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# **Two Agent-Based Models of Trust in Social Networks**

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# Abstract

Trust is a pervasive feature of human social interaction. Much of the recent interest in trust has been at the level of individuals and dyads. But trust is also important in networks, as it enables the formation and maintenance of social cooperation. Understanding this requires an understanding of how trust arises, functions, and is maintained within networks of people.

Developing understandings of how individual behaviours aggregate, and how they evolve within an environment that includes other individuals developing similar behaviours is a difficult task. One way that it may be approached is through computer simulation using agent-based models. This thesis describes the development of two agent-based models of trust.

Agent-based modelling is a novel method within the discipline of social psychology. The thesis first describes what agent-based modelling is, describes some of the situations in which it might be applicable, discusses how it might apply to modelling individuals in a social setting, and discusses the experience of developing the model.

The first model was based on a theoretical cognitive model of behaviour within a particular formal game that has been claimed to involve trust, the Investor Game. This model showed that a population in which all individuals are pursuing similar optimal strategies does not generate any of the interesting behaviours that we would expect to see in real-world interactions involving trust and cooperation. This tends to suggest that modelling trust behaviours also requires modelling behaviours that are untrustworthy, and representing a full range of potential behaviours, including outliers.

The second model is based on a more naturalistic setting, on-line peer-to-peer trading through sites such as New Zealand's Trade Me, or eBay. In this model, individual traders carry characteristics that determine their reliability and honesty, and attempt to find effective strategies for identifying other traders' trustworthiness. This model suggests that, while providing traders with minimal guidance on strategies and allowing them to search for the best strategies may result in them finding effective strategies, this is not the only possible outcome. Somewhat surprisingly, effective trust strategies acted to contain unreliability, rather than dishonesty.



# Acknowledgements

Over the years of writing this thesis has been a number of years in the writing, over which time a number of people have provided support in various forms. My first two supervisors, John Spicer and Stephen Hill, provided a good sounding board for a number of apparently unrelated ideas that I was juggling in the earlier stages of this work. The idea about modelling Trade Me came while Chelle Stevenson sat me down and explained why I should, or should not, trust various traders on Trade Me. I bought a couch for the post-grad room, and got a subject to model thrown in for free.

Over the last six months or so, a lot of people came to the fore in helping me to finish. It simply wouldn't have happened without Linda Jones and Ian Evans stepping in to make sure that that happened. I am enormously grateful to both of them for going out on various limbs for me. I suspect that quite a number of other people may have been engaged in making that happen, particularly Margaret Tennant, Jackie Koenders, the DRC, and an anonymous reviewer. Most of that went on in the background while I continued to plug on with the manuscript, so I am sure that there are others whose efforts on my behalf I don't know about, which makes it difficult to be able to acknowledge them. If this was you, thank you too.

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The practical support of a bunch of other people have been vital. My family have provided both the material, social, and emotional support to enable me to write the thesis. Mum provided much financial support, and a place to stay and work for the last few months that enabled getting the whole document into shape. Mike provided encouragement and material support, particularly in the early stages. Sandy provided a home and a family, and solid, sane, and calm support through a couple of years when things went from mixed up, to shattering, to downright terrifying. Neither she nor the kids had too much idea how diabolical a doctoral student can be in the final stages before submission. Now they get to meet me all over again when I'm not a doctoral student any more.

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# Foreword

In a previous life, prior to beginning to study psychology, I was an engineer as a designer and consultant in electrical power systems. When I first entered the study of psychology, it was pointed out to me that I'd probably find it a little different to engineering. That comment proved somewhat prescient. This thesis in many ways reflects a series of questions that struck engineer abroad in the social sciences.

Electrical engineering students spend an entire academic career understanding and manipulating systems that are composed of many elements. Entering psychology was jumping into a world that was largely dominated by the in depth understanding of single entities. Unlike engineering, in psychology understanding the individual wasn't simply an essential precursor to understanding the system.

Large as the difference in thinking in terms of individuals versus systems was, I found that the the most dramatic difference in thinking involved time. In fact, to an electrical engineer, time was all but missing in psychology. Almost universally, theory and analyses were entirely static. That may not have been entirely strange in itself, but the language that was being used to discuss phenomena drew frequently on words like increase, change, and intervention. Psychology, as an applied discipline, is largely concerned with bringing about change, but the thinking and analysis was in terms of static, that is, unchanging, phenomena.

My interest in trust grew out of an entirely different set of experiences, this time as a somewhat absent-minded foreign student in Indonesia. Talking to Indonesian people, I was struck at how low their expectations of the trustworthiness of their compatriots was. In part that was understandable, as the country is plagued with endemic corruption, and petty crime like pick-pocketing is common. But at a more personal level, I had the frequent experience of people returning my wallet when I had left it in local stores. Even more strikingly, I had left my ATM card in an ATM, with the PIN number punched in. Someone found it, and came across the road to the mall in search of me. I wondered how such low levels of generalised trust had become entrenched, when individual people had shown an extraordinary degree of honesty.

From the two puzzles came this thesis.





# Contents

<b>Abstract</b>	<b>i</b>
<b>Acknowledgements</b>	<b>i</b>
<b>Foreword</b>	<b>i</b>
<b>1 Introduction</b>	<b>1</b>
Objectives and Overview . . . . .	4
<b>2 Systems, dynamics, and emergence</b>	<b>7</b>
Large systems . . . . .	9
Nonlinear systems . . . . .	11
Dynamics of nonlinear systems . . . . .	16
Summary . . . . .	24
<b>3 Modelling and Simulation</b>	<b>27</b>
Modelling . . . . .	27
Why do we need to model? . . . . .	27
What is modelling, and how does it work? . . . . .	28
Models and theory . . . . .	30
Models in practice . . . . .	31
Computer Simulation . . . . .	34
Simulation models, statistical models and theory . . . . .	40
Simulation as a research method . . . . .	42
Features of simulation modelling . . . . .	44
<b>4 Agent-based Models</b>	<b>47</b>
Agents . . . . .	48
Single agents and systems of agents . . . . .	50

Multiagent systems . . . . .	50
Agent-based models . . . . .	51
Agent individuality . . . . .	53
Artificial societies . . . . .	55
Constructing an agent-based model . . . . .	56
Agent-based model construction tools . . . . .	58
Reasons to use agent-based models . . . . .	63
Conclusion . . . . .	64
<b>5 Agents in psychology</b>	<b>65</b>
Agents, social structures, and the transition between levels . . . . .	67
Agents, individuals, and the role of the environment . . . . .	71
Intentions in agent reasoning . . . . .	72
Belief Desire Intention (BDI) model . . . . .	73
Human agents, agency, and social structures . . . . .	74
Human agents in social psychology . . . . .	76
Social cognitive theory as a candidate for research using agents . . . . .	77
Summary . . . . .	78
Drawing on psychological theory for building agent-based trust models . . . . .	79
<b>6 Trust</b>	<b>81</b>
Why be interested in trust? . . . . .	82
Previous research into trust . . . . .	84
Methods used in trust research . . . . .	87
How does trust manifest? . . . . .	88
Cognitive approaches to trust . . . . .	89
Evolutionary games . . . . .	97
Generalised trust: Traits and norms . . . . .	102
Learning trust . . . . .	105
Summary . . . . .	105
Placing trust into an agent-based model . . . . .	106

<b>7</b>	<b>The Basic Breaking Model</b>	<b>109</b>
	Formal games . . . . .	109
	The Investor Game . . . . .	111
	Building the Investor Game model . . . . .	116
	An Investor Game model: Basic Breaking . . . . .	117
	TrustAgent . . . . .	118
	Results . . . . .	119
	Varying the thresholds, with no randomisation . . . . .	119
	Individual variation in strategy realisation . . . . .	120
	Sensitivity to set-points . . . . .	121
<b>8</b>	<b>The Trading Model</b>	<b>125</b>
	Trust in online auctions . . . . .	126
	The Trade Me system auction process . . . . .	127
	Method: Constructing the Trading Model . . . . .	129
	Trader (agent) . . . . .	131
	TradeMe (the main body of the programme) . . . . .	132
	Details of a single trading round . . . . .	135
	Results . . . . .	138
	Dimensions . . . . .	138
	Model validation . . . . .	140
	Exploration of data generated by the model . . . . .	142
	Discussion . . . . .	163
<b>9</b>	<b>Conclusion</b>	<b>167</b>
	Constructing the agents . . . . .	167
	Validation . . . . .	168
	The form of the results from an agent-based model . . . . .	170
	Developing a model, running it, and extracting a result . . . . .	172
	Characteristics indicating that a dynamic approach should be con- sidered . . . . .	172
	Dynamics . . . . .	172
	Aggregation . . . . .	175
	Thinking about social psychology . . . . .	176
	Systems thinking . . . . .	176
	Predictions . . . . .	177
	Theory . . . . .	177
	Summary . . . . .	178

<b>References</b>	<b>181</b>
<b>A Programme listings</b>	<b>191</b>
Basic Breaking Model . . . . .	191
BasicBreaking.java . . . . .	191
TrustAgent . . . . .	200
Trading model . . . . .	215
TradeMe11.java . . . . .	215
Trader.java . . . . .	225
Stream.java . . . . .	234

# List of Figures

2.1	The possible dynamic outcomes of a linear system . . . . .	17
2.2	Phase space map of a dynamic system approaching a point attractor . . . . .	18
2.3	Position in time corresponding to the phase space plot in figure 2.2 . . . . .	19
7.1	Hesitant Strategy State Diagram (Rieskamp, 2001) . . . . .	114
7.2	Moderately-Grim Strategy State Diagram (Rieskamp, 2001) . . . . .	114
7.3	Reactive Strategy State Diagram (Rieskamp, 2001) . . . . .	115
7.4	Half-Back Strategy State Diagram (Rieskamp, 2001) . . . . .	116
8.1	Structure of results data output by the Trading Model . . . . .	139
8.2	Structure plot matrices showing correlations between the outcome variables . . . . .	141
8.3	Distribution of the number of times consensus is reached after 250 rounds, across 25 simulation runs. Consensus can be reached for a number of strategies, between between no consensus on strategies and consensus on all five strategy elements. . . . .	145
8.4	Distribution of the final number of strategy levels at round 250, across 25 runs, each with five different strategies. Most of the strategies have reduced so that either the population has reached a consensus on the strategies, or to there being two different strategies in the population. . . . .	146
8.5	Weighted sum of squares for clusters . . . . .	148
8.6	The three outcome clusters in principal-component space . . . . .	149
8.7	The number of bad communications (BC) and bad payments (BP) generated in each cluster early (trading round 5) and late (trading round 250) in the simulation runs . . . . .	151
8.8	The number of bad deliveries (BD) and good trades (GT) generated in each cluster early (trading round 5) and late (trading round 250) in the simulation runs . . . . .	152

8.9	The strategy weightings on bad communications (WBC) and bad payments (WBP) in each cluster early (trading round 5) and late (trading round 250) in the simulation runs . . . . .	154
8.10	The strategy weightings on bad deliveries (WBD) and good trades (WGT) in each cluster early (trading round 5) and late (trading round 250) in the simulation runs . . . . .	155
8.11	Number of different weightings for each element of strategy over the first 100 trading rounds in Run 12 . . . . .	162
8.12	Sunflower plot showing adoption of strategy element for weight given to the number of bad deliveries by Agents 1-35 in Run 12. . . . .	163

# List of Tables

4.1	<i>Parallels Between Conventional and Simulation Research . . .</i>	57
6.1	<i>Sentence lengths in a typical Prisoner's Dilemma Game (player 1's sentence: player 2's sentence). For example, if player 1 cooperates and player 2 defects, then player 1 is sentenced to 5 years, and player 2 goes free. . . . .</i>	99
7.1	<i>Gains by investors and borrowers at each round, borrower thresholds set at 0.1 and 0.4. . . . .</i>	119
7.2	<i>Gains by investors and borrowers at each round, borrower thresholds set at 0.7 and 1.0. . . . .</i>	120
7.3	<i>Linear regression coefficients, variables influencing borrower gains. . . . .</i>	123
7.4	<i>Linear regression coefficients, variables influencing investor gains . . . . .</i>	123
8.1	<i>Happiness scores for each possible outcome . . . . .</i>	134
8.2	<i>Agent characteristics after initialisation round. . . . .</i>	135
8.3	<i>Agent 2's use of Agent 5's history in making a trust decision. . .</i>	137
8.4	<i>Adoption of strategy elements by Agent 2. . . . .</i>	138
8.5	<i>Per round mean and median values at the 250th trading round.</i>	143
8.6	<i>Difference in overall per round outcomes between round 5 and round 250 across 25 runs . . . . .</i>	144
8.7	<i>Cluster centroids for the three cluster result . . . . .</i>	148
8.8	<i>Poisson regression results for each type of outcome, regressed on the cluster principal component 1 value, reliability, and honesty across Runs 5, 12, and 24. The regression is carried out across all 250 trading rounds in each simulation run. . . .</i>	158
8.9	<i>Change in Poisson regression coefficients for each outcome type, regressed on Cluster, Reliability, and Honesty, between trading rounds 1-50 and 200-250. . . . .</i>	159
8.10	<i>Happiness of the most and least reliable traders, and the most and least honest traders for Runs 5, 12, and 24, early (Rounds 1-25) and late (Rounds 226-250) in the simulation . . . . .</i>	161

