

# Naturalistic Decision Making and Agent-Oriented Cognitive Modelling: A Preliminary Study

Emma Norling

Department of Computer Science and Software Engineering  
University of Melbourne  
E.Norling@csse.unimelb.edu.au

Clint Heinze

Air Operations Division  
Defence Science and Technology Organisation  
Clinton.Heinze@dsto.defence.gov.au

## Abstract

Belief-desire-intention (BDI) agents provide a useful framework for modelling humans in computer simulations (see [1]). The BDI agent model is based in folk psychology, making some assumptions about the nature of reasoning to make tractable the task of representing human cognition. It provides a reasonable first approximation to human cognition, but has some weaknesses. One important area that needs further consideration is the issue of plan selection: an agent may have several plans which can achieve a particular goal – how should it choose which one to use? Theoretical descriptions of the BDI framework usually assume that the agent would use bounded rational choice (as in [1] and [6]), which has been the dominant theory in classical decision making for a number of years.

Rational choice theory has been highly successful in describing decision strategies in controlled laboratory experiments, but it has been recognised that it is not appropriate in all settings (see for example [5] and [8]). Researchers in naturalistic decision making (NDM) (see [4] and [9]) have been studying decision making of experts in their natural settings and note a number of factors which make it difficult to apply rational choice theory. These include things such as time pressure, high stakes, dynamic uncertain settings, and vague or competing goals. When the decision maker has these factors to deal with, their decision making strategies strongly differ from rational choice. In particular, “in NDM, the focus in the decision event is more front-loaded, so that the decision makers are more concerned about sizing up the situation and refreshing their situation awareness through feedback, rather than developing multiple options to compare to one another” ([7]). In this paper we examine models that have been proposed by NDM researchers, with an emphasis on Klein’s recognition-primed decision (RPD) model [2], which appears to be used for up to 96% of expert decisions (see table 7.2 in [3]). We also discuss how these models could be used to modify plan selection in BDI agents to provide a more accurate model of human cognition.

## References

- [1] Michael E. Bratman, David J. Israel, and Martha E. Pollack. Plans and resource-bounded practical reasoning. *Computational Intelligence*, 4(4):349–355, 1988.
- [2] Gary Klein. Recognition-primed decisions. *Advances in Man-Machine Systems Research*, 5:47–92, 1989.
- [3] Gary Klein. *Sources of Power*. The MIT Press, 1998.
- [4] Gary A. Klein, Judith Orasanu, Roberta Calderwood, and Caroline E. Zsombok, editors. *Decision Making in Action: Models and Methods*. Ablex Publishing Corporation, 1993.
- [5] B. A. Mellers, A. Schwartz, and A. D. J. Cooke. Judgement and decision making. *Annual Review of Psychology*, 49:447–478, 1998.
- [6] Anand S. Rao and Michael P. Georgeff. BDI agents: From theory to practice. Technical Report 56, Australian Artificial Intelligence Institute, 1995.
- [7] Caroline E. Zsombok. Naturalistic decision making: Where are we now? In Caroline E. Zsombok and Gary Klein, editors, *Naturalistic Decision Making*, pages 3–16. Lawrence Erlbaum Associates, 1997.
- [8] Caroline E. Zsombok, Lee Roy Beach, and Gary Klein. A literature review of analytical and naturalistic decision making. Technical report, Naval Command, Control and Ocean Surveillance Center Research, Development, Test, and Evaluation Division, 1992.
- [9] Caroline E. Zsombok and Gary Klein, editors. *Naturalistic Decision Making*. Lawrence Erlbaum Associates, 1997.