

DOCTOR OF PHILOSOPHY IN MANAGEMENT

**ESSAYS ON THE AGENCY OF AI: THEORY, METHOD, AND ETHICAL
IMPLICATIONS**

By

SAI DATTATHRANI



भारतीय प्रबंध संस्थान बेंगलूर
INDIAN INSTITUTE OF MANAGEMENT
BANGALORE

2022

DOCTOR OF PHILOSOPHY IN MANAGEMENT

**ESSAYS ON THE AGENCY OF AI: THEORY, METHOD, AND ETHICAL
IMPLICATIONS**

By

Sai Dattathrani

A Dissertation submitted in Partial Fulfillment of the Requirements for the
degree of Doctor of Philosophy at

INDIAN INSTITUTE OF MANAGEMENT BANGALORE

2022

Prof. Ananth Krishnamurthy
Chairperson
Doctoral Programme

Prof. Rahul De'
Chairperson
Dissertation Advisory Committee

Members of the Dissertation Advisory Committee

- | | |
|-----------------------------------|-------------|
| 1. Prof. Rahul De' | Chairperson |
| 2. Prof. Rajendra K. Bandi | Member |
| 3. Prof. Jayaram S. Uparna | Member |

Copyright © 2022 by Sai Dattathrani
All rights reserved.

I dedicate this to my daughter.

ACKNOWLEDGEMENTS

This is one of the best things that has happened to me, and it would not have been possible without many people who have helped me along the way. First and foremost, I would like to thank the chairperson of my dissertation committee for placing his confidence in me. He has been my guiding light throughout. Through my interactions with him, I have learned that a key trait of an academic is to be open to multiple perspectives and evaluate each one of them with due diligence and without dismissing any of them as irrelevant. The other members of my committee have also been immensely kind and supportive. Prof. Bandi helped me refine and position the contribution of the thesis, and Prof. Jayaram Uparna helped me refine the writing. I have also benefited from being part of the academic community at IIM Bangalore. The community does not shy away from critiquing and questioning the status quo within, and the society at large. This is yet another trait I imbibed as an academic.

None of this would have been possible without my family, who supported me and took over many of my responsibilities while I was away. I could focus on my work without having to worry much about home. They have also encouraged and motivated me in times of despair and uncertainty. I cannot thank them enough!

CONTENTS

Essays on the Agency of AI: Theory, Method, and Ethical Implications

1. INTRODUCTION.....	18
1.1. First essay – The Concept of Agency in the Era of AI.....	19
1.2. Second essay – An NLP-based Method to Calibrate the Degree of a Concept Emerging from Unstructured Qualitative Data	21
1.2.1. <i>A brief overview of the method</i>	23
1.3. Third essay - Differences in the Ethical Implications Arising from the Differences in the Degree of Agency of the Interacting Actors.....	27
1.3.1. <i>Data collection</i>	28
1.3.2. <i>Data analysis</i>	28
1.3.3. <i>Findings.....</i>	30
1.3.4. <i>Discussion</i>	31
1.3.5. <i>Conclusion.....</i>	32
1.4. Summary of the thesis	33
1.5. Reference.....	34
1.6. Appendix A	36

1.7.	Appendix B	37
2.	ESSAY 1 - THE CONCEPT OF AGENCY IN THE ERA OF AI	39
2.1.	Abstract	39
2.2.	Introduction	39
2.3.	Background literature.....	42
2.3.1.	<i>Duality of technology</i>	42
2.3.2.	<i>Adaptive Structuration theory.....</i>	43
2.3.3.	<i>Practice theory</i>	43
2.3.4.	<i>Actor-network theory</i>	45
2.3.5.	<i>Sociomateriality</i>	46
2.3.6.	<i>Socio-materiality - Imbrication</i>	46
2.3.7.	<i>Summary.....</i>	47
2.4.	The concept of agency in the era of AI	49
2.4.1.	<i>Agency in the philosophy of action literature</i>	50
2.4.2.	<i>The dimensions of agency to capture the differences (inferred from the philosophy of action literature)</i>	51
2.4.3.	<i>Agency of non-human actors</i>	54
2.5.	An illustrative application of the dimensions to investigate the asymmetry of agency	54
2.5.1.	<i>Methodology</i>	54
2.5.2.	<i>Details of the startup</i>	55
2.5.3.	<i>Details of the early-stage breast cancer detection solution.....</i>	55
2.5.4.	<i>Details of the thermal imaging solution</i>	55
2.5.5.	<i>Details of the AI algorithm</i>	55
2.5.6.	<i>Operational details</i>	56
2.5.7.	<i>Dimensions of agency observed in the field study</i>	57
2.5.8.	<i>Influence on practice</i>	62
2.6.	Discussion	63

2.6.1.	<i>The differences in agency vs. symmetry of agency</i>	63
2.6.2.	<i>Individual agency vs. agency as a process / network</i>	64
2.6.3.	<i>Essentialist vs. relational ontology</i>	65
2.6.4.	<i>Differences in the agency and the ability to influence practice</i>	66
2.7.	Conclusion	67
2.7.1.	<i>Designing ethical AI</i>	67
2.7.2.	<i>Attribution of moral responsibility</i>	68
2.7.3.	<i>Limitations</i>	69
2.8.	Reference	69
3.	ESSAY 2 – AN NLP-BASED METHOD TO CALIBRATE THE DEGREE OF A CONCEPT EMERGING FROM UNSTRUCTURED QUALITATIVE DATA	73
3.1.	Abstract	73
3.2.	Introduction	73
3.3.	Background Literature	75
3.3.1.	<i>Qualitative Comparative Analysis</i>	76
3.3.2.	<i>Summary</i>	78
3.4.	Use of NLP algorithms for improving the indirect method of fuzzy-set calibration of unstructured qualitative data	80
3.4.1.	<i>Systematic grouping</i>	80
3.4.2.	<i>Systematic sorting</i>	81
3.4.3.	<i>Retains researcher’s qualitative assessment</i>	81
3.4.4.	<i>Facilitates qualitative assessment based on external standards</i>	81
3.4.5.	<i>Systematizes ‘more in than out’ and ‘more out than in’ distinctions</i>	82
3.4.6.	<i>Enhances inter-subjectivity and transparency</i>	82
3.5.	Context of the example used to illustrate the method	82

3.6.	Method for measuring the degree of a concept	83
3.7.	Applying the method to an existing study	95
3.8.	Discussion	101
3.9.	Conclusion.....	102
3.10.	Reference.....	103
3.11.	Appendix A – Sentence Vector for the sentence “Clinical examination”	106
3.12.	Appendix B – Semantic Similarity Score Matrix for the Attributes of the Rationality Dimension.....	107
3.13.	Appendix C – Similarity Score Deviation Matrix for the Rationality Dimension	108
3.14.	Appendix D – Colour Coded Categorization (least similar, most similar, ambiguous) of Attributes based on Similarity Strength for the Rationality Dimension	109
4.	ETHICAL IMPLICATIONS ARISING FROM THE DIFFERENCES IN THE DEGREE OF AGENCY OF THE INTERACTING ACTORS.....	111
4.1.	Abstract	111
4.2.	Introduction	111
4.3.	Background literature.....	113
<i>4.3.1</i>	<i>Human vs machine agency: Open questions on the attribution of moral responsibility and changes to human values</i>	<i>114</i>
<i>4.3.2</i>	<i>Human vs machine agency: Open questions on the influence of AI on human decision-making agency</i>	<i>115</i>
<i>4.3.3</i>	<i>Human vs machine agency: Open questions on the changes to the nature of</i>	

<i>work</i>	116
4.3.4 <i>Human vs. machine agency: Open questions on the appropriate design of human-AI assemblages</i>	116
4.3.5 <i>Summary</i>	117
4.4. Research method	117
4.4.1 <i>Research setting</i>	117
4.4.2 <i>Data collection</i>	118
4.4.3 <i>Data analysis</i>	118
4.5. Findings	124
4.5.1 <i>Narrative of the scenarios</i>	124
4.5.2 <i>Dimensions of agency</i>	133
4.5.3 <i>Degree of agency</i>	138
4.5.4 <i>Differences in the degree of agency</i>	146
4.6. Discussion	147
4.6.1 <i>Differences in ethical concerns with the differences in the role of the actors</i>	147
4.6.2 <i>Ethics as a doing</i>	150
4.6.3 <i>The role of endorsement in the reinforcement cycle of agency</i>	150
4.7. Conclusion	151
4.7.1 <i>Informing the open questions in literature through an understanding of the interaction of the dimensions of agency</i>	151
4.7.2 <i>Diminishing of human agency</i>	152
4.7.3 <i>Attribution of moral responsibility</i>	152
4.7.4 <i>Implications for human values</i>	153
4.7.5 <i>Limitations and future research</i>	153
4.8. Reference	153
4.9. Appendix A – Clusters that were discarded for lack of theoretical sense	156

4.10. Appendix B – Comparison of manual and algorithmic calibration of the degree of the rationality dimension 157

4.11. Appendix C – Comparison of manual and algorithmic calibration of the degree of the endorsement dimension 160

5. Conclusion..... 166

Table 1-1: Dimensions of agency	20
Table 1-2: Degree of agency of the actors	30
Table 1-3: Differences in the degree of agency of the interacting actors.....	30
Table 1-4: Summary of differences between AI as a tool and AI as a decision-maker	31
Table 1-5: Mapping the four propositions to the open questions in the existing literature	32
Table 1-6: Summary of the Thesis	33
Table 2-1: Significant themes in the IS literature on agency	48
Table 2-2: Dimensions of agency that account for the differences in agency	53
Table 2-3: Dimensions of agency of the actors from the field study (justification given for dimensions that are not immediately obvious). Some are left intentionally blank because these are not of interest to the study.	57
Table 2-4: Comparison between the agency of humans and technology (Some are left intentionally blank because these are not of interest to the study).....	62
Table 2-5: The stance of the proposed concept of agency on the significant themes on agency in IS literature	66
Table 2-6: Illustrative example of degree of freedom-to-choose and responsibility of different AI algorithms	68
Table 3-1: Summary of the requirements of method to calibrate fuzzy-set values to unstructured qualitative data	79
Table 3-2: Example algorithmically generated semantic scores	82
Table 3-3: Illustrative example of manual calibration of the attributes	85
Table 3-4: An illustrative example of semantic similarity score for all attributes	86
Table 3-5: An illustrative example of deviation from the median of the semantic similarity score.....	87
Table 3-6: Distribution of the deviation from the median	88
Table 3-7: An illustrative example of colour coding of the deviation to determine the membership (Colour legend – Red : least similar, green : ambiguous, black – most similar)	88
Table 3-8: Algorithmic calibration of the attributes (Legend – the attributes are in bold , the rules and justification are within the paranthesis in italics)	90
Table 3-9: Reconciliation of algorithmic and manual calibration mismatches	91
Table 3-10: Degree of rationality dimension	93
Table 3-11: Degree of Agency	94
Table 3-12: Attributes of “comprehensiveness” subtheme of the information quality concept (Source: Iannacci & Cornford, 2018)	95
Table 3-13: Manual calibration	96
Table 3-14: Semantic similarity matrix for the attributes of comprehensiveness.....	96

Table 3-15: Deviation matrix.....	98
Table 3-16: Colour coded categorization of the deviations.....	99
Table 3-17: Algorithmic calibration.....	99
Table 3-18: Comparison between manual and algorithmic calibration for reconciliation.....	100
Table 3-19: Comparison of the existing methods with the proposed method.....	101
Table 4-1: Summary of the discourse on ethics of AI in IS literature.....	113
Table 4-2: Illustrative open codes, memoes, and axial codes.....	119
Table 4-3: Illustrative examples of semantic similarity score between open codes and raw data	121
Table 4-4: Dimensions of agency of actors	133
Table 4-5: Degree of the rationality dimension of agency.....	139
Table 4-6: Degree of Endorsement Dimension of Agency	141
Table 4-7: Freedom Dimension of Agency	142
Table 4-8: Consciousness dimension of agency	144
Table 4-9: Degree of agency of the actors	144
Table 4-10: Differences in the degree of dimensions of agency between actors.....	145
Table 4-11: Differences in the human-AI interactions in the two scenarios	148
Table 4-12: Mapping the propositions with the existing literature on agency and ethics of AI.....	152
Table 4-13: Degree of moral Responsibility based on the degree of freedom-to-choose and endorsement	152

Figure 1-1: Method to calibrate the degree of a concept that emerges from unstructured qualitative data	23
Figure 1-2: Illustrative example of actors and the sub-attributes of the rationality dimension of agency (identified from themes coded from unstructured qualitative data)	24
Figure 1-3: Illustrative example of the manually calibrated membership of attributes of Rationality dimension based on a standard (such as specialization of knowledge)	24
Figure 1-4: Illustrative examples of semantic similarity between each of the attributes generated using NLP techniques	25
Figure 1-5: Calibration based on the semantic similarity value (the justification for calibration is given within brackets in the illustrated table)	25
Figure 1-6: Calibrated degree of rationality dimension of agency from the aggregation of the value of each attribute	27
Figure 1-7: Illustrative example of the degree of agency calibrated based on the aggregate of the value of each dimension	27
Figure 1-8: ML Techniques Used to Verify Prior Theory Influencing Manual Codes	29
Figure 1-9: Degree of Agency of the Actors	30
Figure 1-10: Differences in the Degree of Agency of the Actors	31
Figure 1-11: Reinforcement Cycle of Agency	32
Figure 2-1: Summary of Philosophy of action literature	50
Figure 2-2: Illustration of the early-stage cancer detection solution	56
Figure 2-3: Illustration of the operation details of the early-stage breast cancer detection	57
Figure 2-4: AI's influence on practice	62
Figure 3-1: Degree membership values of crisp QCA and fuzzy-set QCA	74
Figure 3-2: Example rules for calibrating Likert-scale responses using 5 value fuzzy set (Source: Liu et al., 2017)	74
Figure 3-3: Calibration of degree to unstructured qualitative data	84
Figure 3-4: Example themes and subthemes (attributes)	85
Figure 3-5: Descriptive statistics of the semantic similarity scores	87
Figure 3-6: Alternate categorization of the deviations that can be used for grouping and sorting	88
Figure 4-1: ML Techniques Used to Verify Prior Theory Influencing Manual Codes	119
Figure 4-2: Example of the themes identified in the thematic coding phase (For a Neurologist)	121
Figure 4-3: Hierarchical clusters	123
Figure 4-4: AI based solution for early-stage cancer screening	125
Figure 4-5: Operational details	126
Figure 4-6: Details of the Rapid AI solution	128
Figure 4-7: Operation details of brain stroke protocol with Rapid AI	128

Figure 4-8: Degree of Agency of the Actors	145
Figure 4-9: Differences in the Degree of Agency of the Actors.....	146
Figure 4-10: Variations in the ethical concerns arising from the differences in the degree of agency of the actors.....	149
Figure 4-11: Reinforcement Cycle of Agency	151

Essays on the Agency of AI: Theory, Method, and Ethical Implications

Abstract

With increasing computing power and technologies such as big data, the capabilities of AI are becoming superior. AI can now make autonomous decisions in critical areas such as cancer detection. While some hail the superior capabilities of AI and are optimistic about its ability to enhance the living conditions of humans, others do not share the same view. The discourse on the impact of AI is highly polarized and lacks a clear understanding of the dynamics of the interaction between humans and AI. As a consequence, the design of human-AI assemblages could be less efficient.

The IS discipline is well positioned to address these issues with its long tradition of understanding the socio-technical interactions of humans and technology. An essential part of the discipline is to understand the dynamic interactions of the agencies of humans and information systems. The IS discipline has investigated the material agency, i.e., the ability of technology to act, and its influence on human agency. However, there are shortcomings in the current paradigms of agency discussed in the IS discipline. They either treat the agency of humans and technology symmetrically or privilege humans. Neither of these stances lends itself to the study of AI's autonomous decision-making capability. The notion of agency has to be extended to accommodate the fact that, unlike traditional information systems, AI can act on its own with minimal human intervention, but it is different from the agency of humans. This autonomous decision-making ability of AI motivated this dissertation and therefore, the overarching research question of the thesis is "how is the agency of AI different from humans and information systems? What are the implications thereof for the human agency?" The first essay introduces the notion of degrees and dimensions of agency to help understand the differences and similarities in the agency of humans, traditional information systems, and AI. And the third essay provides insights into the implication of these differences for human agency through a qualitative field study of human-AI interactions conducted in a healthcare setting. As part of the empirical research, it was also required to devise a methodology to calibrate the degree of agency. Hence, the thesis proposes a method to calibrate the degree of agency from unstructured qualitative data. The thesis makes the following contribution to the IS discipline –

1. It reconceptualizes agency
2. It provides a methodology to calibrate the degree of a concept, such as agency, that emerges from unstructured qualitative data
3. It provides insights into the ethical impact of AI's agency on human agency and the implications for designing human-AI assemblages.