Journal of Consumer Studies*, *34*(4), 400–404. <https://doi.org/10.1111/j.1470-6431.2010.00880.x>
- Donoghue, S. (2000). Projective techniques in consumer research. *Journal of Consumer Sciences*, *28*
- Donohoe, H., Stellefson, M., & Tennant, B. (2012). Advantages and limitations of the e-Delphi technique. *American Journal of Health Education*, *43*(1), 38–46. <https://doi.org/10.1080/19325037.2012.10599216>
- Dorahy, M. J., Huntjens, R. J. C., Marsh, R. J., Johnson, B., Fox, K., & Middleton, W. (2021). The sense of self over time: Assessing diachronicity in dissociative identity disorder, psychosis and healthy comparison groups. *Frontiers in Psychology*, *12*, 620063–620063. <https://doi.org/10.3389/fpsyg.2021.620063>
- Egan, K. (1992). Imagination in teaching and learning. Ages 8–15. *British Journal of Educational Studies*, *40*(4), 415–417. <https://doi.org/10.2307/3121055>
- Eggen, P.D. (2020). Information Processing and Human Memory. <https://doi.org/10.1093/acrefore/9780190264093.013.864>

- Ekman, P. (1992). An argument for basic emotions. *Cognition & Emotion*, 6(3–4), 169–200.
- Emerging Issues Task Force, International Neuroethics Society (2019) Neuroethics at 15: The Current and Future Environment for Neuroethics, *AJOB Neuroscience*, 10:3, 104-110, 10.10 https://doi.org/80/21507740.2019.1632958
- Erden, Y. J., & Brey, P. (2023). Neurotechnology and ethics guidelines for human enhancement: The case of the hippocampal cognitive prosthesis. *Artificial Organs*, 47(8), 1235–1241. https://doi.org/10.1111/aor.14615
- Eth, D., Foust, J.-C., & Whale, B. (2013). The prospects of whole brain emulation within the next half-century. *Journal of Artificial General Intelligence*, 4(3), 130–152. https://doi.org/10.2478/jagi-2013-0008
- Fazio, S., & Mitchell, D. B. (2009). Persistence of self in individuals with Alzheimer's disease: Evidence from language and visual recognition. *Dementia*, 8(1), 39–59. https://doi.org/10.1177/1471301208099044
- Fei, D. (2020). From the mind isolated with the body to the mind being embodied: Contemporary approaches to the philosophy of the body. *Cultures of Science*, 3(3), 206–219. https://doi.org/10.1177/2096608320960242
- Feltzer, Y. M. (2010). Doing Mixed Methods Research Pragmatically: Implications for the Rediscovery of Pragmatism as a Research Paradigm. *Journal of Mixed Methods Research*, 4, 6-16. https://doi.org/10.1177/1558689809349691
- Fern, E. F. (1982). The use of focus groups for idea generation: The effects of group size, acquaintanceship, and moderator on response quantity and quality. *Journal of Marketing Research*, 19(1), 1–13. https://doi.org/10.2307/3151525
- Finch, H., Lewis, J., & Turley, C. (2003). Focus groups. *Qualitative research practice: A guide for social science students and researchers*. Sage.
- Finstad, K. (2009). Response interpolation and scale sensitivity: Evidence against 5-point scales. *Journal of User Experience*, 5(3), 104–110.
- Fischer, V., & O'Mara, S. M. (2022). Neural, psychological, and social foundations of collective memory: Implications for common mnemonic processes, agency, and identity. *Progress in Brain Research*, 274(1), 1–30. https://doi.org/10.1016/bs.pbr.2022.07.004
- Fivush, R., Habermas, T., Waters, T. E. A., & Zaman, W. (2011). The making of autobiographical memory: Intersections of culture, narratives and identity.

*International Journal of Psychology*, 46(5), 321–345.  
<https://doi.org/10.1080/00207594.2011.596541>

- Flink, T., & Kaldewey, D. (2018). The new production of legitimacy: STI policy discourses beyond the contract metaphor. *Research Policy*, 47(1), 14–22. <https://doi.org/10.1016/j.respol.2017.09.008>.
- Fludernik, M., & Pirlet, C. (2012). Narratology. In M. Middeke, T. Müller, C. Wald, & H. Zapf (Eds.), *English and American studies: Theory and practice* (pp. 225–230). J.B. Metzler. [https://doi.org/10.1007/978-3-476-00406-2\\_13](https://doi.org/10.1007/978-3-476-00406-2_13)
- Frankl, V. E. (1985). *Man's search for meaning*. Simon and Schuster.
- Frictional Games. (2015). *Soma*.
- Funk, C., Kennedy, B., & Sciupac, E. P. (2016). US public wary of biomedical technologies to enhance human abilities. <https://www.pewresearch.org/science/2016/07/26/u-s-public-wary-of-biomedical-technologies-to-enhance-human-abilities/>
- Gabbert, Fiona, and Rebecca Wheeler, 'Memory Conformity Following Collaborative Remembering', in Michelle L. Meade, and others (eds), *Collaborative Remembering: Theories, Research, and Applications* (Oxford, 2017; online edn, Oxford Academic, 18 Jan. 2018), <https://doi.org/10.1093/oso/9780198737865.003.0006>, pbr.2022.07.004
- Galdas, P. (2017). Revisiting Bias in Qualitative Research: Reflections on Its Relationship With Funding and Impact. *International Journal of Qualitative Methods*, 16(1). <https://doi.org/10.1177/1609406917748992>
- Galesic, M., & Bosnjak, M. (2009). Effects of questionnaire length on participation and indicators of response quality in a web survey. *Public Opinion Quarterly*, 73(2), 349–360. <https://doi.org/10.1093/poq/nfp031>
- García-Gavilanes, R., Mollgaard, A., Tsvetkova, M., & Yasseri, T. (2017). The memory remains: Understanding collective memory in the digital age. *Science Advances*, 3(4), Article e1602368. <https://doi.org/doi:10.1126/sciadv.1602368>
- Gargon, E., Crew, R., Burnside, G., & Williamson, P. R. (2019). Higher number of items associated with significantly lower response rates in COS Delphi surveys. *Journal of Clinical Epidemiology*, 108, 110–120. <https://doi.org/https://doi.org/10.1016/j.jclinepi.2018.12.010>
- Gasparyan, A. Y., Yessirkepov, M., Duisenova, A., Trukhachev, V. I., Kostyukova, E. I., & Kitas, G. D. (2018). Researcher and author impact metrics: variety, value, and context. *Journal of Korean Medical Science*, 33(18):e139. <https://doi.org/10.3346/jkms.2018.33.e139>



- Gaver, W., Krogh, P. G., Boucher, A., & Chatting, D. (2022). Emergence as a feature of practice-based design research. *Proceedings of the 2022 ACM Designing Interactive Systems Conference* (pp. 517–526). <https://doi.org/10.1145/3532106.3533524>
- Gavrilova, N. S., & Gavrilov, L. A. (2019). Are we approaching a biological limit to human longevity? *The Journals of Gerontology: Series A*, 75(6), 1061–1067. <https://doi.org/10.1093/gerona/glz164>
- Geraci, R. M. (2010). *Apocalyptic AI: Visions of heaven in robotics, artificial intelligence, and virtual reality*. Oxford University Press.
- Gerrig, R. J. (1993). *Experiencing narrative worlds: On the psychological activities of reading*. Yale University Press.
- Gibson, A., & Lang, C. The pragmatic maxim as learning analytics research method. Proceedings of the 8th International Conference on Learning Analytics and Knowledge. <https://doi.org/10.1145/3170358.3170384>
- Gilgun, J. F. (2008). Lived Experience, Reflexivity, and Research on Perpetrators of Interpersonal Violence. *Qualitative Social Work*, 7(2), 181-197. <https://doi.org/10.1177/1473325008089629>
- Glaser, B. G. (1992). *Basics of Grounded Theory Analysis*. Mill Valley, CA: Sociology Press.
- Glaser, B. G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. Mill Valley, CA: Sociology Press.
- Glaser, B. G., Author, B. B., & Author, C. C. (1998). *Doing Grounded Theory: Issues and Discussions*. Mill Valley, CA: Sociology Press.
- Goff, P. (2017). Panpsychism. In *The Blackwell companion to consciousness* (pp. 106–124). <https://doi.org/https://doi.org/10.1002/9781119132363.ch8>
- Goff, P. (2019). <https://philipgoffphilosophy.com/books>
- Goldman Sachs (2023, August 1). AI investment forecast to approach \$200 billion globally by 2025. <https://www.goldmansachs.com/intelligence/pages/ai-investment-forecast-to-approach-200-billion-globally-by-2025.html>
- Goldwater, J. (2021). Uploads, faxes, and you: Can personal identity be transmitted? *American Philosophical Quarterly*, 58(3), 233–250.
- Gondry. (2004). *The eternal sunshine of the spotless mind*. Anonymous; Content This Is That.

- Gordon, R., Ciorciari, J., & van Laer, T. (2018). Using EEG to examine the role of attention, working memory, emotion, and imagination in narrative transportation. *European Journal of Marketing*, *52*(1/2), 92–117. <https://doi.org/10.1108/EJM-12-2016-0881>
- Goult, B. T. (2021). The mechanical basis of memory - The MeshCODE theory. *Frontiers in Molecular Neuroscience*, *14*, Article 592951. <https://doi.org/10.3389/fnmol.2021.592951>
- Gray, D. E. (2004). *Doing research in the real world*. Sage.
- Graziano, M. S. A. (2019). *Rethinking consciousness: A scientific theory of subjective experience*. W.W. Norton & Company.
- Green, J. D., Reid, C. A., Kneuer, M. A., & Hedgebeth, M. V. (2023). The Proust effect: Scents, food, and nostalgia. *Current Opinion Psychol*, *50*, Article 101562. <https://doi.org/10.1016/j.copsyc.2023.101562>
- Green, M. C. (2004). Transportation into narrative worlds: The role of prior knowledge and perceived realism. *Discourse Processes*, *38*(2), 247–266. [https://doi.org/10.1207/s15326950dp3802\\_5](https://doi.org/10.1207/s15326950dp3802_5)
- Green, M. C. (2007). Linking self and others through narrative. *Psychological Inquiry*, *18*(2), 100–102. <http://www.jstor.org/stable/20447364>
- Green, M. C. (2008). Research challenges: Research challenges in narrative persuasion. *Information Design Journal*, *16*(1), 47–52. <https://doi.org/https://doi.org/10.1075/idj.16.1.07gre>
- Green, M. C. (2021). Transportation into narrative worlds. In L. B. Frank & P. Falzone (Eds.), *Entertainment-education behind the scenes: Case studies for theory and practice* (pp. 87–101). Springer International Publishing. [https://doi.org/10.1007/978-3-030-63614-2\\_6](https://doi.org/10.1007/978-3-030-63614-2_6)
- Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of Personality and Social Psychology*, *79*(5), 701–721. <https://doi.org/10.1037/0022-3514.79.5.701>
- Green, M. C., & Brock, T. C. (2002). In the mind's eye: Transportation-imagery model of narrative persuasion. In M. C. Green, J. J. Strange, & T. C. Brock (Eds.), *Narrative impact: Social and cognitive foundations* (pp. 315–341). Lawrence Erlbaum Associates Publishers.
- Green, M. C., Chatham, C., & Sestir, M. A. (2012). Emotion and transportation into fact and fiction. *Scientific Study of Literature*, *2*(1), 37–59. <https://doi.org/https://doi.org/10.1075/ssol.2.1.03gre>

- Green, M. C., & Jenkins, K. M. (2014). Interactive narratives: Processes and outcomes in user-directed stories. *Journal of Communication*, 64(3), 479–500. <https://doi.org/10.1111/jcom.12093>
- Green, M. (2014, September 09). *Narrative Form* [Lecture]
- Gripp, T. (2013). The five foundational design pillars of SOMA. <https://frictionalgames.com/2013-12-the-five-foundational-design-pillars-of-soma/>
- Guerini, R., Marraffa, M., Meini, C., & Paternoster, A. (2019). Editorial: Self and memory: A multidisciplinary debate. *Frontiers in Psychology*, 9. <https://doi.org/10.3389/fpsyg.2018.02676>
- Guest, G., & Fleming, P. (2015). *Public health research methods*. Sage. <https://doi.org/10.4135/9781483398839>
- Guo, Y., Lu, Z., Kuang, H., & Wang, C. (2020). Information avoidance behavior on social network sites: Information irrelevance, overload, and the moderating role of time pressure. *International Journal of Information Management*, 52, Article 102067. <https://doi.org/10.1016/j.ijinfomgt.2020.102067>.
- Hain, D., Jurowetzki, R., Squicciarini, M., & Xu, L. (2023). Unveiling the neurotechnology landscape: Scientific advancements, innovations, and major trends. United Nations Educational, Scientific, and Cultural Organization.
- Hamby, A., Motro, D., Shawver, Z., & Gerrig, R. (2023). Examining readers' emotional responses to stories. *Journal of Media Psychology*, 35(3), 131–144. <https://doi.org/10.1027/1864-1105/a000356>
- Hammarberg, K., Kirkman, M., & de Lacey, S. (2016). Qualitative research methods: When to use them and how to judge them. *Human reproduction*, 31(3), 498–501. <https://doi.org/10.1093/humrep/dev334>
- Hampson, R. E., Song, D., Robinson, B. S., Fetterhoff, D., Dakos, A. S., Roeder, B. M., She, X., Wicks, R. T., Witcher, M. R., Couture, D. E., Laxton, A. W., Munger-Clary, H., Popli, G., Sollman, M. J., Whitlow, C. T., Marmarelis, V. Z., Berger, T. W., & Deadwyler, S. A. (2018). Developing a hippocampal neural prosthetic to facilitate human memory encoding and recall. *Journal of neural engineering*, 15(3), 036014. <https://doi.org/10.1088/1741-2552/aaaed7>
- Hanson, R. (2016). *The Age of Em: Work, Love, and Life when Robots Rule the Earth*. OUP Oxford.

- Harari, Y. N. (2018). Geeks guide to the galaxy. In D. B. Kirtley (Ed.), *Interview*. <https://www.wired.com/2018/09/geeks-guide-yuval-noah-harari/>
- Harmon-Jones, C., Bastian, B., & Harmon-Jones, E. (2016). The discrete emotions questionnaire: A new tool for measuring state self-reported emotions. *PLOS ONE*, *11*(8), Article e0159915. <https://doi.org/10.1371/journal.pone.0159915>
- Harper, D. (2002). Talking about pictures: A case for photo elicitation. *Visual Studies*, *17*(1), 13–26. <https://doi.org/10.1080/14725860220137345>
- Harris, C. B., Paterson, H. M., & Kemp, R. I. (2008). Collaborative recall and collective memory: What happens when we remember together? *Memory*, *16*(3), 213–230. <https://doi.org/10.1080/09658210701811862>
- Haslam, M., Yaden, D., & Medaglia, J. D. (2021). Moral framing and mechanisms influence public willingness to optimize cognition. *Journal of Cognitive Enhancement*, *5*(2), 176–187. <https://doi.org/10.1007/s41465-020-00190-4>
- Hassabis, D., & Maguire, E. A. (2007). Deconstructing episodic memory with construction. *Trends in Cognitive Sciences*, *11*(7), 299–306. <https://doi.org/https://doi.org/10.1016/j.tics.2007.05.001>
- Hasson, F., Keeney, S., & McKenna, H. (2000). Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing*, *32*(4), 1008–1015.
- Hennink, M. M. (2014). *Understanding Focus Group Discussions*. OUP USA.
- Herman, D. (2009). *Basic elements of narrative*. John Wiley & Sons.
- Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences*, *102*(46), 16569–16572. <https://doi.org/doi:10.1073/pnas.0507655102>
- Ho, S., Scheufele, D., & Corley, E. (2011). Value predispositions, mass media, and attitudes toward nanotechnology: The interplay of public and experts. *Science Communication*, *33*, 167–200. <https://doi.org/10.1177/1075547010380386>
- Hodgetts, C. J., Shine, J. P., Lawrence, A. D., Downing, P. E., & Graham, K. S. (2016). Evidencing a place for the hippocampus within the core scene processing network. *Human Brain Mapping*, *37*(11), 3779–3794. <https://doi.org/https://doi.org/10.1002/hbm.23275>
- Höhne, J. K., Krebs, D., & Kühnel, S. M. (2021). Measurement properties of completely and end labeled unipolar and bipolar scales in Likert-type questions on income (in)equality. *Social Science Research*, *97*, Article 102544. <https://doi.org/10.1016/j.ssresearch.2021.102544>

- Holtrop, J. S., Scherer, L. D., Matlock, D. D., Glasgow, R. E., & Green, L. A. (2021). The importance of mental models in implementation science. *Front Public Health*, 9, Article 680316. <https://doi.org/10.3389/fpubh.2021.680316>
- Hrastinski, S., & Jandrić, P. (2023). Imagining education futures: Researchers as fiction authors. *Postdigital Science and Education*, 5(3), 509–515. <https://doi.org/10.1007/s42438-023-00403-x>
- Hsieh, H.-F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277–1288. <https://doi.org/10.1177/1049732305276687>
- Hughes, J. (2007). The Computability of Religious and Transhumanist Views of Metaphysics, Suffering, Virtue and Transcendence in an Enhanced Future. The Institute of Ethics and Emerging Technologies. <http://ieet.org/archive/20070326-Hughes-ASU-H+Religion.pdf>.
- Human Brain Project (<https://www.humanbrainproject.eu/en/>)
- Human Connectome Project (<https://www.humanconnectome.org/>)
- Ienca, M. (2021). On neurorights. *Frontiers in Human Neuroscience*, 15. <https://doi.org/10.3389/fnhum.2021.701258>
- Ienca, M., & Malgieri, G. (2022). Mental data protection and the GDPR. *Journal of Law and the Biosciences*, 9(1), <https://doi.org/10.1093/jlb/ljac006>
- Inayatullah, S. (2013). Futures studies. Theories and methods. In N. Al-Fodham (Ed.), *There's a future. Visions for a better world* (pp. 36–66). BBVA Group.
- Information Commissioner's Office. (2023). *Tech futures - Neurotechnology*. <https://ico.org.uk/media/about-the-ico/research-and-reports/ico-tech-futures-neurotechnology-0-1.pdf>
- Ip, B. (2011). Narrative structures in computer and video games: Part 1: Context, definitions, and initial findings. *Games and Culture*, 6(2), 103–134. <https://doi.org/10.1177/1555412010364982>
- Izard, C. E. (1991). *The psychology of emotions*. Springer Science & Business Media.
- Jacques, P. L. S., Carpenter, A. C., Szpunar, K. K., & Schacter, D. L. (2018). Remembering and imagining alternative versions of the personal past. *Neuropsychologia*, 110, 170–179. <https://doi.org/10.1016/j.neuropsychologia.2017.06.015>

- Jamieson, S. (2004). Likert scales: How to (ab)use them. *Medical Education*, 38(12), 1217–1218. <https://doi.org/https://doi.org/10.1111/j.1365-2929.2004.02012.x>
- Jankowska, D. M., & Karwowski, M. (2015). Measuring creative imagery abilities. *Frontiers in Psychology*, 6. <https://doi.org/10.3389/fpsyg.2015.01591>
- Jarrier, E., Bourgeon-Renault, D., Derbaix, M., & Petr, C. (2017, June 24). *Narrative transportation scale: Measure development for transmedia experience* 14th International Conference on Arts and Culture Management, Beijing, China. <https://hal.science/hal-02139849>
- Jennings, G. R. (2005). Business, social science methods used in. In K. Kempf-Leonard (Ed.), *Encyclopedia of social measurement* (pp. 219–230). Elsevier. <https://doi.org/https://doi.org/10.1016/B0-12-369398-5/00270-X>
- Johnson, G. A., Tian, Y., Ashbrook, D. G., Cofer, G. P., Cook, J. J., Gee, J. C., Hall, A., Hornburg, K., Kaczorowski, C. C., Qi, Y., Yeh, F.-C., Wang, N., White, L. E., & Williams, R. W. (2023). Merged magnetic resonance and light sheet microscopy of the whole mouse brain. *Proceedings of the National Academy of Sciences*, 120(17), Article e2218617120. <https://doi.org/doi:10.1073/pnas.2218617120>
- Johnson, J. L., Adkins, D., & Chauvin, S. (2020). A review of the quality indicators of rigor in qualitative research. *American Journal of Pharmaceutical Education*, 84(1), Article 7120. <https://doi.org/10.5688/ajpe7120>
- Johnson-Laird, P., Joshi, A., Webber, B., & Sag, I. (1981). *Elements of discourse understanding*. Cambridge University Press.
- Jones, A., & Brooker, C. (Executive Producers). (2011–present). *Black Mirror* [Television Series]. Zeppotron.
- Jones, J., & Hunter, D. (1995). Qualitative research: Consensus methods for medical and health services research. *British Medical Journal*, 311(7001), 376–380. <https://doi.org/10.1136/bmj.311.7001.376>
- Jonides, J., Lewis, R. L., Nee, D. E., Lustig, C. A., Berman, M. G., & Moore, K. S. (2008). The mind and brain of short-term memory. *Annual Review of Psychology*, 59(1), 193–224. <https://doi.org/10.1146/annurev.psych.59.103006.093615>
- Jordan, P., & Silva, P. A. (2021, July). Science fiction—an untapped opportunity in HCI research and education. In International Conference on Human-Computer Interaction (pp. 34-47). Cham: Springer International Publishing.

- Jorm, A. F. (2015). Using the Delphi expert consensus method in mental health research. *Australian and New Zealand Journal of Psychiatry*, 49(10), 887–897. <https://doi.org/10.1177/0004867415600891>
- Josselyn, S. A., Köhler, S., & Frankland, P. W. (2015). Finding the engram. *Nature Reviews Neuroscience*, 16(9), 521–534. <https://doi.org/10.1038/nrn4000>
- Jun, L. C. (2017). *I meet myself*. (Version 2.07) [App].
- Jung, R. E., Flores, R. A., & Hunter, D. (2016). A new measure of imagination ability: Anatomical brain imaging correlates. *Frontiers in Psychology*, 7. <https://doi.org/10.3389/fpsyg.2016.00496>
- Jünger, S., Payne, S. A., Brine, J., Radbruch, L., & Brearley, S. G. (2017). Guidance on conducting and Reporting Delphi studies (CREDES) in palliative care: Recommendations based on a methodological systematic review. *Palliative Medicine*, 31(8), 684–706. <https://doi.org/10.1177/0269216317690685>
- Kandel, E. R. (2007). *In search of memory: The emergence of a new science of mind*. WW Norton & Company.
- Keeney, S., McKenna, H. A., & Hasson, F. (2011). *The Delphi technique in nursing and health research*. John Wiley & Sons.
- Keightley, E. (2010). Remembering research: Memory and methodology in the social sciences. *International Journal of Social Research Methodology*, 13(1), 55–70. <https://doi.org/10.1080/13645570802605440>
- Keightley, E., & Schlesinger, P. (2014). Digital media - Social memory: Remembering in digitally networked times. *Media Culture & Society*, 36, 745–747. <https://doi.org/10.1177/0163443714532985>
- Kensinger, E. A., & Ford, J. H. (2020). Retrieval of emotional events from memory. *Annual Review of Psychology*, 71, 251–272. <https://doi.org/10.1146/annurev-psych-010419-051123>
- Key, B., Zalucki, O., & Brown, D. J. (2022). A first principles approach to subjective experience. *Frontiers in Systems Neuroscience*, 16. <https://doi.org/10.3389/fnsys.2022.756224>
- Kieliba, P., Clode, D., Maimon-Mor, R. O., & Makin, T. R. (2021). Robotic hand augmentation drives changes in neural body representation. *Science Robotics*, 6(54), Article eabd7935. <https://doi.org/doi:10.1126/scirobotics.abd7935>

- Kiely, K. M. (2014). Cognitive function. In A. C. Michalos (Ed.), *Encyclopedia of quality of life and well-being research* (pp. 974–978). Springer Netherlands. [https://doi.org/10.1007/978-94-007-0753-5\\_426](https://doi.org/10.1007/978-94-007-0753-5_426)
- Kim, T., & Biocca, F. (1997). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. *Journal of Computer-Mediated Communication*, 3(2). <https://doi.org/10.1111/j.1083-6101.1997.tb00073.x>
- Kirkeby-Hinrup, A., & Fazekas, P. (2021). Consciousness and inference to the best explanation: Compiling empirical evidence supporting the access-phenomenal distinction and the overflow hypothesis. *Consciousness and Cognition*, 94, Article 103173. <https://doi.org/https://doi.org/10.1016/j.concog.2021.103173>
- Klein, S. B. (2013). The complex act of projecting oneself into the future. *Wiley Interdisciplinary Reviews: Cognitive Science*, 4(1), 63–79. <https://doi.org/doi.org/10.1002/wcs.1210>
- Klein, S. B., Loftus, J., & Kihlstrom, J. F. (2002). Memory and temporal experience: The effects of episodic memory loss on an amnesic patient's ability to remember the past and imagine the future. *Social Cognition*, 20(5), 353–379. <https://doi.org/10.1521/soco.20.5.353.21125>
- Klein, S. B., Robertson, T. E., & Delton, A. W. (2010). Facing the future: Memory as an evolved system for planning future acts. *Memory & Cognition*, 38(1), 13–22. <https://doi.org/10.3758/MC.38.1.13>
- Kleynen, M., Braun, S., Bleijlevens, M., Lexis, M., Rasquin, S., Halfens, J., Wilson, M., Beurskens, A., & Masters, R. (2014). Using a Delphi technique to seek consensus regarding definitions, descriptions and classification of terms related to implicit and explicit forms of motor learning. *PLOS ONE*, 9, Article e100227. <https://doi.org/10.1371/journal.pone.0100227>
- Klimmt, C., Roth, C., Vermeulen, I., Vorderer, P., & Roth, F. S. (2012). Forecasting the experience of future entertainment technology: “Interactive storytelling” and media enjoyment. *Games and Culture: A Journal of Interactive Media*, 7, 187–208. <https://doi.org/10.1177/1555412012451123>
- Knowles, B., & Hanson, V. L. (2018). The wisdom of older technology (non)users. *Communications of the ACM*, 61(3), 72–77. <https://doi.org/10.1145/3179995>
- Koch, C. (2012). *Consciousness: Confessions of a romantic reductionist*. MIT Press.
- Koene, R. (2023). *Glossary*. The Carboncopies Foundation.



- Koene, R. A. (2013). Embracing competitive balance: The case for substrate-independent minds and whole brain emulation. In *Singularity Hypotheses: A Scientific and Philosophical Assessment* (pp. 241–267). Springer Science & Business Media.
- Koverola, M., Drosinou, M., Palomäki, J., Halonen, J., Kunnari, A., Repo, M., Lehtonen, N., & Laakasuo, M. (2020). Moral psychology of sex robots: An experimental study – How pathogen disgust is associated with interhuman sex but not interandroid sex. *Paladyn, Journal of Behavioral Robotics*, 11(1), 233–249. <https://doi.org/doi:10.1515/pjbr-2020-0012>
- Koverola, M., Kunnari, A., Drosinou, M., Palomäki, J., Hannikainen, I. R., Jirout Košová, M., Kopecký, R., Sundvall, J., & Laakasuo, M. (2022). Treatments approved, boosts eschewed: Moral limits of neurotechnological enhancement. *Journal of Experimental Social Psychology*, 102, Article 104351. <https://doi.org/https://doi.org/10.1016/j.jesp.2022.104351>
- Kreiner, G. (2016). The slavery of the h-index-Measuring the unmeasurable. *Frontiers in Human Neuroscience*, 10, 556. <https://doi.org/10.3389/fnhum.2016.00556>
- Kroes, M. C. W., & Fernández, G. (2012). Dynamic neural systems enable adaptive, flexible memories. *Neuroscience & Biobehavioral Reviews*, 36(7), 1646–1666. <https://doi.org/https://doi.org/10.1016/j.neubiorev.2012.02.014>
- Kujala, S., Walsh, T., Nurkka, P., & Crisan, M. (2013). Sentence completion for understanding users and evaluating user experience. *Interacting with Computers*, 26(3), 238–255. <https://doi.org/10.1093/iwc/iwt036>
- Kumar, N., Ali, Z., & Haldar, R. (2023). Novelty in research: A common reason for manuscript rejection! *Indian Journal of Anaesthesia*, 67(3), 245–246. [https://doi.org/10.4103/ija.ija\\_143\\_23](https://doi.org/10.4103/ija.ija_143_23)
- Laakasuo, M., Drosinou, M., Koverola, M., Kunnari, A., Halonen, J., Lehtonen, N., & Palomäki, J. (2018). What makes people approve or condemn mind upload technology? Untangling the effects of sexual disgust, purity and science fiction familiarity. *Palgrave Communications*, 4(1), 1–14. <https://doi.org/10.1057/s41599-018-0124-6>
- Laakasuo, M., Repo, M., Drosinou, M., Berg, A., Kunnari, A., Koverola, M., Saikkonen, T., Hannikainen, I. R., Visala, A., & Sundvall, J. (2021). The dark path to eternal life: Machiavellianism predicts approval of mind upload technology. *Personality and Individual Differences*, 177, Article 110731. <https://doi.org/https://doi.org/10.1016/j.paid.2021.110731>
- Lenic, J. G. (2018–2020). *Altered Carbon* [Television series]. Virago Productions.

- Levine, J. (1983). Materialism and qualia: The explanatory gap. *Pacific Philosophical Quarterly*, 64(4), 354–361.  
<https://doi.org/https://doi.org/10.1111/j.1468-0114.1983.tb00207.x>
- Lewis, P. J., & Hildebrandt, K., (2019). Storytelling as Qualitative Research, In P. Atkinson, S. Delamont, A. Cernat, J.W. Sakshaug, & R.A. Williams (Eds.), SAGE Research Methods Foundations.  
<https://doi.org/10.4135/9781526421036754858>
- Lewis, R. (2023, November 25). An Overview of the Leading Theories of Consciousness. *Psychology Today*.  
<https://www.psychologytoday.com/gb/blog/finding-purpose/202308/an-overview-of-the-leading-theories-of-consciousness>
- Licata, L., & Mercy, A. (2015). Collective memory, social psychology of. In J. D. Wright (Ed.), *International encyclopedia of the social & behavioral sciences* (2nd ed.; pp. 194–199). Elsevier.  
<https://doi.org/https://doi.org/10.1016/B978-0-08-097086-8.24046-4>
- Likert, R. (1932). A technique for the measurement of attitudes. In R. S. Woodworth (Ed.), *Archives of Psychology*, 22(140), 5–55.
- Lindley, J. (2015). *A pragmatics framework for design fiction*. Conference: European Academy of Design. <https://doi.org/10.7190/ead/2015/69>
- Lindley, J., & Coulton, P. (2015). *Back to the future: 10 years of design fiction* Proceedings of the 2015 British HCI Conference, Lincoln, Lincolnshire, United Kingdom. <https://doi.org/10.1145/2783446.2783592>
- Lindley, J., & Potts, R. (2014). *A machine learning: An example of HCI prototyping with design fiction*. Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational, Helsinki, Finland. <https://doi.org/10.1145/2639189.2670281>
- Linke, U. (2015). Collective memory, anthropology of. In J. D. Wright (Ed.), *International encyclopedia of the social & behavioral sciences* (2<sup>nd</sup> ed.; pp. 181–187). Elsevier. <https://doi.org/https://doi.org/10.1016/B978-0-08-097086-8.12036-7>
- Linssen, C., & Lemmens, P. (2016). Embodiment in whole-brain emulation and its implications for death anxiety. *Journal of Evolution and Technology*, 26(2), 1–15. [https://jetpress.org/v26.2/linssen\\_lemmens.pdf](https://jetpress.org/v26.2/linssen_lemmens.pdf)
- Livingstone, S. (1998). Audience research at the crossroads: The “implied audience” in media and cultural theory. *European Journal of Cultural Studies*, 1(2), 193–217. <https://doi.org/10.1177/136754949800100203>
- Luka Inc. (2017). *Replika*. (Version 9.5.1) [App].

- MacDuffie, K. E., Ransom, S., & Klein, E. (2022). Neuroethics inside and out: A comparative survey of neural device industry representatives and the general public on ethical issues and principles in neurotechnology. *AJOB Neuroscience*, *13*(1), 44–54.  
<https://doi.org/10.1080/21507740.2021.1896596>
- Maciel, C., & Pereira, V. C. (2013). Digital legacy and interaction. Human–Computer Interaction Series.
- Maher, C., Hadfield, M., Hutchings, M., & de Eyto, A. (2018). Ensuring rigor in qualitative data analysis: A design research approach to coding combining NVivo with traditional material methods. *International Journal of Qualitative Methods*, *17*(1), Article 1609406918786362.  
<https://doi.org/10.1177/1609406918786362>
- Makkonen, M., Hujala, T., & Uusivuori, J. (2016). Policy experts’ propensity to change their opinion along Delphi rounds. *Technological Forecasting and Social Change*, *109*, 61–68.  
<https://doi.org/https://doi.org/10.1016/j.techfore.2016.05.020>
- Marketsandmarkets.com. (2023). *Humanoid robot industry worth \$13.8 billion by 2028*. <https://www.marketsandmarkets.com/PressReleases/humanoid-robot.asp>
- Marks, D. F. (1973). Visual imagery differences in the recall of pictures. *British Journal of Psychology*, *64*(1), 17–24.  
<https://doi.org/https://doi.org/10.1111/j.2044-8295.1973.tb01322.x>
- Masci, D. (2013). *To count our days: The scientific and ethical dimensions of radical life extension*. <https://www.pewresearch.org/religion/2013/08/06/to-count-our-days-the-scientific-and-ethical-dimensions-of-radical-life-extension/>
- Maswood, R., Rasmussen, A. S., & Rajaram, S. (2019). Collaborative remembering of emotional autobiographical memories: Implications for emotion regulation and collective memory. *Journal of Experimental Psychology General*, *148*(1), 65–79. <https://doi.org/10.1037/xge0000468>
- Matar, J. L., Maybery, D. J., McLean, L. A., & Reupert, A. (2018). Web-based health intervention for young people who have a parent with a mental illness: Delphi study among potential future users. *Journal of Medical Internet Research*, *20*(10), Article e10158. <https://doi.org/10.2196/10158>
- Matthes, J., Karsay, K., Schmuck, D., & Stevic, A. (2020). “Too much to handle”: Impact of mobile social networking sites on information overload, depressive symptoms, and well-being. *Computers in Human Behavior*, *105*, Article 106217.  
<https://doi.org/https://doi.org/10.1016/j.chb.2019.106217>

- McAdams, D. P., Bauer, J. J., Sakaeda, A. R., Anyidoho, N. A., Machado, M. A., Magrino-Failla, K., White, K. W., & Pals, J. L. (2006). Continuity and change in the life story: A longitudinal study of autobiographical memories in emerging adulthood. *Journal of Personality, 74*(5), 1371–1400. <https://doi.org/https://doi.org/10.1111/j.1467-6494.2006.00412.x>
- McCarthy, R. A., & Warrington, E. K. (1990). 14 - Autobiographical memory. In R. A. McCarthy & E. K. Warrington (Eds.), *Cognitive neuropsychology* (pp. 296–328). Academic Press. <https://doi.org/https://doi.org/10.1016/B978-0-12-481845-3.50017-5>
- McChesney, J., & Bichsel, J. (2020). *The ageing of tenure-track faculty in higher education: Implications for succession and diversity*. College and University Professional Association for Human Resources.
- McCormick, D. A., Lavond, D. G., Clark, G. A., Kettner, R. E., Rising, C. E., & Thompson, R. F. (1981). The Engram found? Role of the cerebellum in classical conditioning of nictitating membrane and eyelid responses. *Bulletin of the Psychonomic Society, 18*(3), 103–105. <https://doi.org/10.3758/BF03333573>
- McKenna, H. P. (1994). The Delphi technique: A worthwhile research approach for nursing? *Journal of Advanced Nursing, 19*(6), 1221–1225. <https://doi.org/10.1111/j.1365-2648.1994.tb01207.x>
- McKeown, A., & Lawrence, D. R. (2021). Does a mind need a body? *Cambridge Quarterly of Healthcare Ethics, 30*(4), 563–574. <https://doi.org/10.1017/S0963180121000049>
- McLeod, J. (2003). Why we interview now—Reflexivity and perspective in a longitudinal study. *International Journal of Social Research Methodology, 6*(3), 201–211. <https://doi.org/10.1080/1364557032000091806>
- McMahan, A. (2003). Immersion, Engagement, and Presence: A Method for Analyzing 3-D Video Games. In M. J. P. Wolf, & B. Perron (Eds.), *The Video Game Theory Reader* (pp. 67-86). Abingdon-on-Thames: Routledge, Taylor & Francis Group
- McNamee, M. J., & Edwards, S. D. (2006). Transhumanism, medical technology and slippery slopes. *Journal of Medical Ethics, 32*(9), 513–518. <https://doi.org/10.1136/jme.2005.013789>
- Meade, M. L., & Roediger, H. L. (2002). Explorations in the social contagion of memory. *Memory & Cognition, 30*, 995–1009. <https://doi.org/10.3758/BF03194318>

- Mehta, N. (2011). Mind-body dualism: A critique from a health perspective. *Mens Sana Monographs*, 9(1), 202–209. <https://doi.org/10.4103/0973-1229.77436>
- Meijering, J. V., & Tobi, H. (2016). The effect of controlled opinion feedback on Delphi features: Mixed messages from a real-world Delphi experiment. *Technological Forecasting and Social Change*, 103, 166–173. <https://doi.org/https://doi.org/10.1016/j.techfore.2015.11.008>
- Mendoza, M. (2015). *The evolution of storytelling*. <https://reporter.rit.edu/tech/evolution-storytelling>
- Metitieri, T., & Mele, S. (2020). Women in neuroscience: A short time travel. In S.D Sala (Ed.), *Encyclopedia of Behavioral Neuroscience* (2nd ed.; pp. 71–76). <https://doi.org/10.1016/B978-0-12-819641-0.00007-4>
- Metzger, S. L., Littlejohn, K. T., Silva, A. B., Moses, D. A., Seaton, M. P., Wang, R., Dougherty, M. E., Liu, J. R., Wu, P., Berger, M. A., Zhuravleva, I., Tu-Chan, A., Ganguly, K., Anumanchipalli, G. K., & Chang, E. F. (2023). A high-performance neuroprosthesis for speech decoding and avatar control. *Nature*, 620, 1037–1046 <https://doi.org/10.1038/s41586-023-06443-4>
- Michaelian, K. (2016). *Mental time travel: Episodic memory and our knowledge of the personal past*. MIT Press.
- Minsky, M. (1987). The society of mind. *The Personalist Forum*, 3(1), 19–32.
- Miranda, M. I. (2012). Taste and odor recognition memory: The emotional flavor of life. *Reviews in the Neurosciences*, 23(5-6), 481–499. <https://doi.org/10.1515/revneuro-2012-0064>
- Mohr, A., Raman, S., & Gibbs, B. (2013). Which publics? When? Exploring the policy potential of involving different publics in dialogue around science and technology. Sciencewise-ERC
- Moore, M.-L., & Milkoreit, M. (2020). Imagination and transformations to sustainable and just futures. *Elementa: Science of the Anthropocene*, 8(1). <https://doi.org/10.1525/elementa.2020.081>
- Morse, J. M. (2003). Principles of mixed methods and multi-method research design. In C. Teddlie, & A. Tashakkori (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 189-208). Thousand Oaks, CA: Sage Publication.
- Moyer-Gusé, E. (2008). Toward a theory of entertainment persuasion: Explaining the persuasive effects of entertainment-education messages.

*Communication Theory*, 18(3), 407–425.  
<https://doi.org/https://doi.org/10.1111/j.1468-2885.2008.00328.x>

- Mullally, S. L., & Maguire, E. A. (2014). Memory, imagination, and predicting the future: A common brain mechanism? *The Neuroscientist*, 20(3), 220–234.  
<https://doi.org/10.1177/1073858413495091>
- Mullen, G. & Davidenko, N. (2021). Time Compression in Virtual Reality. *Timing & Time Perception*. 9. 1-16. 10.1163/22134468-bja10034.
- Murphy, J., Hayden, M., Murphy, B., & Ballantine, J. (2021). *Approaches to analysis of qualitative research data: A reflection of the manual and technological approaches*. *Accounting, Finance & Governance Review*, 27(1). <https://doi.org/10.52399/001c.22026>
- Murphy, M., Black, N., Lamping, D., McKee, C., Sanderson, C., Askham, J., & Marteau, T. (1998). Consensus development methods, and their use in clinical guideline development. *Health Technology Assessment*, 2(3), i-88.  
<https://doi.org/10.3310/hta2030>
- Nani, A., Manuello, J., Mancuso, L., Liloia, D., Costa, T., & Cauda, F. (2019). The neural correlates of consciousness and attention: Two sister processes of the brain. *Frontiers in Neuroscience*, 13.  
<https://doi.org/10.3389/fnins.2019.01169>
- Nasa, P., Jain, R., & Juneja, D. (2021). Delphi methodology in healthcare research: How to decide its appropriateness. *World Journal Methodology*, 11(4), 116–129. <https://doi.org/10.5662/wjm.v11.i4.116>
- National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. (1978). *The Belmont report, Ethical principle and guidelines for the protection of human research subjects*.
- Neisser, U. (1986). Nested structure in autobiographical memory. In D. C. Rubin (Ed.), *Autobiographical memory* (pp. 71–81). Cambridge University Press.
- Nestor, M. S., Fischer, D., & Arnold, D. (2020). “Masking” our emotions: Botulinum toxin, facial expression, and well-being in the age of COVID-19. *Journal of Cosmetic Dermatology*, 19(9), 2154–2160.  
<https://doi.org/10.1111/jocd.13569>
- Niederberger, M., & Spranger, J. (2020). Delphi technique in health sciences: A map. *Frontiers in Public Health*, 8.  
<https://doi.org/10.3389/fpubh.2020.00457>
- Nishanth, M. J., & Jha, S. (2022). Understanding the neural basis of survival instinct vs. suicidal behavior: a key to decode the biological enigma of

- human suicidal behavior, *European Archives of Psychiatry and Clinical Neuroscience* 272, 531–533. <https://doi.org/10.1007/s00406-021-01269-5>
- Noë, A. (2005). Against Intellectualism. *Analysis*, 65(4), 278–290. <https://doi.org/10.1093/analys/65.4.278>
- Northoff, G., & Huang, Z. (2017). How do the brain's time and space mediate consciousness and its different dimensions? Temporo-spatial theory of consciousness (TTC). *Neuroscience & Biobehavioral Review*, 80, 630–645. <https://doi.org/10.1016/j.neubiorev.2017.07.013>
- Ochieng, C. A., Minion, J. T., Turner, A., Blell, M., & Murtagh, M. J. (2021). What does engagement mean to participants in longitudinal cohort studies? A qualitative study. *BMC Medical Ethics*, 22(1), 77. <https://doi.org/10.1186/s12910-021-00648-w>
- Ofcom. (2021, June 9). Online Nation. [https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0013/220414/online-nation-2021-report.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0013/220414/online-nation-2021-report.pdf)
- Office of National Statistics Census. (2011, 2021). <https://www.ons.gov.uk/census/census2021dictionary/variablesbytopic/demographyvariables/census2021/sex>
- Ogbeifun, E., Mbohwa, C., & Pretorius, J.-H. C. (2017). Achieving consensus devoid of complicity: Adopting the Delphi technique. *International Journal of Productivity and Performance Management*, 66(6), 766–779. <https://doi.org/10.1108/IJPPM-08-2015-0112>
- Olson, Eric T., "Personal Identity", *The Stanford Encyclopedia of Philosophy* (Fall 2023 Edition), Edward N. Zalta & Uri Nodelman (Eds.). <https://plato.stanford.edu/archives/fall2023/entries/identity-personal/>
- Oliver, R. L. (1977). Effect of expectation and disconfirmation on postexposure product evaluations: An alternative interpretation. *Journal of Applied Psychology*, 62(4), 480–486. <https://doi.org/10.1037/0021-9010.62.4.480>
- Olshansky, S. J., & Carnes, B. A. (2019). Inconvenient truths about human longevity. *The Journals of Gerontology: Series A*, 74(Supplement\_1), S7–S12. <https://doi.org/10.1093/gerona/glz098>
- O.Nyumba, T., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution*, 9(1), 20–32. [https://doi.org/https://doi.org/10.1111/2041-210X.12860](https://doi.org/10.1111/2041-210X.12860)
- O'regan, J. K., Myin, E., & Noë, A. (2005). Sensory consciousness explained (better) in terms of “corporality” and “alerting capacity.” *Phenomenology*

*and the Cognitive Sciences*, 4(4), 369–387.  
<https://doi.org/10.1007/s11097-005-9000-0>

- Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools*, 13(1), 48–63.  
<https://www.proquest.com/scholarly-journals/validity-issue-mixed-research/docview/211030483/se-2>
- Ortega-de San Luis, C., & Ryan, T. J. (2022). Understanding the physical basis of memory: Molecular mechanisms of the engram. *Journal of Biological Chemistry*, 298(5), Article 101866.  
<https://doi.org/10.1016/j.jbc.2022.101866>
- Oyserman, D., Elmore, K., & Smith, G. (2012). Self, self-concept, and identity. In *Handbook of self and identity* (2nd ed.; pp. 69–104). The Guilford Press.
- Page, R. (2018). *Narratives online: Shared stories in social media*. Cambridge University Press.
- Pan, Y., & Steed, A. (2016). A comparison of avatar-, video-, and robot-mediated interaction on users' trust in expertise. *Frontiers in Robotics and AI*, 3(12).  
<https://doi.org/10.3389/frobt.2016.00012>
- Papadopoulos, D. (2011). The imaginary of plasticity: Neural embodiment, epigenetics and ecomorphs. *The Sociological Review*, 59(3), 432–456.  
<https://doi.org/10.1111/j.1467-954X.2011.02025.x>
- Parente, F. J., Anderson, J. K., Myers, P., & O'Brien, T. (1984). An examination of factors contributing to Delphi accuracy. *Journal of Forecasting*, 3(2), 173–182. [https://www.semanticscholar.org/paper/An-examination-of-factors-contributing-to-delphi-Parente-Anderson/55294d75a3a190302e7e60e1f09762f9bc1da40b?utm\\_source=direct\\_link](https://www.semanticscholar.org/paper/An-examination-of-factors-contributing-to-delphi-Parente-Anderson/55294d75a3a190302e7e60e1f09762f9bc1da40b?utm_source=direct_link)
- Parfit, D. (1971). Personal identity. *The Philosophical Review*, 80(1), 3–27
- Pargament, K. I. (1999). The psychology of religion and spirituality? Yes and no. *The International Journal for the Psychology of Religion*, 9(1), 3–16.  
[https://doi.org/10.1207/s15327582ijpr0901\\_2](https://doi.org/10.1207/s15327582ijpr0901_2)
- Paterson, H., & Monds, L. (2018). Forensic applications of social memory research. In Michelle L. Meade, and others (Eds) *Collaborative remembering: Theories, research, and applications*. Oxford University Press.
- Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health Serv Res*, 34(5 Pt 2), 1189–1208.



- Paulhus, D. L. (1991). Measurement and control of response bias. In John P. Robinson, Phillip R. Shaver, Lawrence S. Wrightsman (Eds), *Measures of personality and social psychological attitudes* (pp. 17–59). Academic Press. <https://doi.org/10.1016/B978-0-12-590241-0.50006-X>
- Petroni, S. (2021). Representing space and movement in digital discourse. *Studi di filologia linguistica e letteratura*. In *onore di Anna Maria Guerrieri* (pp. 241–259). SISMELE.
- Pew Research Center. (2013). *Living to 120 and beyond: Americans' views on aging, medical advances and radical life extension*. <https://www.pewresearch.org/religion/2013/08/06/living-to-120-and-beyond-americans-views-on-aging-medical-advances-and-radical-life-extension/>
- Pham, M., Goering, S., Sample, M., Huggins, J. E., & Klein, E. (2018). Asilomar survey: Researcher perspectives on ethical principles and guidelines for BCI research. *Brain-Computer Interfaces*, 5(4), 97–111. <https://doi.org/10.1080/2326263X.2018.1530010>
- Phan, D., Siong, L. Y., Pathirana, P. N., & Seneviratne, A. (2015). Smartwatch: Performance evaluation for long-term heart rate monitoring. 2015 International symposium on bioelectronics and bioinformatics (ISBB).
- Pillemer, D. B., Krensky, L., Kleinman, S. N., Goldsmith, L. R., & White, S. H. (1991). Chapters in narratives: Evidence from oral histories of the first year in college. *Journal of Narrative and Life History*, 1(1), 3–14. <https://doi.org/10.1075/jnlh.1.1.02ch; a>
- Plano Clark, V., & Badiee, M. (2010). Research questions in mixed methods research. In *SAGE Handbook of Mixed Methods in Social & Behavioral Research* (2 ed., pp. 275-304). SAGE Publications, Inc., <https://doi.org/10.4135/9781506335193>
- Pluye, P., & Hong, Q. N. (2014). Combining the power of stories and the power of numbers: mixed methods research and mixed studies reviews. *Annual Review of Public Health*, 35, 29–45. <https://doi.org/10.1146/annurev-publhealth-032013-182440>
- Pourgiv, F., Sadighi, F., & Nikzad Kaloorazi, M. H. (2003). The effect of points of view on the readability of short stories. *Narrative Inquiry*, 13(2), 469–471. <https://doi.org/https://doi.org/10.1075/ni.13.2.15pou>
- Primack, B. A., Shensa, A., Escobar-Viera, C. G., Barrett, E. L., Sidani, J. E., Colditz, J. B., & James, A. E. (2017). Use of multiple social media platforms and symptoms of depression and anxiety: A nationally-representative study among US young adults. *Computers in Human Behavior*, 69, 1–9. <https://doi.org/10.1016/j.chb.2016.11.013>

- Proyas, A. (2004). *I Robot* [Film]. Davis Entertainment; Laurence Mark Productions; Overbrook Films; Mediastream IV
- Qin, H., Patrick Rau, P.-L., & Salvendy, G. (2009). Measuring player immersion in the computer game narrative. *International Journal of Human-Computer Interaction*, 25(2), 107–133. <https://doi.org/10.1080/10447310802546732>
- Raman, S., B. Nerlich, & et al. (2019). *Making science public: Highlights from the Leverhulme research programme*. <https://www.nottingham.ac.uk/sociology/documents/making-science-public/making-science-public-final-report.pdf>
- Rank, S. G., & Jacobson, C. K. (1977). Hospital nurses' compliance with medication overdose orders: A failure to replicate. *Journal of Health and Social Behavior*, 18(2), 188–193. <https://doi.org/10.2307/2955382>
- Rantanen, R. (2012). Considerable life extension versus immortality. *Nordicum-Mediterraneum*, 7. <https://doi.org/10.33112/nm.7.2.6>
- Richard, V. M., & Lahman, M. K. E. (2015). Photo-elicitation: Reflexivity on method, analysis, and graphic portraits. *International Journal of Research & Method in Education*, 38(1), 3–22. <https://doi.org/10.1080/1743727X.2013.843073>
- Richardson, D. C., Griffin, N. K., Zaki, L., Stephenson, A., Yan, J., Curry, T., Noble, R., Hogan, J., Skipper, J. I., & Devlin, J. T. (2018). Measuring narrative engagement: The heart tells the story. *bioRxiv*, Article 351148. <https://doi.org/10.1101/351148>
- Richardson, D. C., Griffin, N. K., Zaki, L., Stephenson, A., Yan, J., Curry, T., Noble, R., Hogan, J., Skipper, J. I., & Devlin, J. T. (2020). Engagement in video and audio narratives: contrasting self-report and physiological measures. *Scientific Reports*, 10(1), Article 11298. <https://doi.org/10.1038/s41598-020-68253-2>
- Riegelsberger, J., Counts, S., Farnham, S. D., & Philips, B. C. (2006). Sounds good to me: Effects of photo and voice profiles on gaming partner choice. Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work.
- Rieger, K. L., West, C. H., Kenny, A., Chooniedass, R., Demczuk, L., Mitchell, K. M., Chateau, J., & Scott, S. D. (2018). Digital storytelling as a method in health research: A systematic review protocol. *Systematic Reviews*, 7(1). <https://doi.org/10.1186/s13643-018-0704-y>
- Riggio, R.E., & Riggio, C.R. (in press). Social contagion. *The Encyclopedia of Mental Health* (3rd ed.). Elsevier

- Robinson, H. (1998). *Materialism in the philosophy of mind*.  
<https://www.rep.routledge.com/articles/thematic/materialism-in-the-philosophy-of-mind/v-1>
- Robinson, J. A. (1976). Sampling autobiographical memory. *Cognitive Psychology*, 8(4), 578–595. [https://doi.org/10.1016/0010-0285\(76\)90020-7](https://doi.org/10.1016/0010-0285(76)90020-7)
- Roediger, H. L., Meade, M. L., & Bergman, E. T. (2001). Social contagion of memory. *Psychonomic Bulletin & Review*, 8, 365–371. <https://doi.org/10.3758/BF03196174>.
- RRI Tools. <https://rri-tools.eu/public-engagement>
- Teeuwen, R. M., Wacongne, C., Schnabel, U.H., Self, M.W. & Roelfsema, P.R. (2018). A neuronal basis of iconic memory in macaque primary visual cortex. *Current Biology*, 31(24), 5401-5414e4. <https://doi.org/10.1016/j.cub.2021.09.052>
- Rogers, E. M. (1962). *Diffusion of Innovations*. Free Press, New York.
- Romine, W. L., Schroeder, EN. L., Graft, J., Yang, F., Sadeghi, R., Zabihimayvan, M., Kadariya, D., & Banerjee, T. (2020). Using machine learning to train a wearable device for measuring students' cognitive load during problem-solving activities based on electrodermal activity, body temperature, and heart rate: Development of a cognitive load tracker for both personal and classroom use. *Sensors*, 20(17), Article 4833. <https://doi.org/10.3390/s20174833>
- Rosenbaum, R. S., Gilboa, A., Levine, B., Winocur, G., & Moscovitch, M. (2009). Amnesia as an impairment of detail generation and binding: Evidence from personal, fictional, and semantic narratives in K.C. *Neuropsychologia*, 47(11), 2181–2187. <https://doi.org/https://doi.org/10.1016/j.neuropsychologia.2008.11.028>
- Rowlands, M. J. (2010). *The new science of the mind: From extended mind to embodied phenomenology*. Mit Press.
- Royet, J.-P., Zald, D., Versace, R., Costes, N., Lavenne, F., Koenig, O., & Gervais, R. (2000). Emotional responses to pleasant and unpleasant olfactory, visual, and auditory stimuli: A positron emission tomography study. *Journal of Neuroscience : the official journal of the Society for Neuroscience*, 20(20), 7752–7759. [https://doi.org/10.1523/JNEUROSCI.20-20-0 20\(20\), 7752–7759](https://doi.org/10.1523/JNEUROSCI.20-20-0 20(20), 7752-7759).
- RRI Tools (n.d.). <https://rri-tools.eu/>
- Ruan, Z. (2023). The fundamental challenge of a future theory of consciousness. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.1029105>

- Rupert, R. D. (2009). *Cognitive systems and the extended mind*. Oxford University Press.
- Isabel Ruiz-Mallén, Maria Heras & Karla Berrens (2021) Responsible research and innovation in science education: insights from evaluating the impact of using digital media and arts-based methods on RRI values, *Research in Science & Technological Education*, 39:3, 263-284. <https://doi.org/10.1080/02635143.2020.1763289>
- Ryan, M.-L. (2007). Toward a definition of narrative. In D. Herman (Ed.), *The Cambridge companion to narrative* (pp. 22–36). Cambridge University Press. [https://doi.org/DOI: 10.1017/CCOL0521856965.002](https://doi.org/DOI:10.1017/CCOL0521856965.002)
- Ryan, T. J., & Frankland, P. W. (2022). Forgetting as a form of adaptive engram cell plasticity. *Nature Reviews Neuroscience*, 23(3), 173–186. <https://doi.org/10.1038/s41583-021-00548-3>
- Salles, A., Stahl, B., Bjaalie, J., Domingo-Ferrer, J., Rose, N., Rainey, S., & Spranger, T. (2017). *Opinion and action plan on “data protection and privacy.”* Human Brain Project.
- Sample, M., Sattler, S., Blain-Moraes, S., Rodríguez-Arias, D., & Racine, E. (2020). Do publics share experts’ concerns about brain–computer interfaces? A trinational survey on the ethics of neural technology. *Science, Technology, & Human Values*, 45(6), 1242–1270. <https://doi.org/10.1177/0162243919879220>
- Sandberg, A. (2013). Feasibility of whole brain emulation. In V. C. Müller (Ed.), *Philosophy and theory of artificial intelligence* (pp. 251–264). Springer Berlin Heidelberg. [https://doi.org/10.1007/978-3-642-31674-6\\_19](https://doi.org/10.1007/978-3-642-31674-6_19)
- Sandberg, A. & Bostrom, N. (2008): Whole Brain Emulation: A Roadmap, Technical Report #2008-3, Future of Humanity Institute, Oxford University. [www.fhi.ox.ac.uk/reports/2008-3.pdf](http://www.fhi.ox.ac.uk/reports/2008-3.pdf)
- Sattler, S., & Pietralla, D. (2022). Public attitudes towards neurotechnology: Findings from two experiments concerning brain stimulation devices (BSDs) and brain-computer interfaces (BCIs). *PLOS ONE*, 17(11), Article e0275454. <https://doi.org/10.1371/journal.pone.0275454>
- Schacter, D. L., & Madore, K. P. (2016). Remembering the past and imagining the future: Identifying and enhancing the contribution of episodic memory. *Memory Studies*, 9(3), 245–255. <https://doi.org/10.1177/1750698016645230>
- Schacter, D. L., Addis, D. R., & Buckner, R. L. (2007). Remembering the past to imagine the future: The prospective brain. *Nature Reviews Neuroscience*, 8(9), 657–661. <https://doi.org/10.1038/nrn2213>

- Schacter, D. L., Addis, D. R., Hassabis, D., Martin, V. C., Spreng, R. N., & Szpunar, K. K. (2012). The future of memory: Remembering, imagining, and the brain. *Neuron*, 76(4), 677–694. <https://doi.org/10.1016/j.neuron.2012.11.001>
- Schulz, A., Fletcher, R. J., & Popescu, M. (2020). Are news outlets viewed in the same way by experts and the public? A comparison across 23 European countries. *Human-Computer Interaction eJournal*. Reuters Institute for the Study of Journalism.
- Schwitzgebel, E. (2023). AI systems must not confuse users about their sentience or moral status. *Patterns*, 4(8), 1–4. <https://doi.org/10.1016/j.patter.2023.100818>
- Scully, I. D., Napper, L. E., & Hubbach, A. (2017). Does reactivation trigger episodic memory change? A meta-analysis. *Neurobiology of Learning and Memory*, 142, 99–107. <https://doi.org/https://doi.org/10.1016/j.nlm.2016.12.012>
- Shaver, P., Schwartz, J., Kirson, D., & O'Connor, C. (1987). Emotion knowledge: further exploration of a prototype approach. *Journal of Personality and Social Psychology*, 52(6), 1061–1086. <https://doi.org/10.1037/0022-3514.52.6.1061>
- Shen, L., & Seung, S.-y. (2018). On measures of message elaboration in narrative communication. *Communication Quarterly*, 66(1), 79–95. <https://doi.org/10.1080/01463373.2017.1334682>
- Shorrock, S. (2018). Suitably qualified and experienced? Five questions to ask before buying human factors training or consultancy. *Humanistic Systems - Understanding and Improving Human Work* <https://humanisticsystems.com/2018/06/05/suitably-qualified-and-experienced-five-questions-to-ask-a-commercial-human-factors-training-or-consultancy-provider/>
- Silver, J. (1999). *The Matrix* [Film]. Warner Brothers.
- Simeone, A. L., Cools, R., Depuydt, S., Gomes, J. M., Goris, P., Grocott, J., Esteves, A., & Gerling, K. (2022). *Immersive speculative enactments: bringing future scenarios and technology to life using virtual reality*. CHI Conference on Human Factors in Computing Systems, New Orleans, LA, USA. <https://doi.org/10.1145/3491102.3517492>
- Simon, S. A., de Araujo, I. E., Gutierrez, R., & Nicolelis, M. A. L. (2006). The neural mechanisms of gustation: A distributed processing code. *Nature Reviews Neuroscience*, 7(11), 890–901. <https://doi.org/10.1038/nrn2006>

- Simons, D. J., & Chabris, C. F. (2011). What people believe about how memory works: A representative survey of the U.S. population. *PLOS ONE*, 6(8), Article e22757. <https://doi.org/10.1371/journal.pone.0022757>
- Simons, D. J., & Chabris, C. F. (2012). Common (mis)beliefs about memory: A replication and comparison of telephone and mechanical Turk survey methods. *PLOS ONE*, 7(12), Article e51876. <https://doi.org/10.1371/journal.pone.0051876>
- Sim, J. (1998). Collecting and analysing qualitative data: Issues raised by the focus group. *Journal of Advanced Nursing*, 28(2), 345–352. <http://www.ncbi.nlm.nih.gov/pubmed/9725732>
- Simundić, A. M. (2013). Bias in research. *Biochemia Medica*, 23, 12-15. <https://doi.org/10.11613/BM.2013.003>
- Small, S. A. (2021). *Forgetting: The benefits of not remembering*. Crown.
- Smith, B.C. (2016). Proust, the Madeleine and Memory. In: Groes, S. (eds) *Memory in the Twenty-First Century*. Palgrave Macmillan, London. [https://doi.org/10.1057/9781137520586\\_3](https://doi.org/10.1057/9781137520586_3)
- Soares de Lima, E., Feijó, B., & Furtado, A. (2019). Procedural generation of quests for games using genetic algorithms and automated planning. XVIII Brazilian Symposium on Computer Games and Digital Entertainment (SBGames 2019). Rio de Janeiro, Brazil. <https://doi.org/10.1109/SBGames.2019.00028>
- Sovacool, B. K., Hess, D. J., Amir, S., Geels, F. W., Hirsh, R., Medina, L. R., Miller, C., Palavicino, C. A., Phadke, R., & Ryghaug, M. (2020). Sociotechnical agendas: Reviewing future directions for energy and climate research. *Energy Research & Social Science*, 70, Article 101617. <https://doi.org/10.1016/j.erss.2020.101617>
- Spencer, L., Ritchie, J., & O'Connor, W. (2003). Analysis: Practices, principles and processes. In *Qualitative research practice: A guide for social science students and researchers*, 199, 218. Sage. <https://api.semanticscholar.org/CorpusID:15027803>
- Sporns, O., Tononi, G., & Kötter, R. (2005). The human connectome: A structural description of the human brain. *PLoS Computational Biology*, 1(4), Article e42. <https://doi.org/10.1371/journal.pcbi.0010042>
- Squire, L. R., & Zola-Morgan, J. T. (1991). The cognitive neuroscience of human memory since H.M. *Annual Review of Neuroscience*, 34, 259–288. <https://doi.org/10.1146/annurev-neuro-061010-113720>

- Stack, G. (1998). Bibliography. In *Materialism*. In *The Routledge Encyclopedia of Philosophy*. Taylor and Francis.  
<https://www.rep.routledge.com/articles/thematic/materialism/v-1/bibliography/materialism-bib>. doi:10.4324/9780415249126-DC098-1
- Steger, M. F., Kashdan, T. B., Sullivan, B. A., & Lorentz, D. (2008). Understanding the search for meaning in life: personality, cognitive style, and the dynamic between seeking and experiencing meaning. *Journal of personality*, 76(2), 199–228. <https://doi.org/10.1111/j.1467-6494.2007.00484.x>
- Steinhart, E. (2014). *Your digital afterlives: Computational theories of life after death*. Springer.
- Stendardi, D., Biscotto, F., Bertossi, E., & Ciaramelli, E. (2021). Present and future self in memory: The role of vmPFC in the self-reference effect. *Social Cognitive and Affective Neuroscience*, 16(12), 1205–1213. <https://doi.org/10.1093/scan/nsab071>
- Stoetzler, M., & Yuval-Davis, N. (2002). Standpoint theory, situated knowledge and the situated imagination. *Feminist Theory*, 3(3), 315–333. <https://doi.org/10.1177/146470002762492024>
- Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences*, 30(3), 299–313. <https://doi.org/10.1017/S0140525X07001975>
- Suddendorf, T., & Busby, J. (2003). Mental time travel in animals? *Trends in Cognitive Sciences*, 7(9), 391-396.
- Sugawara, Y., Narimatsu, H., & Fukao, A. (2012). Coverage of genomic medicine: Information gap between lay public and scientists. *Risk Management and Healthcare Policy*, 5, 83–90. <https://doi.org/10.2147/RMHP.S33661>
- Sukalla, F., Bilandzic, H., Bolls, P. D., & Busselle, R. W. (2016). Embodiment of Narrative Engagement. *Journal of Media Psychology*, 28(4), 175–186. <https://doi.org/10.1027/1864-1105/a000153>
- Swain, R., Truelove, V., Rakotonirainy, A., & Kaye, S.-A. (2023). A comparison of the views of experts and the public on automated vehicles technologies and societal implications. *Technology in Society*, 74, Article 102288. <https://doi.org/https://doi.org/10.1016/j.techsoc.2023.102288>
- Szpunar, K. K., & McDermott, K. B. (2008). Episodic future thought and its relation to remembering: Evidence from ratings of subjective experience. *Consciousness and Cognition*, 17(1), 330–334. <https://doi.org/10.1016/j.concog.2007.04.006>

- Tal-Or, N., & Cohen, J. (2010). Understanding audience involvement: Conceptualizing and manipulating identification and transportation. *Poetics*, 38(4), 402–418. <https://doi.org/https://doi.org/10.1016/j.poetic.2010.05.004>
- Tal-Or, N., & Cohen, J. (2016). Unpacking engagement: Convergence and divergence in transportation and identification. *Annals of the International Communication Association*, 40(1), 33–66. <https://doi.org/10.1080/23808985.2015.11735255>
- Tanenbaum, T. J. (2014). Design fictional interactions: Why HCI should care about stories. *Interactions*, 21(5), 22–23. <https://doi.org/10.1145/2648414>
- Taylor, R., & Judd, L. (1989). Delphi method applied to tourism. 95–98. In S. Witt, & L. Moutinho, (Eds.), *Tourism marketing and management handbook*. Prentice Hall.
- Teresa L. Swift, S. L. W. n. (2001). Misconceptions about brain injury among the general public and non-expert health professionals: an exploratory study. *Brain Injury*, 15(2), 149–165. <https://doi.org/10.1080/02699050117322>
- Thakral, P. P., Yang, A. C., Addis, D. R., & Schacter, D. L. (2021). Divergent thinking and constructing future events: Dissociating old from new ideas. *Memory*, 29(6), 729–743. <https://doi.org/10.1080/09658211.2021.1940205>
- The Data Protection Act. (2018). Article 13 and 14 <https://www.dataprotection.ie/en/individuals/know-your-rights/right-be-informed-transparency-article-13-14-gdpr#:~:text=Any%20processing%20of%20personal%20data,lawful%2C%20fair%2C%20and%20transparent..>
- Thomas, R. M. (2003). *Blending qualitative and quantitative research methods in theses and dissertations*. Corwin Press.
- Thomsen, D. K. (2009). There is more to life stories than memories. *Memory*, 17(4), 445–457. <https://doi.org/10.1080/09658210902740878>
- Thomsen, D. K., & Berntsen, D. (2008). The cultural life script and life story chapters contribute to the reminiscence bump. *Memory*, 16(4), 420–435. <https://doi.org/10.1080/09658210802010497>
- Thorley, C. (2013). Memory conformity and suggestibility. *Psychology, Crime & Law*, 19(7), 565–575. <https://doi.org/10.1080/1068316X.2011.648637>
- Tippett, L. J., Prebble, S. C., & Addis, D. R. (2018). The persistence of the self over time in mild cognitive impairment and Alzheimer's disease. *Frontiers in Psychology*, 9. <https://doi.org/10.3389/fpsyg.2018.00094>



- Tononi, G., & Koch, C. (2015). Consciousness: Here, there and everywhere? *Philosophical Transactions of the Royal Society B: Biological Sciences*, 370(1668), Article 20140167. <https://doi.org/doi:10.1098/rstb.2014.0167>
- Tulving, E. (1985). Memory and consciousness. *Canadian Psychology/Psychologie Canadienne*, 26(1), 1–12. <https://doi.org/10.1037/h0080017>
- Tulving, E. (2002). Episodic memory: From mind to brain. *Annual Review of Psychology*, 53(1), 1–25. <https://doi.org/10.1146/annurev.psych.53.100901.135114>
- UNESO. (2023). *Unveiling the neurotechnology landscape: scientific advancements innovations and major trends*. <https://doi.org/10.54678/OCBM4164>
- United Nations. (2020). *United Nations, World social report 2020: Inequality in a rapidly changing world*. <https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/02/World-Social-Report2020-FullReport.pdf>
- Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*, 15(3), 398-405. <https://doi.org/https://doi.org/10.1111/nhs.12048>
- Vallat-Azouvi, C., Pradat-Diehl, P., & Azouvi, P. (2012). The working memory questionnaire: A scale to assess everyday life problems related to deficits of working memory in brain-injured patients. *Neuropsychological Rehabilitation*, 22(4), 634–649. <https://doi.org/10.1080/09602011.2012.681110>
- Vanderveren, E., Bijttebier, P., & Hermans, D. (2017). The importance of memory specificity and memory coherence for the self: Linking two characteristics of autobiographical memory [Hypothesis and theory]. *Frontiers in Psychology*, 8. <https://doi.org/10.3389/fpsyg.2017.02250>
- van Krieken, K., Hoeken, H., & Sanders, J. (2017). Evoking and measuring identification with narrative characters – A linguistic cues framework. *Frontiers in Psychology*, 8. <https://doi.org/10.3389/fpsyg.2017.01190>
- Vasconcelos, A. P. S. L., Lucchetti, A. L. G., Cavalcanti, A. P. R., da Silva Conde, S. R. S., Gonçalves, L. M., Moriguchi, E. H., Chazan, A. C. S., Tavares, R. L. C., da Silva Ezequiel, O., & Lucchetti, G. (2022). Comparison of the role of different levels of religiousness and spirituality in controversial ethical issues and clinical practice among Brazilian resident physicians: Results from the multicenter SBRAMER study. *Journal of Religion and Health*. <https://doi.org/10.1007/s10943-022-01702-6>

- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478. <https://doi.org/10.2307/30036540>
- Veugelers, R., Gaakeer, M. I., Patka, P., & Huijsman, R. (2020). Improving design choices in Delphi studies in medicine: The case of an exemplary physician multi-round panel study with 100% response. *BMC Medical Research Methodology*, 20(1), 156. <https://doi.org/10.1186/s12874-020-01029-4>
- Vogel, C., Zwolinsky, S., Griffiths, C., Hobbs, M., Henderson, E., & Wilkins, E. (2019). A Delphi study to build consensus on the definition and use of big data in obesity research. *International Journal of Obesity*, 43(12), 2573–2586. <https://doi.org/10.1038/s41366-018-0313-9>
- Voneida, T. J. (1998). Sperry's concept of mind as an emergent property of brain function and its implications for the future of humankind. *Neuropsychologia*, 36(10), 1077–1082. [https://doi.org/10.1016/s0028-3932\(98\)00061-x](https://doi.org/10.1016/s0028-3932(98)00061-x)
- Walker, M. (2011). Personal Identity and Uploading. *Journal of Evolution and Technology*, 22(1), 37–52. <https://api.semanticscholar.org/CorpusID:16692132>
- Weijters, B., Baumgartner, H., & Schillewaert, N. (2013). Reversed item bias: An integrative model. *Psychological Methods*, 18(3), 320–334. <https://doi.org/10.1037/a0032121>
- Weinberger, N., Woll, S., Kyba, C. C. M., & Schulte-Römer, N. (2021). The value of citizen participation in technology assessment, responsible research and innovation, and sustainable development. *Sustainability*, 13(21), Article 11613. <https://www.mdpi.com/2071-1050/13/21/11613>
- Wesp, E. (2014). A too-coherent world: Game studies and the myth of “narrative” media. *Game Studies*, 14. [https://www.researchgate.net/publication/287070115\\_A\\_Too-Coherent\\_World\\_Game\\_Studies\\_and\\_the\\_Myth\\_of\\_Narrative\\_Media](https://www.researchgate.net/publication/287070115_A_Too-Coherent_World_Game_Studies_and_the_Myth_of_Narrative_Media)
- Wexler, A., & Thibault, R. (2019). Mind-reading or misleading? Assessing direct-to-consumer electroencephalography (EEG) devices marketed for wellness and their ethical and regulatory implications. *Journal of Cognitive Enhancement*, 3, 131–137. <https://doi.org/10.1007/s41465-018-0091-2>
- White, T. L., Thomas-Danguin, T., Olofsson, J. K., Zucco, G. M., & Prescott, J. (2020). Thought for food: Cognitive influences on chemosensory perceptions and preferences. *Food Quality and Preference*, 79, Article 103776. <https://doi.org/XXXX>

- Wiener, N. (1951). Homeostasis in the individual and society. *Journal of the Franklin Institute*, 251(1), 65–68.  
<https://doi.org/10.1016/j.foodqual.2019.103776>
- Wilson, B. A., & Wearing, D. (1995). Prisoner of consciousness: A state of just awakening following herpes simplex encephalitis. On *broken memories: Case studies in memory impairment*. Blackwell Publishing.
- Wilson, T. D., & Gilbert, D. T. (2005). Affective forecasting: Knowing what to want. *Current Directions in Psychological Science*, 14(3), 131–134.  
<https://doi.org/10.1111/j.0963-7214.2005.00355.x>
- Winding, M., Pedigo, B. D., Barnes, C. L., Patsolic, H. G., Park, Y., Kazimiers, T., Fushiki, A., Andrade, I. V., Khandelwal, A., Valdes-Aleman, J., Li, F., Randel, N., Barsotti, E., Correia, A., Fetter, R. D., Hartenstein, V., Priebe, C. E., Vogelstein, J. T., Cardona, A., & Zlatic, M. (2023). The connectome of an insect brain. *Science*, 379(6636), Article eadd9330.  
<https://doi.org/doi:10.1126/science.add9330>
- Wong, L. P. (2008). Focus group discussion: a tool for health and medical research. *Singapore Medical Journal*, 49(3), 256–260.
- Yoshikawa, H., Weisner, T. S., Kalil, A., & Way, N. (2008). Mixing qualitative and quantitative research in developmental science: Uses and methodological choices. *Developmental Psychology*, 44(2), 344–354. <https://doi.org/10.1037/0012-1649.44.2.344>
- Yuste, R., Genser, J., & Herrmann, S. (2021). It's time for neuro-rights. *Horizons – Journal of International Relations and Sustainable Development*, (18), 154-164
- Zabelina, D. L., & Condon, D. M. (2020). The four-factor imagination scale (FFIS): Measure for assessing frequency, complexity, emotional valence, and directedness of imagination. *Psychological Research*, 84(8), 2287–2299. <https://doi.org/10.1007/s00426-019-01227-w>
- Zamawe, F. C. (2015). The implication of using NVivo software in qualitative data analysis: Evidence-based reflections. *Malawi Medical Journal*, 27(1), 13–15. <https://doi.org/10.4314/mmj.v27i1.4>
- Zhou, Z., Liu, Y., Feng, Y., Klepin, S., Tsimring, L. S., Pillus, L., Hasty, J., & Hao, N. (2023). Engineering longevity—Design of a synthetic gene oscillator to slow cellular aging. *Science*, 380(6643), 376–381.  
<https://doi.org/doi:10.1126/science.add7631>
- Zylinska, J. (Ed.) (2002). *The Cyborg Experiments: The Extensions of the Body in the Media Age*. Continuum.



## **Appendix A: Pilot Questionnaire**

### **Start of Block: Block 1**

School of Computer Science Ethics Reference:

Funded by: UK Engineering and Physical Sciences Research Council

Creating minds in data; what are the implications of cybernetic immortality?

### **What is the research about?**

This research aims to explore awareness of a concept called mind uploading and attitudes towards this proposition. Your participation will provide perceptions around this futuristic concept which is being researched and developed by a number of organisations including The Human Brain Project, The Mind Uploading Research Group, BRAIN Initiative and the 2045 Strategic Social Initiative. There are no risks to participation since you will simply be commenting on a hypothetical concept.

### **What does the research involve?**

Participation in the research is voluntary and involves completing an online questionnaire. The main survey consists of 6 structured questions together with an opportunity to comment on the concept in more detail. The online survey should no more than 13 minutes to complete. Anyone above the age of 18 is eligible to take part.

### **Prize draw (optional)**

If you participate in the survey, you can elect to be entered into a raffle. This raffle will be anonymous and not linked to your survey responses. The prize, which will be drawn by random number generation and will be £20 of shopping vouchers. You will have an option to choose if you wish to be entered into the raffle at the end of the survey. Opting in will require you to send a separate email confirming your entry to the researcher - Angela Thornton - [angela.thornton@nottingham.ac.uk](mailto:angela.thornton@nottingham.ac.uk) - to ensure that anything identifying you as an individual is kept separate to your survey responses.

### **Data security and privacy**

Since it is possible that individual characteristics may have a bearing on responses there is a section at the end of the main questionnaire which asks for some demographic information such as age, sex, and ethnicity. If you are not comfortable disclosing this information, then you can still complete the survey but if you can provide at least some of the demographic information that would be

greatly appreciated.

All data is anonymised and will be stored on password protected University of Nottingham servers. The results of the research will be disseminated via conference presentations and journal publications. Your data may be archived and reused in future for purposes that are in the public interest, or for historical, scientific, or statistical purposes. The data will be stored on password protected University of Nottingham servers.

### **Right to withdraw**

You may withdraw from the study at any time and do not have to give reasons for why you no longer want to take part. If you wish to withdraw, please contact the researcher who gathered the data. If you receive no response from the researcher, please contact the School of Computer Science's Ethics Committee.

If you wish to file a complaint or exercise your rights, you can contact the Ethics Committee at the following address:

cs-ethicsadmin@cs.nott.ac.uk

### **Privacy Notice**

The University of Nottingham is committed to protecting your personal data and informing you of your rights in relation to that data. The University will process your personal data in accordance with the General Data Protection Regulation (GDPR) and the Data Protection Act 2018 and this privacy notice is issued in accordance with GDPR Articles 13 and 14.

The University of Nottingham, University Park, Nottingham, NG7 2RD is registered as a Data Controller under the Data Protection Act 1998 (registration No. Z5654762, <https://ico.org.uk/ESDWebPages/Entry/Z5654762>).

The University has appointed a Data Protection Officer (DPO). The DPO's postal address is:

Data Protection Officer,  
Legal Services  
A5, Trent Building,  
University of Nottingham,  
University Park,

Nottingham  
NG7 2RD

The DPO can be emailed at [dpo@nottingham.ac.uk](mailto:dpo@nottingham.ac.uk)

### **Why we collect your personal data.**

We collect personal data under the terms of the University's Royal Charter in our capacity as a teaching and research body to advance education and learning. Specific purposes for data collection on this occasion are for a research project on the personal understanding of data.

### **The legal basis for processing your personal data under GDPR.**

Under the General Data Protection Regulation, the University must establish a legal basis for processing your personal data and communicate this to you. The legal basis for processing your personal data on this occasion is Article 6(1e) processing is necessary for the performance of a task carried out in the public interest.

### **How long we keep your data.**

The University may store your data for up to 25 years and for a period of no less than 7 years after the research project finishes. The researchers who gathered or processed the data may also store the data indefinitely and reuse it in future research.

### **Who we share your data with.**

Extracts of your data may be disclosed in published works that are posted online for use by the scientific community. Your data may also be stored indefinitely by members of the researcher team and/or be stored on external data repositories (e.g., the UK Data Archive) and be further processed for archiving purposes in the public interest, or for historical, scientific, or statistical purposes.

### **How we keep your data safe.**

We keep your data securely and put measures in place to safeguard it. These safeguards include anonymization of data and encryption of devices on which your data is stored.

### **Your rights as a data subject.**

GDPR provides you, as a data subject, with a number of rights in relation to your personal data. Subject to some exemptions, you have the right to: withdraw your consent at any time where that is the legal basis of our processing, and in such

circumstances, you are not obliged to provide personal data for our research. object to automated decision-making, to contest the decision, and to obtain human intervention from the controller. access (i.e., receive a copy of) your personal data that we are processing together with information about the purposes of processing, the categories of personal data concerned, recipients/categories of recipient, retention periods, safeguards for any overseas transfers, and information about your rights. have inaccuracies in the personal data that we hold about you rectified and, depending on the purposes for which your data is processed, to have personal incomplete data completed be forgotten, i.e., to have your personal data erased where it is no longer needed, you withdraw consent and there is no other legal basis for processing your personal data, or you object to the processing and there is no overriding legitimate ground for that processing.

### **Special category personal data.**

In addition to the legal basis for processing your personal data, the University must meet a further basis when processing any special category data, including: personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person's sex life or sexual orientation. The basis for processing your sensitive personal data on this occasion is Article 9(2j) processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.

If you require advice on exercising any of the above rights, please contact the University's data protection team:

[data-protection@nottingham.ac.uk](mailto:data-protection@nottingham.ac.uk)

End of Block: Block 1

---

Start of Block: Block 2



## **Consent**

I have read and understood the project information sheet, or it has been read to me.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study requires me to provide data and that this will involve completing an online questionnaire.

## **Use of my data in the study**

I understand that data which can identify me will not be shared beyond the project team.

I agree that the data provided by me may be used for the following purposes:

Presentation and discussion of the project and its results in research activities (e.g., project meetings, conferences).

Publications and reports describing the project and its results.

Dissemination of the project and its results, including publication of data on web pages and databases.

I give permission for my words to be quoted for the purposes described above.

## **Reuse of my data**

I give permission for the data that I provide to be reused for the sole purposes of future research and learning.

I understand and agree that this may involve depositing my data in a data repository, which may be accessed by other researchers.

## **Security of my data**

I understand that safeguards will be put in place to protect my identity and my data during the research, and if my data is kept for future use.

I confirm that a written copy of these safeguards has been given to me in the University's privacy notice, and that they have been described to me and are

acceptable to me. I understand that no computer system is completely secure and that there is a risk that a third party could obtain a copy of my data.

## Copyright

I give permission for data gathered during this project to be used, copied, excerpted, annotated, displayed, and distributed for the purposes to which I have consented.

Researcher's contact details

Name: Angela Thornton

Phone: 07779585022

Email: angela.thornton@nottingham.ac.uk

## Consent

I confirm that I have read the information above, and I agree to take part in this study

- I agree and wish to proceed (1)
  
- I do not agree and would like to leave the survey (2)

*Skip To: End of Survey If Consent I have read and understood the project information sheet or it has been read to me. I con ... = I do not agree and would like to leave the survey*

**End of Block: Block 2**

---

**Start of Block: Block 3**

Q1 Thinking about new technology, compared to other people you know, how would you describe yourself?





- I am generally the first to try a new technology product (1)
  
- I am generally among the first to try a new technology product (2)
  
- I am generally in the middle when it comes to trying a new technology product. (3)

I am generally among the last to try a new technology product, (4)

I am generally the last to try a new technology product (5)

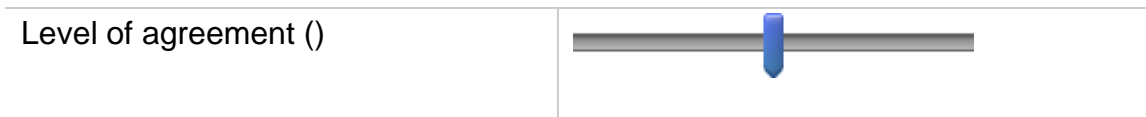
Q2 The next question looks at your attitudes to science fiction (sci fi). For each of the 4 statements below please indicate to what extent do you agree or disagree with each of the following statements. Please use a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree:

1      2      3      3      4      5

I think science fiction (sci fi) is an interesting topic ()	
I try to actively follow the latest developments in the natural sciences or technology ()	
I often contemplate matters dealing with Artificial Intelligence (AI) ()	
I am familiar with Transhumanism ()	

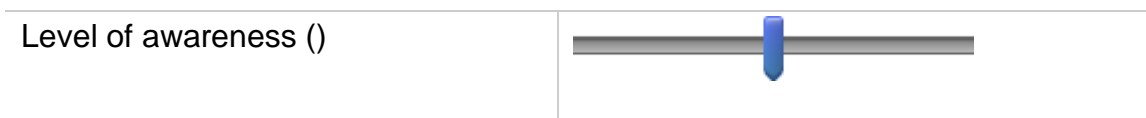
Q3 Transhumanists believe that science and technology can help human beings develop beyond what is physically and mentally possible at the present time (Source: Cambridge Dictionary). Some transhumanists believe “that is possible and necessary to eliminate aging and even death, and to overcome the fundamental limits of the physical and mental capabilities currently set by the restrictions of the physical body.” To what extent, if at all, do you agree with this premise? Please use a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree.

1      2      3      3      4      5



Q4 How aware, if at all, are you of the concept of mind uploading? Please use a scale of 1 to 5 where 1 is not at all aware and 5 is extremely aware.

0 1 2 3 4 5



Q5a For the purposes of this survey mind uploading is defined as converting a mind into digital data to allow it to be uploaded into an artificial carrier such as a supercomputer. This would allow you to live in a world of unbounded virtual experiences and effectively achieve cybernetic immortality. Overall, how favourable or unfavourable are you towards the concept of mind uploading as described above? Please use a scale of 1 to 5 where 1 is very unfavourable and 5 is very favourable.

1 2 3 3 4 5



Q5b Why did you give that favourability rating?

---

---

---

---

---

Q6 If mind uploading was available when your physical body was dying would you want your mind to be uploaded? Please assume that after uploading your brain would also die.

- Yes (1)
- No (2)
- Not sure (3)

End of Block: Block 3

---

Start of Block: Block 4

**Q7 Demographics** The next short set of questions ask about population characteristics.

What is your sex? For the purposes of this survey your sex refers to characteristics that are biologically defined and assigned at birth rather than the gender you identify with.

- Male (1)
- Female (2)
- Intersex (characteristics that are neither exclusively male nor female) (3)
- Prefer not to say (4)

**Q8** What is your ethnic group?

- English/Welsh/Scottish/Northern Irish/British (1)
- Irish (2)
- Gypsy or Irish Traveller (3)
- Any other White background (4)
- White and Black Caribbean (5)
- White and Black African (6)
- White and Asian (7)

- Indian (8)
- Pakistani (9)
- Bangladeshi (10)
- Chinese (11)
- Any other Asian background (12)
- African (13)
- Caribbean (14)
- Any other Black/African/Caribbean background (15)
- Arab (16)
- Any other ethnic group (17)
- Prefer not to say (18)

Q9 Which age group do you belong to?

- 18-24 years (1)
- 25-34 years (2)
- 35-44 years (3)

- 45-54 years (4)
- 55-64 years (5)
- 65 years or above (6)
- Prefer not to say (7)

Q10 What is your highest level of completed education?

- Less than high school (1)
- High school graduate (2)
- College graduate (3)
- Undergraduate degree (4)
- Master's degree (5)
- Professional degree (6)
- Doctorate (7)
- Prefer not to say (8)

Q11 What is your current employment status?

- Employed full time (35 hours a week or more) (1)

- Employed part time (less than 35 hours a week) (2)
- Unemployed looking for work (3)
- Unemployed not looking for work (4)
- Retired (5)
- Student (6)
- Prefer not to say (7)

End of Block: Block 4

---

Start of Block: Block 5

Q12 The survey you have just completed is the first of several that may be required as the PhD on mind uploading develops over the next 3-4 years. As the project and technology develops it would be useful to look at your responses over time. If you are willing to take part in any future research on this topic, please give your consent below. You have the right to withdraw your consent at any time and to choose not to participate in any future research any time.

I confirm that I have read the information above and agree to take part in this study:

- I agree to be recontacted to see if I am willing to take part in future research on this topic (1)
- I do not agree to be re-contacted for future research (2)

Q13 You can now elect to be entered into a raffle. This raffle will be anonymous and not linked to your responses to the survey. The prize will be



£20 of shopping vouchers which will be drawn by random number generation.  
Would you like to be entered into the raffle?

Yes (1)

No (2)

To confirm your entry into the raffle please send a separate email confirming your entry to Angela Thornton:

[angela.thornton@nottingham.ac.uk](mailto:angela.thornton@nottingham.ac.uk)

Thank you for taking the time to participate. If you are interested in learning more there is a link to a video made by the 2045 Strategic Social Initiative which looks at mind uploading from a Transhumanist perspective (other information sources are available).

**End of Block: Block 5**

## **Appendix B: Study 1 Discussion Guide**

### **Introduction**

- Introduce researcher and role in discussion (i.e., to facilitate not direct). Explain notes and recordings taken for use in analysis only.
- Housekeeping – phones to silent, confirm audio and video recording for analysis only. Request turn video feeds on so we can see each other while we talk but reassure participants that they can opt out of sharing their feed and being video recorded. Option to blur background to protect personal identity/privacy.
- Forum - all contributions welcomed, nothing is right or wrong and given the futuristic nature of the topic we are all testing out ideas and exploring. Recognise that there may be different viewpoints so respect other people's views when discussing. Try not to all talk at once for recording.
- Up to 90-minute discussion with comfort breaks as and when required by individuals.
- Any questions?

### **Warm Up/Icebreakers**

- Ask everyone to say their first name and say what technological innovation has made the most impact on their life and why? What technological innovation they like the least and why?

- Go round the group in turn (either based on seating arrangement or in alphabetical order of first name) and ask those who have chosen an item to show it to the group and explain how/why it represents mind uploading.

### **Perceptions of Mind Uploading**

- Acknowledge the responses that “bring an item” has generated and ask:
- Where do you think you have got these impressions from?
- (If not uncovered during bring an item ask - How does mind uploading make you feel? (Explore positive and negative emotions) Why?
- When spontaneous comments exhausted or if participants struggle, read out and show brief concept as follows:
  - Imagine that a person’s brain could be scanned in great detail and recreated in a computer simulation. The person’s mind and memories, emotions and personality would be duplicated. In effect, a new and equally valid version of that person would now exist, in a potentially immortal, digital form. This futuristic possibility is called mind uploading. The science of the brain and of consciousness increasingly suggests that mind uploading is possible – there are no laws of physics to prevent it. The technology is likely to be far in our future; it may be centuries before the details are fully worked out – and yet given how much interest and effort is already directed towards that goal, mind uploading seems inevitable.
- How do you react to this statement? Why?
- How well does this description of mind uploading reflect your previous impressions? Why?
- What sort of person do you think wrote this statement? Why?
- Describe what do you think mind uploading might offer you if anything? Why?

- What concerns, if any, do you have about mind uploading?
- What, if anything, do you think mind uploading might offer society?
- What negative effects, if any, could you see mind uploading having on society?
- Disclose that the concept was written by Michael SA Graziano - a Professor of Psychology and Neuroscience at Princeton University. What are your reactions now you know who wrote this? Does it change how you feel about mind uploading? Why?
- Prompts from pilot - personal rights, data privacy, data security, data safety, immortality, legacy, life and death, impact on humanity, virtual existence, personal identity.

### **Bringing Mind Uploading to the Public (if time)**

- Explain that we are conscious that mind uploading doesn't exist and we are looking to understand how best to communicate the idea to the public.
- Thinking generally, how do you like to be informed/ educated about new concepts? Why?
- Say: One of the challenges for future research is to find a way of describing this hypothetical concept.
- What mediums of communication and visualisation might help to conceptualise new ideas?
- *For each ask* - Why is that?

- (Once spontaneous ideas generated and discussed or if participants struggling say:
- Some of the possible approaches include the following:(write on whiteboard/flipchart for reference):
  - Telling a story or using a vignette about an individual having their mind uploaded
  - Writing a newspaper article about the topic
  - Using videos to show hypothetical scenarios; both positive and negative (ContraVision, Mancini et al., 2010)
  - Using Virtual Reality (VR) hubs or worlds to visualise the concept.
  - Theatre to “play out” someone’s journey to mind uploading including audience participation.
  - Gamifying the concept - exploring and visualising it through game play?
- Which of these, if any, would help people to suspend disbelief when talking about mind uploading? Why?

**Wrap Up and Homework (5 mins)**

- Any questions/comments?
- Confirm online vouchers will be emailed to participants.

## Appendix C: Study 2 Discussion Guide – Stage 1

### Aim:

To ask participants to reflect on and identify key memories personal to them (autobiographical) from their earliest recollection to present day. This stage will revisit past events and experiences.

### Pre-interview task:

Create a memory board/collage using drawings, pictures, photos etc to capture memorable moments to date. Feel free to use other media such as sound or video etc to capture these memories.

### Housekeeping

- Check OK to record audio and transcribe automatically via Teams
- Recap on aim of stage 1
- Confirm 1 hour
- Check have completed memory board – will discuss shortly

### Interview

- How would you describe memories/What are they to you?
- Complete the following – My memories matter to me because...
- Which memories have you picked as memorable (represented on the collage?)
- Talk me through how you created your collage in as much detail as you wish.
- How did you decide if a memory was memorable enough to be chosen?
- Are both positive and negative memories included?
- How did you capture and record your memories?
- Any changes over time e.g., physical to digital? Impact of this?
- How and when do you revisit your memories if at all?
- What helps you recall a memory e.g., emotional, contextual cues?
- How accurate do you think memory is generally?
- And how accurate do you feel your own memory of personal events is?
- Do you think accuracy changes over time?
- What are the possible implications of memories being inaccurate?
- What makes a memory stand out/persist e.g., subject, emotions?
- What memories are you more likely to forget over time?
- What is the impact of memory loss?
- To what extent, if at all, are there memories that you try to forget?
- What would it mean if your personal memories could be preserved or even enhanced?

### Wrap Up

- Any other comments
- Confirm next stage interview – when2meet to schedule (likely January 2022)

Homework:

Consider what key moments and memories you might make in the future e.g., next few years, next 10–20 years. Note these down in any form you like as we will discuss them in the next session.

## Appendix D: Study 2 Discussion Guide – Stage 2

### Aim:

To encourage participants to anticipate key moments and memories (autobiographical) in the future and to consider how these might be stored and shared with others.

### Pre-interview task:

Choose 1 of the 3 exercises described here. The future can be as far off as you can reasonably imagine however many years that may be. You can choose to include both positive and more negative possibilities – whatever you are comfortable to envisage and are happy to share with me. If you feel uncomfortable about revealing the content of the event, you can describe it in very general terms.

1. **Create** a future memory board/collage using drawings, pictures, photos etc to capture key moments and memories that you might make. Feel free to use other media such as sound or video etc to capture these memories. (Same approach as memory board in Stage 1)
2. **Draw** and illustrate/annotate a timeline from present day to future Identity key moments and memories you might make.
3. Imagine future scenarios in your life that might produce key moments and memories. When you have a specific event in mind **write** a brief description of the event.

### Interview (assume Why/How etc throughout)

#### **Future**

- Check OK to record audio and transcribe automatically via Teams
- Recap on aim of stage 2
- Confirm up to 1 hour
- Check have completed pre-interview task – will discuss shortly
- Before this exercise, to what extent, if at all, have you thought about the future?
  - Experiences you might have/memories you might make?



- How easy or difficult it was to think about future memories ahead of this discussion?
- Talk me through your imagined/future memories in as much detail as you wish.
- How did you decide which memories to include?
- Have you chosen to include any more negative possibilities in your future?
- What expectations does each memory or memories represent?
- What emotions do you associate with each memory?
- How would you classify or categorise these events? (e.g., partner/family, job/career etc.)
- What do you think has shaped these expectations?
- How else might your future look?
- To what extent can you imagine different/alternative futures?
  - Explore alternative pathways.
- What impact would these alternatives have?
- If struggle – think back to a memory you have already made. What could have been the alternative?
- What impact would that have had?

### **Mind (if time)**

- In the first session and today we have been talking about memories specifically. Along with many other things memories are part of our mind and I'd like to explore this in more detail. Complete the following 2 sentences.
- My mind is ...
- Without my mind I would be...
- To what extent do you agree or disagree with each of the following statements where 1 is strongly disagree and 5 is strongly agree:
  1. The mind is what the brain does.
  2. The mind is more than the brain e.g., brain + the whole nervous system, the body, and our environment
  3. The brain and body could exist separately.
  4. Being able to emulate/replicate a brain wouldn't produce a mind.

### **Technology (if time/appropriate)**

- What role might digital technology play in capturing, storing, and sharing your memories in the future?
- How is this different, if at all, to how you use such technology currently?
- What, if anything, do you know about Brain to Computer or Brain to Machine Interfaces (BCIs or BMs)?
- (Explain if required – “This is a device that translates neuronal information into commands capable of controlling external software or hardware such as a computer or robotic arm. These/ are often used as assisted living devices for individuals with motor or sensory impairments (Nature). I will also show a short clip for NextMind <https://youtu.be/RR7tHXV14xk>
- How do you feel about such devices (positives, negatives, hopes, fears etc)?

- If aware - Where did you get this information?
- If aware - Have you had any experience of BCIs/BMIs? If yes – which?
- If unaware – Would you be interested in trying out such a device?

### Wrap Up

- Any other comments or questions
- Confirm next stage interview – Stage 3 – likely Spring/Summer 2022 (need to organise some technology/stimulus material)

## Appendix E: Questionnaire for AI Apps

Q1 Which of the 4 apps did you interact with? You can choose multiple options.

Alter Ego (1)

I Meet Myself (2)

Replika (3)

Karen (4)

Q2a How would you describe your experience with **Alter Ego**? Leave blank if you didn't interact with this app.

---

---

---

---

Q2b How would you describe your experience with **I Meet Myself**? Leave blank if you didn't interact with this app.

---

---

---

---

---

Q2c How would you describe your experience with **Replika**? Leave blank if you didn't interact with this app.

---

---

---

---

---

Q2d How would you describe your experience with **Karen**? Leave blank if you didn't interact with this app.

---

---

---

---

---

Q3 If you interacted with more than one app, which was your favourite? Please choose one only.

- Alter Ego (1)
- I Meet Myself (2)
- Replika (3)
- Karen (4)

Q4 If you interacted with Karen did you choose to take up the offer of a personalised profile?

- Yes (1)
- No (2)
- I did not interact with Karen (3)

## Appendix F: BCI Questionnaire

---

### Start of Block: BCI Questions

Q1 Please confirm that you watched all 6 videos in order.

Yes (1)

No (2)

Q2a Please give me 3 words to describe your reaction to the Muse headband?

---

---

---

---

---

Q2b How likely would you be to use the Muse headband if it was given to you to try?

Very likely (7)

Fairly likely (8)

Not very likely (9)

Not at all likely (10)



Q3a Please give me 3 words to describe your reaction to BrainBit?

---

---

---

---

---

Q3b How likely would you be to use BrainBit if it was given to you to try?

- Very likely (7)
- Fairly likely (8)
- Not very likely (9)
- Not at all likely (10)

Q4a Please give me 3 words to describe your reaction to NextMind?

---

---

---

---

---



Q4b How likely would you be to use NextMind if it was given to you to try?

- Very likely (7)
- Fairly likely (8)
- Not very likely (9)
- Not at all likely (10)

5a Please give me 3 words to describe your reaction to Neurable?

---

---

---

---

---

Q5b How likely would you be to use Neurable if it was given to you to try?

- Very likely (7)
- Fairly likely (8)
- Not very likely (9)
- Not at all likely (10)



Q6a Please give me 3 words to describe your reaction to Neurable VR?

---

---

---

---

---

Q6b How likely would you be to use Neurable VR if it was given to you to try?

- Very likely (7)
- Fairly likely (8)
- Not very likely (9)
- Not at all likely (10)

Q6a Please give me 3 words to describe your reaction to Uploading Memories?

---

---

---

---

---

Q6b What, if anything, did you find believable in Uploading Memories?

---

---

---

---

---

Q6c What, if anything, did you find unbelievable in Uploading Memories?

---

---

---

---

---

---

Q7 Overall how do you feel about the type of future technologies shown in these videos?

- Very positive (7)
- Fairly positive (8)
- Not very positive (9)
- Not at all positive (10)

Q8 If there any other comments you wish to make about these videos on future technologies?

---

---

---

---

---

## Appendix G: AfterLives Questionnaire

Start of Block: Start



Consent I confirm I have read the information and agree to take part in this survey.

Yes (1)

No (2)

PROLIFIC ID “What is your Prolific ID?”

Start of Block: Introduction

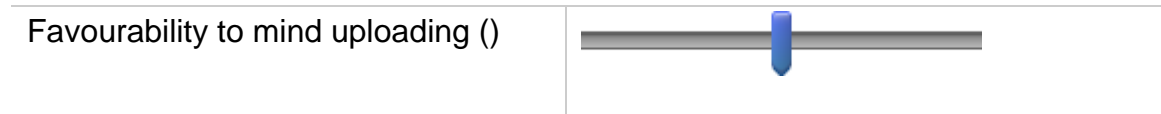
QA Before we meet the characters and experience their story, how aware, if at all, are you of the concept of mind uploading? Please use a scale of 1 to 5 where 1 is not at all aware and 5 is extremely aware.

1      2      3      4      5

Awareness of mind uploading ()	A horizontal slider bar with a blue vertical marker. The bar is divided into five equal segments corresponding to the scale 1-5. The blue marker is positioned between the second and third segments, indicating a value of approximately 2.5.
--------------------------------	--

QF Overall how favourable or unfavourable are you towards the concept of mind uploading? Please use a scale of 1 to 5 where 1 is very unfavourable and 5 is very favourable

1 2 3 4 5



## ASSUME

The story you are about to engage with - Afterlives - asks you to assume a world far in the future where we have developed the technology to upload our minds. In the future this is an established process, and several companies host different uploaded worlds. However, not everyone wants to or can afford to upload, and the experience can vary. Some uploads - like Nathan who you will meet - continue to live on in virtual worlds as avatars which co-exist with the real world of living beings. Other uploads - like Simon - either exist as avatars or - in some scenes - have been downloaded so they continue to exist in physical form in the real world. Nathan and Simon's experiences are revealed through video clips and a walk through of game play and narrated by an objective third person.

---

### Start of Block: Block\_2

Context First of all we need to have a shared vision of how mind uploading might be achieved through whole brain emulation. Please watch the following video which is 5 minutes long and shows one perspective on the topic. Apologies for the YouTube ads which I have no control over.

---

### Start of Block: Block\_3

Characters So let's meet two individuals who have chosen to upload - Nathan and Simon - and follow their uploading journeys. Back story on each:



Nathan is a software developer, aged 27 at time of death from a punctured lung in a car accident. He is uploaded to Lakeview, from Horizon, which is a virtual world populated by uploads who exist as life like avatars.

Simon works in a bookstore and initially had his brain scanned as part of a recovery effort after he was involved in a car crash. Simon's existence as an upload spans several worlds including an underwater facility on Earth - the only place to have survived a meteor collision. There are references to the ARK which is a virtual reality containing human brain scans which when launched into space would safeguard the last humans. Catherine, who features in some segments, is a brain scan of a Computer Scientist who was working on the ARK.

Nathan\_upload Nathan was scanned and uploaded when he was close to death following a car accident. This short clip shows how the process was for Nathan.

Q1 How comfortable are you with the scanning process shown for Nathan?  
Choose one only.

- Extremely uncomfortable (1)
- Slightly uncomfortable (2)
- Neither comfortable nor uncomfortable (3)
- Slightly comfortable (4)

- Extremely comfortable (5)

Nathan at Horizon And this is Nathan's uploading to the virtual world of Lakeview.

Nathan's First Day Nathan wakes up to start his first day as an upload in Lakeview.

Q2 How appealing do you find Nathan's initial experience as an upload? Choose one only.

- Extremely unappealing (1)
- Slightly unappealing (2)
- Neither appealing nor unappealing (3)
- Slightly appealing (4)
- Extremely appealing (5)

Nathan\_Tech\_2 However there are different levels of access depending on your subscription.

Q3 Based on this second scenario, how appealing do you find Nathan's experience as an upload? Choose one only.

- Extremely unappealing (1)

- Slightly unappealing (2)
- Neither appealing nor unappealing (3)
- Slightly appealing (4)
- Extremely appealing (5)

Q4 In which scenario do you feel Nathan's existence as an upload is worth having?

Choose one only.

- Lakeview if resources are unlimited (first clip) (1)
- Lakeview with limited resources (second clip) (2)
- Lakeview with either unlimited or limited resources (3)
- Neither scenario at Lakeview (5)

---

**Start of Block: Block 5**

Simon That was Nathan's initial upload experience. Let's meet Simon and compare his experience.

Q5 How comfortable are you with the scanning process shown for Simon? Choose one only.

- Extremely uncomfortable (1)
- Slightly uncomfortable (2)
- Neither comfortable nor uncomfortable (3)
- Slightly comfortable (4)
- Extremely comfortable (5)

Q65 How comfortable are you with Simon's uploading? Choose one only.

- Extremely uncomfortable (1)
- Slightly uncomfortable (2)
- Neither comfortable nor uncomfortable (3)
- Slightly comfortable (4)
- Extremely comfortable (5)

Simon\_2 Simon considers several questions about his new existence as an upload in the underwater facility on Earth.

Q6 Simon talks about no longer being human. To what extent, if at all, do you believe in using science and technology to help us develop both physically and mentally? Choose one only.

- To a great extent (1)
- To some extent (2)
- Not at all (3)

Simon\_copy Simon gets uploaded multiple times sometimes in different forms.

Q7 In this clip Simon's arms and hands look robotic. If it was the only choice would you want to exist as an upload in a robot body? Choose one only.

- Yes (1)
- No (2)
- Not sure (3)

---

**Start of Block: Block 6**

Simon-last This is Simon's final upload. Please note this clip contains some swearing.

Simon\_Alt Or is this Simon's final upload?

strictly

Q8 Catherine - who features in some of the clips - is proud that their efforts have enabled humanity to live on although. Simon has another view. If it came down to a final choice for your survival, how would you feel? Choose one only.

- I'd want to survive if I was a copy or an original (1)
- I'd want to survive but only as an original (2)

Q9 If you had to choose which would be more important to you? Choose one only.

- That I survive regardless of what happens to humanity (1)

- That humanity survives even if I don't (2)

So, Nathan and Simon demonstrate different possibilities for mind uploading.

Which Afterlife do you think is most likely?

### Start of Block: Welcome



#### Intro

Thank you for experiencing the story. The following questions should take no more than 30 minutes to complete.

The first 5 questions all ask you to rate elements on a scale. Apologies for the visual boredom ...

Please note that the scales measure different things and some are 5-point, some 6-point and some 7-point scales.

While there is some overlap in content they are looking at different aspects so please complete them all.

The second section re-visits your views on mind uploading and you will be able to give more varied responses to the question formats.

**Q10\_TRANSPORTATION Did the story transport you to another world?**

Please indicate to what extent each statement represents your opinion about the story you have just experienced. Please use a seven-point scale ranging from 1 “not at all” to 7, “very much.” One response per row.



1 - Not

7 - very

at all

2 (3)

3 (4)

4 (5)

5 (6)

6 (7)

much

(2)

(8)

While I was experiencing the story, I could easily picture the events in it taking place (1)

While I was experiencing the story, I thought about the events occurring in the room I was in (2)

I could picture myself in the scenes described in the story (3)

I was mentally involved in the story while experiencing it (4)

After the story ended, I found it easy to put it out of my mind. (5)

I wanted to learn how the story ended (6)

I found myself thinking of ways the story could have turned out differently (7)

I had a vivid mental image of Nathan. (8)

I had a vivid  
 mental image  
 of Nora. (9)

○ ○ ○ ○ ○ ○ ○

**Q11\_CHARACTER IDENTIFICATION Did you identify with Nathan?**

Please indicate to what extent you agree with each statement about the character - Nathan - in the story you have just experienced. Please use a seven-point scale ranging from 1- “strongly disagree” to 7 - “strongly agree.” One response per row.

	1 strongly disagree (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7- strongly agree (7)
I think I understand Nathan well (1)							
I understood the events in the story the way Nathan							

understood  
them (2)

During the  
story, I felt  
like Nathan  
felt (3)

During the  
story, I  
could really  
“get inside”  
Nathan’s  
head (4)

I tend to  
understand  
why  
Nathan did  
what he did  
(5)

---

Q12 If you didn't identify with Nathan for any reason please explain why

---

---

---

**Q13 Did you identify with Simon?**

Please indicate to what extent you agree with each statement about the character - Simon - in the story you have just experienced. Please use a seven-point scale ranging from 1- “strongly disagree” to 7 - “strongly agree.” One response per row.

	1 strongly disagree (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7- strongly agree (7)
I think I understand Simon well (1)							
I understood the events in the story the way Simon understood them (2)							
During the story, I felt							

like Simon

felt (3)

During the

story, I

could

really “get

inside”

Simon's

head (4)

I tend to

understand

why Simon

did what

he did (5)

Q14 If you didn't identify with Simon for any reason please explain why

---

---

Q15\_NARRATIVE ENGAGEMENT **Did you engage with the story?**

Please indicate to what extent you agree with each statement about the story you have just experienced. Please use a seven-point scale ranging from 1- “strongly disagree” to 7 - “strongly agree.” One response per row.

	1	2	3	4	5	6	7
	strongly disagree (1)	(2)	(3)	(4)	(5)	(6)	strongly agree (7)
At points, I had a hard time making sense of what was going on in the story. (1)							
My understanding of the characters is unclear. (2)							
I had a hard time recognizing the thread of the story. (3)							
I found my mind wandering while experiencing the story. (4)							

While  
experiencing  
the story, I  
found myself  
thinking about  
other things. (5)

I had a hard  
time keeping  
my mind on the  
story. (6)

During the  
story, my body  
was in the  
room, but my  
mind was inside  
the world  
created by the  
story. (7)

The story  
created a new  
world, and then  
that world  
suddenly  
disappeared



when the story  
ended. (8)

At times during  
the story, the  
story world was  
closer to me  
than the real  
world. (9)

The story  
affected me  
emotionally.  
(10)

During the  
story, when a  
main character  
succeeded, I  
felt happy, and  
when they  
suffered in  
some way, I felt  
sad. (11)

I felt sorry for  
some of the  
characters in  
the story. (12)

Q16\_DISCRETE EMOTIOND - DEQ **What emotions did you feel?**

Please indicate to what extent you experienced these emotions while experiencing the story. Please use a seven-point scale ranging from 1 - “not at all” to 7 - “an extreme amount.” One response per row.

	1 - not at all (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 - an extreme amount (7)
Dread (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sad (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Happy (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Terror (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grief (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Anxiety (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nervous (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Lonely (8)

Scared (9)

Satisfaction  
(10)

Empty (11)

Panic (12)

Fear (13)

Worry (14)

Enjoyment (15)

Liking (16)

Q17\_FOUR FACTOR IMAGINATION SCALE - FFIS **How imaginative are you?**

For each question please indicate how accurately this statement represents you.

Please use a six-point scale ranging from 1- “very inaccurate” to 6 - “very accurate.” One response per row.

This is a long question, but it is the last of this type.

	1 - very inaccurate	2 (8)	3 (9)	4 (10)	5 (11)	6 - very accurate
I am lost in imagination most of the time (1)						
I find myself lost in imagination very frequently (2)						
I find myself daydreaming often (3)						
I spend much of my time						

daydreaming

(4)

I get lost in  
my fantasies

(5)

I get lost in  
thoughts that  
aren't related  
to what's  
going on  
around me

(6)

Sometimes it  
is as though I  
wake-up from  
daydreaming

(7)

My mind  
wanders in  
unpredictable  
ways (8)

I often  
fantasize  
about

impossible

things (9)

Imagining my

future makes

me feel blue

(10)

I become

depressed

when

imagining my

future (11)

Imagining

things in the

future makes

me fearful

(12)

The things I

imagine

make me sad

(13)

My fantasies

lead to

negative

emotions

(14)

I visualize

negative

outcomes for

the future of

the world

(15)

My

daydreams

are

unpleasant

(16)

My fantasies

are less

detailed than

most

peoples' (17)

Most people

seem to have

more

complex

imaginations

than me (18)

My  
imaginings  
are not very  
complex (19)

My fantasies  
do not  
involve many  
details (20)

I have  
difficulty  
picturing the  
details of a  
situation I  
have not  
previously  
experienced  
(21)

My  
daydreams  
have a clear  
goal (22)

My  
daydreams  
are directed  
towards a



specific  
outcome (23)

My fantasies  
are quite  
purposeful  
(24)

There is a  
purpose for  
my fantasies  
(25)

When I  
imagine my  
future, I like  
to plan its  
details (26)

**Edn\_S1 That's the end of Section 1 which looks at the story. Section 2 which is about mind uploading follows.**

## Section\_2

The next set of questions are about mind uploading. Some of the concepts are mentioned in the story - Afterlives - involving Nathan and Simon.

Q18 How appealing do you find the concept of living forever/immortality? Choose one only.

- Extremely unappealing (1)
- Slightly unappealing (2)
- Neither appealing nor unappealing (3)
- Slightly appealing (4)
- Extremely appealing (5)

Q19 How appealing do you find the concept of life extension i.e., fixed term of extra life which you decide? Choose one only.

- Extremely unappealing (1)
- Slightly unappealing (2)
- Neither appealing nor unappealing (3)
- Slightly appealing (4)

Extremely appealing (5)

Q20 Which is the most appealing to you? Choose one only.

Living forever/immortality (1)

Life extension (2)

Neither (3)

Q21 Why is that?

---

---

---

---

---

22 Which of the following possible attributes of mind uploading are most appealing to you? Please choose the Top 3 by ranking them in order from most (1) to least appealing (3). Just write 1, 2 and 3 in the appropriate boxes.

- \_\_\_\_\_ Being there for loved ones after death (2)
- \_\_\_\_\_ Being able to enhance cognitive abilities (3)
- \_\_\_\_\_ Instant communication with other uploads (4)
- \_\_\_\_\_ No physical limitations (5)

- \_\_\_\_\_ No physical pain (6)
- \_\_\_\_\_ Increased happiness and well-being (7)
- \_\_\_\_\_ Continuing to learn and develop (8)
- \_\_\_\_\_ Preserving brilliant minds (9)
- \_\_\_\_\_ Backing up memory so that nothing is lost or forgotten (10)
- \_\_\_\_\_ Being able to control emotions/feelings (11)
- \_\_\_\_\_ Less consumption/impact on the planet (12)
- \_\_\_\_\_ New perspectives and experiences (13)
- \_\_\_\_\_ May allow humanity to survive (14)

Q23 Which of the following possible aspects of mind uploading are most worrying? Please choose the Top 3 concerns by ranking them in order from most worrying (1) to least worrying (3). Just write 1, 2 and 3 in the appropriate boxes.

- \_\_\_\_\_ Against religion/spiritual beliefs (14)
- \_\_\_\_\_ Against natural laws (15)
- \_\_\_\_\_ Just a copy or clone (16)
- \_\_\_\_\_ Mental abuse/torture (26)
- \_\_\_\_\_ Hacking/lack of privacy (27)
- \_\_\_\_\_ Ownership of my mind (28)
- \_\_\_\_\_ Corrupt/evil minds preserved (29)

- \_\_\_\_\_ Life should be finite (30)
- \_\_\_\_\_ No physical body (31)
- \_\_\_\_\_ Unequitable access e.g., only rich and powerful (32)
- \_\_\_\_\_ Life would lose its meaning (33)
- \_\_\_\_\_ Impact on humanity as a species (34)
- \_\_\_\_\_ Don't believe an uploaded mind would carry on living (35)
- \_\_\_\_\_ We need sensory input and output (36)
- \_\_\_\_\_ Hardware failure e.g., servers storing our data/minds (37)

Q24 As an upload, if you had a choice between existing as an avatar in a virtual world or being embodied/downloaded into a physical form which would you choose? Choose one only.

- Avatar (1)
- Physical body (2)
- No preference (3)
- Not sure (4)
- Depends on form of physical body (5)

Q25 To what extent would you be concerned that you would not truly be “you” if you were uploaded? Choose one only.

- Extremely unconcerned (1)
- Slightly unconcerned (2)
- Neither unconcerned nor concerned (3)
- Slightly concerned (4)
- Extremely concerned (5)

Subjective Simon's experience is specific to him but how do you think you would feel if you were an upload?

Q26 If I was an upload, I would feel ... (write in your answer)

---

---

---

---

---

SubjectiveQ In one of the clips, Simon is asked a series of questions about his subjective experience as an upload. Please choose one for each of the following three questions

Q27 I would be troubled by the fact that I am no longer strictly human?

- No (1)
- Somewhat I would feel I had lost myself (2)
- Yes, I would mourn my previous existence (3)
- I wouldn't care what form I took as long as I got to carry on (4)

Q28 How would you perceive your new existence?

- It would be a direct continuation of my previous self (1)
- Like a new chapter in my life (2)
- It would be like being born all over again – a complete do-over (3)
- It would be something completely different and nothing to do with my previous self (4)

Q29 Do you think this new existence would be a life worth living?

- Yes, just as much as my previous life (1)
  - Like a new chapter in my life (2)
  - Yes, but with less meaning (3)
  - Maybe we could find a new sense of meaning in this world (4)
  - No, it's too detached from reality and everything I know (5)
- 

Q30 What would make a new existence as an upload worth living for you?

---

---

---

---

---

---

Q31 If mind uploading was available when your physical body was dying would you want your mind to be uploaded? Please assume that the process of uploading would mean your brain would also die. Choose one only.

- Yes (1)
- No (2)
- Not sure (3)



QA2 After this experience, how aware, if at all, are you of the concept of mind uploading compared to at the start?

- Less aware (1)
- No change (2)
- More aware (3)

QF2 After this experience, how favourable, if at all, are you towards the concept of mind uploading compared to at the start?

- Less favourable (1)
- No change (2)
- More favourable (3)

**Start of Block: Improvements**

Story The final few questions are about the story and how it is realised.

Q32 Thinking first about the story itself, how do you think it could be improved if at all?

---

---

---

---

---

Q33 Thinking about the actual website how do you think it could be improved if at all?

---

---

Q34 If we progress this idea do you think it would be more engaging as a story telling website or as a game? Choose one only.

Website (1)

Game (2)

Q35 Some of the clips are taken from Amazon's drama *Upload*. Had you seen this programme before you experienced the story - *Afterlives*? Choose one only.

Yes (1)

No (2)

Not sure (3)

Q36 Some of the clips are taken from a game called *Soma*. Had you seen and/or played this game before you experienced the story *Afterlives*? Choose one only.

Yes (1)

No (2)

Not sure (3)

Q37 Are there any other comments you would like to make?

---

Q64 Thank you for taking the time to experience the story.



## Appendix H: Science Fiction Hobby-ism Scale

---

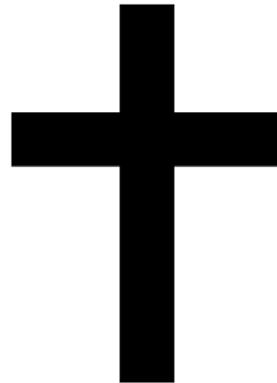
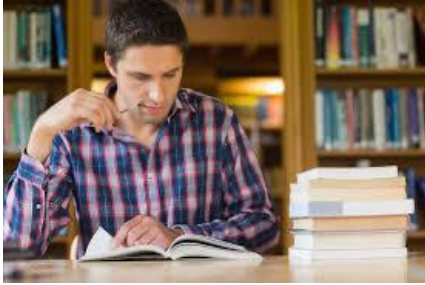
### Item

---

1. I think science fiction is an interesting topic
  2. I've spent a considerable amount of time on science fiction (such as movies, TV series, literature or games)
  3. I often spot science or technology related errors in science fiction films, TV series, or books
  4. I consider myself a major consumer of science fiction
  5. I've actively visited events having to do with science fiction
  6. I'm active in a society, association or community (including online communities) that focuses on science fiction
  7. I try to actively follow the latest developments in the natural sciences or technology
  8. Fiction dealing with the future is often more interesting than fiction dealing with other topics
  9. I'm well familiar with transhumanism
  10. I often contemplate on matters dealing with artificial intelligence
  11. I spend a considerable amount of time getting to know space and space technology
  12. I often think about what machines are like in the future
-

## Appendix I: Memory Boards

### *Panellist EC Future Memories*





***Panellist Ay Future Memories***

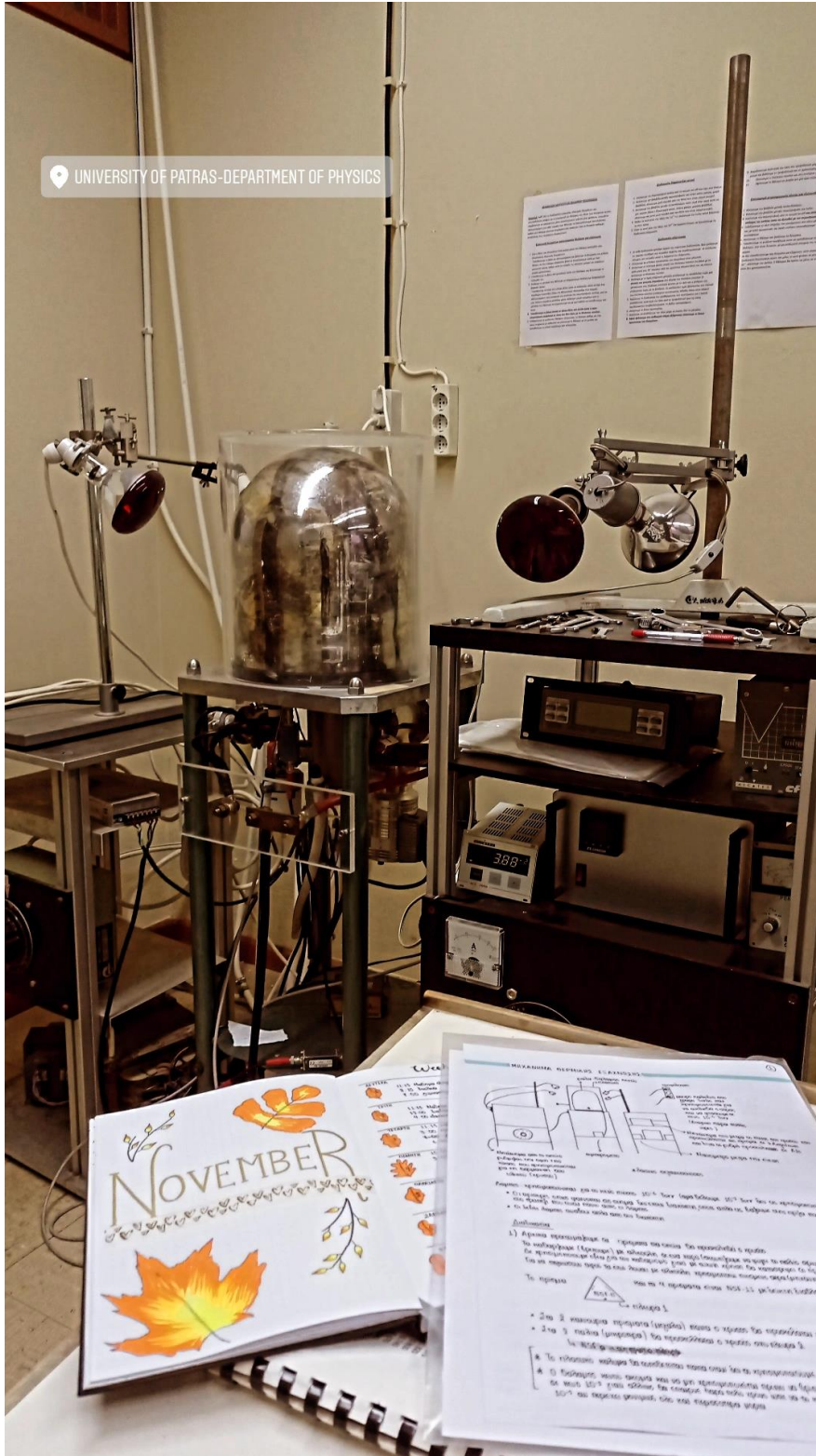




**Panellist J Past Memories**



## Panellist M Past Memories







***Panellist A Past Memories***



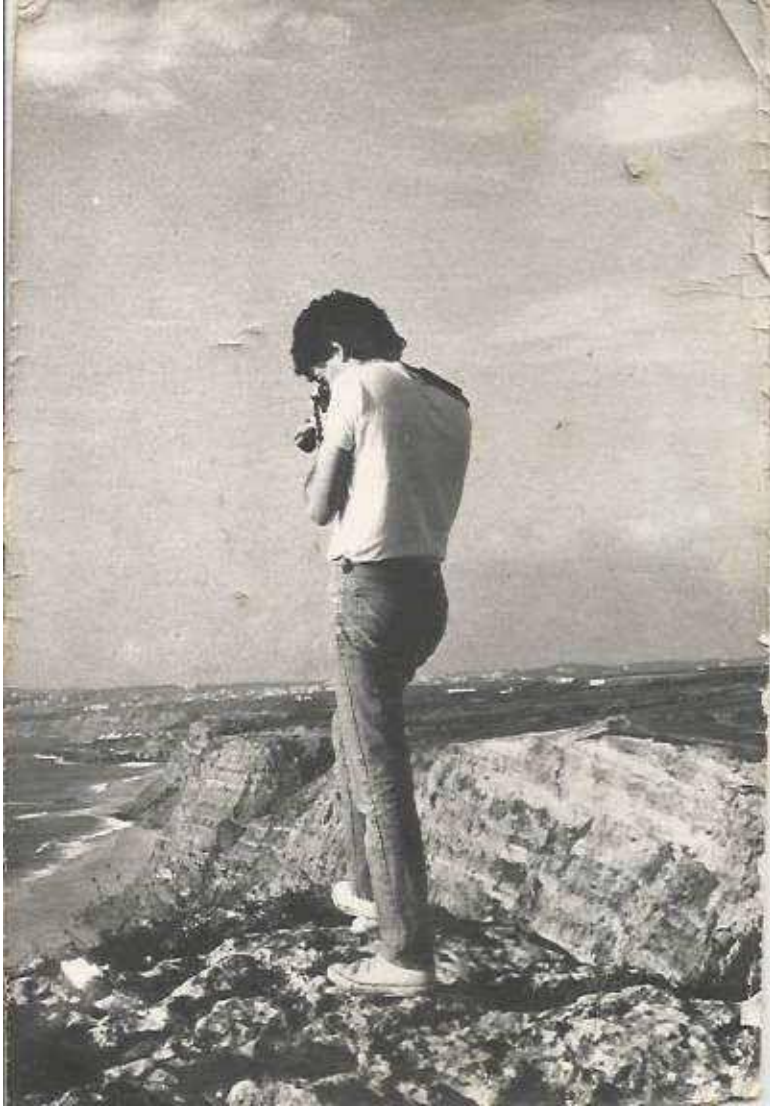












***Panellist J Future Memories***













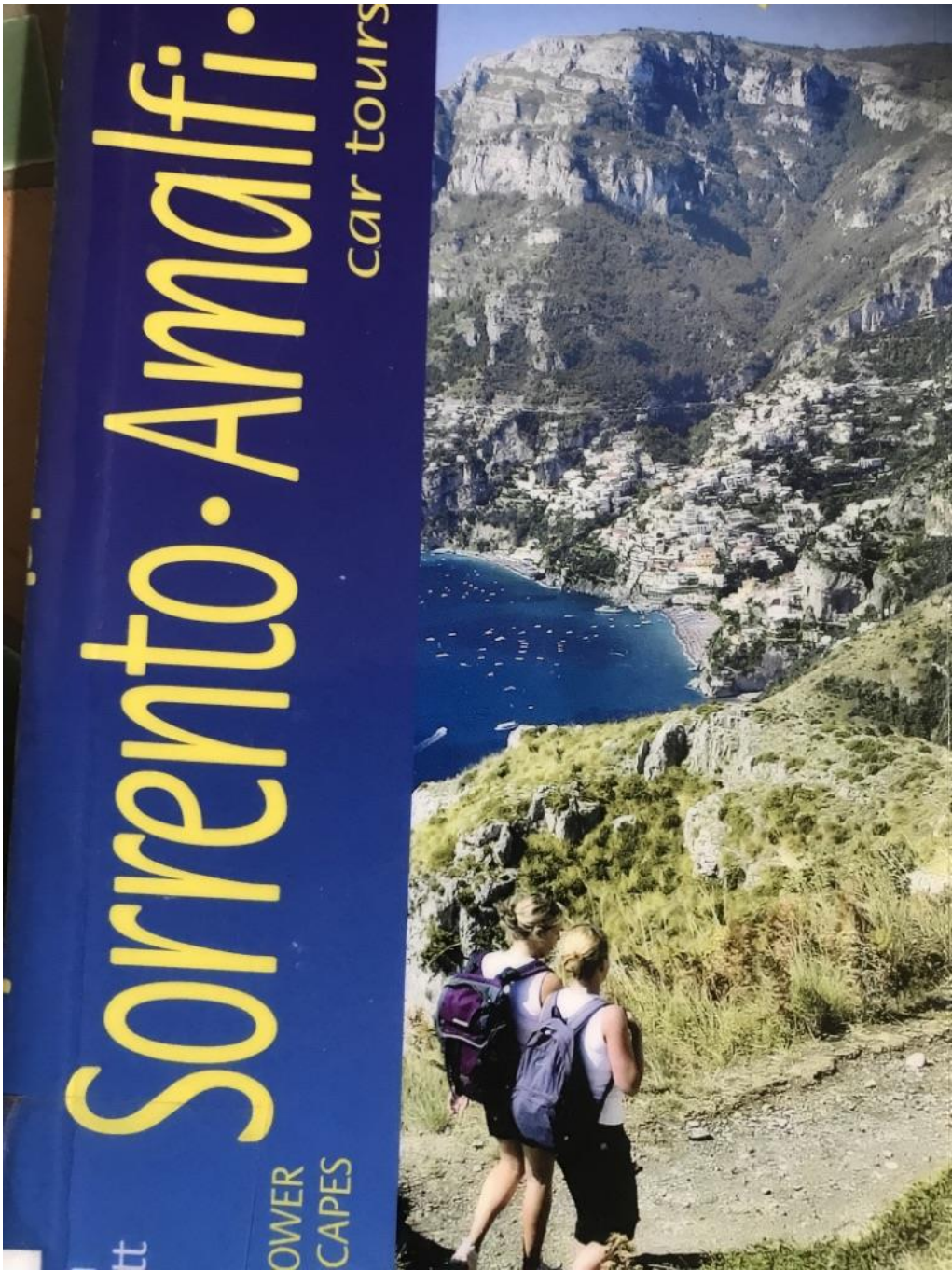


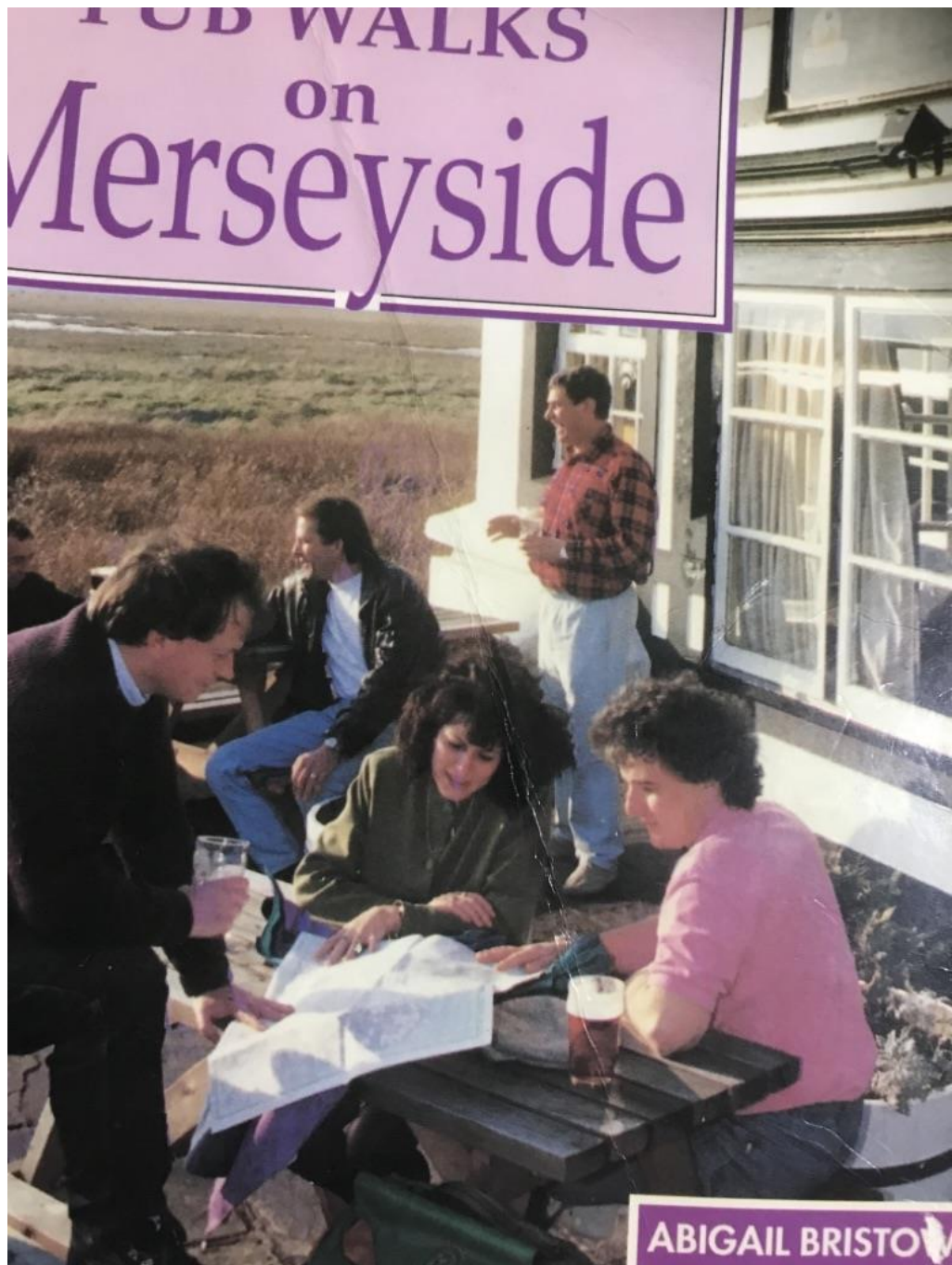












to Sefton's Natural Coast



[www.seftonsnaturalcoast.com](http://www.seftonsnaturalcoast.com)



Turn The Free Information Hidden In Your  
Council's Planning Office Into A £25,000 -  
Part Time Sales Lead Brokerage Business

Introduction.....	4
Module 1: Setting Up Your Sales Lead Brokerage.....	8
Module 2: Demystifying The Planning System.....	16
Module 3: Collecting & Processing Planning Information.....	28
Module 4: Creating A Totally Professional Product.....	62
Module 5: Your Ready Made Marketing Strategy.....	75
Module 6: Selling Your Service Successfully.....	87
Module 7: Maximising Your Planning Profits.....	103
Summary And Six Day Start-Up Action Plan.....	110





## Appendix J: Narrative Changes

### Act 1 – Set up

Introduce characters & character's worlds (before uploading):

Both main characters are only given a brief back story. However, comments from participants indicated that they wanted to know more about Nathan and Simon. Specifically, they requested more information on them and their background as well as more detail on the path to and process of mind uploading.

I would spend more time setting up the story to give context and build understanding and identification with the characters. When I introduce them, I would show more footage of Nathan and Simon in the real world and where possible their interactions with other people. The scenes I am thinking of not only improve characterisation (and possibly increase the story's emotional impact) but also give more background on mind uploading.

The new scenes would include Nathan's interactions with his family, girlfriend (Ingrid), and best friend and business partner Jamie at Thanksgiving Dinner. These scenes also introduce Lakeview as a premium afterlife provider as well as discussing the free version (Beyond) that Nathan and Jamie are developing before Nathan's death. I would add the scene that introduces Nora and her job as a customer support "angel" at Horizon – the company that manages Lakeview – as this provides more detail on the upload process.

I would also include more of the early scenes in Soma. These show Simon's memories of the car accident where he sustained brain damage and also Simon in his apartment. Interactions with other characters pre-upload are limited although he does chat to one of his friends and the doctor performing the brain scan later that day. Nevertheless, you still get a sense of the back story and his character.

#### Introduce characters and character's worlds (once uploaded)

Nathan's uploaded world (Lakeview) is shown including his room, the view from the window, the hotel, and his customer support "angel" - Nora - who is his link to the real world. Nathan is also shown living on a budget floor at Lakeview.

Simon's world is shown via the initial setting for the brain scan and his upload to a facility filled with machines and body suits.

While both these introductions to the characters uploaded worlds are short providing additional detail on Nathan and Simon's worlds would require a lot of footage and potentially detract from the key themes. I feel that their uploaded worlds are better explored, and my research objectives are better met through the events that they experience as uploads.

#### Character's aim/dramatic question:

Simon's objective is clear, although I could provide more backstory, but Nathan's objectives are less apparent. I would try to clarify Nathan's goals because they

enhance the discussion about equitable access to mind uploading and the risks associated with uploading such as missing, corrupted, or deleted memories/data.

Simon has a clear objective: to help Catherine launch the ARK and save humanity which can be deduced from the clips. Not only is the focus of the game but it also raises the question of surviving as a copy vs. an original which is an important theme.

Nathan's objectives are less apparent, but they include investigating his missing memories from the so-called "accident" that caused his death. Another objective is the launch of his free digital afterlife programme, *Beyond*. These aspects were not included on the website. While these are aims, they are given varying degrees of priority in Upload's televised story. I am considering including them as they could add to the discussion about equitable access to mind uploading and the risks associated with uploading such as missing, corrupted, or deleted memories.

#### Inciting incident:

Both Nathan and Simon's worlds change/are disrupted when they are uploaded. However, the incident that sets them on their narrative journey is different.

In *Soma*, Simon's main objective of helping Catherine launch the ARK is clear from the videos although the backstory to this is not shown. In the actual game the goal first becomes apparent in Site Lambda where Catherine explains how humanity has been wiped out by a meteor and all that is left are brain scans (uploads) in a

spaceship called the ARK. I would include this additional scene in the next version of the website as it provides useful context.

Nathan is alerted to the suspicious circumstances of the car crash both by one of his neighbours early in Season 1 (episode 2) and subsequently by Nora when she realises his missing memories have been deleted but neither of these incidents was included. I will add these clips as they provide background information.

#### Plot point 1 – The character tries to achieve the goal

This point signals the transition to Act 2 where the character tries to achieve their goal. Because of the narrative structure, it is difficult to pinpoint this in either *Upload* or *Soma*. Some scenes show Nathan and Simon making decisions about the goal for example in *Soma* at Site Lambda where Simon decides to help Catherine retrieve the ARK.

In *Upload*, it could be where Nathan decides to hack into his previous business partner's phone based on suspicions about the software deal they were working on.

Neither of these scenes were shown and would not contribute significantly.

#### **Act 2 – Confrontation**

The character faces multiple challenges and obstacles:

Simon faces multiple challenges as he tries to process aspects of his new existence such as the fact he is no longer human and that there can be multiple copies of him since the system duplicates rather than transfers his mind. These are shown albeit briefly. I have omitted typical gameplay such as puzzle solving, avoiding predators, or killing them as they do not relate directly to my research themes.

Nathan's challenges are varied and include restoring his missing memories and hacking into the servers to prevent Horizon (who run Lakeview) from instigating a programme called "Mind Frisk" which will access and share residents' thoughts. While these were not included, I may include elements when I re-design the website. The missing memories and "Mind Frisk" depict some of the participant's concerns about mind uploading namely the security and privacy of neural data.

Nathan's challenges are varied and include restoring his missing memories and hacking into the servers to prevent Horizon (who run Lakeview) from instigating a programme called "Mind Frisk" which will access and share residents' thoughts. While these were not included, I may include elements when I re-design the website. The missing memories and "Mind Frisk" depict some of the participant's concerns about mind uploading namely the security and privacy of neural data.

In this middle part, participants would have liked to have seen more footage of Nathan and Simon living their newly uploaded lives. This is easy to achieve using footage from Upload where Nathan interacts with both the living and other uploads.

Simon's afterlife in Soma is darker and more disorientating since the game requires Simon to solve puzzles and avoid predators in several different settings. His main contact is with Catherine who is herself a brain scan. The biggest challenge in showing both Simon and Nathan as uploads is to balance the tone since while Upload has dark moments it is generally comedic. In contrast, Soma has a dark, unsettling ambiance as befits a horror game so this will be more of a challenge, and I am exploring the best way to do this.

#### Plot point 2 – uncertain outcome:

This is typically a climactic scenario where the main character could win or lose. This is not easily identified for either Upload or Soma and hence wasn't specifically included and will not be.

#### **Act 3 – Resolution**

According to the traditional story arc, the final act (3) should provide a resolution or ending, and participants indicated that they wanted to learn how the story ended.

Nathan's fate is not resolved either in the video clips or the series itself since the last season of Upload ended on a cliffhanger where he has downloaded to a new body and there are signs that it may be failing. However, given that Season 3 is airing in the Autumn/Winter of 2023 I may be able to add to Nathan's story and possibly include an ending.

Soma includes two alternate endings for Simon. The endings play on the concept that rather than transferring his mind Simon is copied so multiple versions of him are possible. The first finale shows Simon (v3) left alone in the dark in an abyss while the latest copy (v4) safely makes it to the ARK. The alternative shows Simon (v4) on the ARK and reunited with Catherine. The end shot is the ARK leaving the planet.

Hence while I may be able to resolve Nathan's story Simon's remains open. However, I could ask participants to choose whether Simon ends up in the dark of the abyss alone or an idyllic virtual world with Catherine.