Summary

Part I Introduction

The specific problem adressed in this thesis is: what is the rational use of theory and experiment in the process of scientific discovery, in theory and in the practice of drug research for Parkinson's disease? The thesis aims to answer the following specific questions: what is: 1) the structure of a theory?; 2) the process of scientific reasoning?; 3) the route between theory and experiment? In the first part I further discuss issues about rationality in science as introduction to part II, and I present an overview of my case-study of neuropharmacology, for which I interviewed researchers from the Groningen Pharmacy Department, as an introduction to part III.

Part II Discovery

In this part I discuss three theoretical models of scientific discovery according to studies in the fields of Logic, Cognition, and Computation. In those fields the structure of a theory is respectively explicated as: a set of sentences; a set of associated memory chunks; and as a computer program that can generate the observed data. Rationality in discovery is characterized by: finding axioms that imply observation sentences; heuristic search for a hypothesis, as part of problem solving, by applying memory chunks and production rules that represent skill; and finding the shortest program that generates the data, respectively. I further argue that reasoning in discovery includes logical fallacies, which are neccesary to introduce new hypotheses. I also argue that, while human subjects often make errors in hypothesis evaluation tasks from a logical perspective, these evaluations are rational given a probabilistic interpretation.

Part III Neuropharmacology

In this last part I discusses my case-study and a model of discovery in a practice of drug research for Parkinson's disease. I discuss the dopamine theory of Parkinson's disease and model its structure as a qualitative differential equation. Then I discuss the use and reasons for particular experiments to both test a drug and explore the function of the brain. I describe different kinds of problems in drug research leading to a discovery. Based on that description I distinguish three kinds of reasoning tasks in discovery, inference to: the best explanation, the best prediction and the best intervention. I further demonstrate how a part of reasoning in neuropharmacology can be computationally modeled as qualitative reasoning, and aided by a computer supported discovery system