Foreword

The matter of anticipation is, as the editors of this volume state in their preface, a rather new topic. Given the almost constant use we make of anticipation in our daily living, it seems odd that the bulk of psychologists have persistently ignored it. However, the reason for this disregard is not difficult to find. The dogma of the scientific revolution had from the outset laid down the principle that future conditions and events could not influence the present. The law of causation clearly demands that causes should precede their effects and, therefore, concepts such as purpose, anticipation, and even intention were taboo because they were thought to involve things and happenings that lay ahead in time.

An analysis of the three concepts – purpose, anticipation, and intention – shows that they are rooted in the past and transcend the present only insofar as they contain mental representations of things to be striven for or avoided. Purposive or goal-directed action could be circumscribed as action carried out to attain something desirable. In each case, the particular action is chosen because, in the past, it has more or less reliably led to the desired end. The only way the future is involved in this procedure is through the belief that the experiential world manifests some regularity and allows the living organism to anticipate that what has worked in the past will continue to work in the future. This belief does not have to be conscious. Skinner's rats continued to turn left in a maze where the left arm had been baited. They did so because the meat pellet they found the first time had "reinforced" them to repeat the turn to the left. But positive and negative reinforcement can work only with organisms that have evolved to act as though actions could be relied on to have constant results. The anticipation is implicit.

On the conceptual level, to anticipate means to project into what lies ahead a mental representation abstracted from past experience. In many cases we might not call such a projection an anticipation, although, in principle, it is. If, for instance, you are about to go for a walk, take a look at the sky, and pick up your umbrella, you do this because you have learned from experience that the kind of clouds you saw through the window forebode rain. You are not anticipating an event but merely its possibility.

Tools are another example. The material and shape of a hammer have been developed and refined over the course of many generations' experiences and you trust the tool you now hold in your hand to drive in future nails just as it drove in nails in the past. You may not actually anticipate its action, you simply believe that it will work.

If you have ever had the appalling driving experience of your foot going all the way to the floor board when you needed to brake, you will know just how unquestioningly you anticipated the brake pedal to do what it is supposed to do.

In one form or another anticipation pervades the fabric of our experience. As living organisms we constantly rely on a great deal of regularity in the world as we perceive it. It may not always work out, but apparently it works often enough for us to survive. To the examples I gave, many others could be added as illustration of the variety of the term's applications. The contributions to this volume spring from very different sources and are likely to provide a welcome starting ground for the classification and modeling of different kinds of anticipation.

Ernst von Glasersfeld
Scientific Reasoning Research Institute
University of Massachusetts
Amherst, MA 01003, USA

Preface

This book evolved out of the first Workshop on *Adaptive Behavior in Anticipatory Learning Systems*, held on the 11th of August in Edinburgh, UK, in conjunction with the *7th International Conference on Simulation of Adaptive Behavior*: *from Animals to Animats*. Although the matter of anticipation is a rather new and often misunderstood topic, the workshop yielded a lot of attention and interest among a large mixture of people including computer scientists, psychologists, philosophers, neuroscientists, and biologists. The workshop itself was a great success, starting from the very conceptual bottom and moving to first applications of anticipatory behavior systems at the end of the day. It became clear that there is more behind anticipation than the mere relation to prediction, expectation, or planning. Nor is there anything mysterious about the topic. Psychological as well as philosophical issues revealed the strong motivation of the topic and also initiated controversy and discussion. Fundamental distinctions between different forms of anticipations helped to structure thoughts and ideas. Conceptual reflections on representations and dynamical systems showed the different possible manifestations of anticipatory processes. Anticipations also seem to form the basis of attention, motivation, emotion, and personality. Solid approaches revealed that anticipations can, but not necessarily do, significantly improve the adaptive behavior of agents, including robots, stock traders, plot guidance agents, and animat-like adaptive agents.

Despite these exciting ideas and reflections many questions remain to be solved. Fundamental questions such as in what circumstances anticipatory behavior is actually beneficial or which environmental properties allow anticipatory behavior to be beneficial remain to be answered. To make it even more challenging, anticipatory behavior is not clearly defined at this point. Which types of anticipatory behaviors are most suitable for which environmental properties?

These questions form the major concern of this book. The articles are meant to stimulate thought as well as provide guidance for future, more detailed and revealing analysis, development, understanding, and creation. The book is structured similar to the workshop day. First, philosophical thoughts and concepts are meant to stimulate the reader's concerns about this topic. Fundamental cognitive psychology experiments then confirm the existence of anticipatory behavior in animals and humans and outline a first framework of anticipatory learning and behavior. Next, several distinctions and frameworks of anticipatory processes are discussed, including first implementations of those concepts. Finally, several anticipatory systems and studies on anticipatory behavior are presented.

March 2003

Martin V. Butz,
Olivier Sigaud,
and Pierre Gérard

Organization

We are thankful to the organizers of the 7th International Conference on Simulation of Adaptive Behavior (SAB VII) for giving us the possibility to hold the workshop on Adaptive Behavior in Anticipatory Learning Systems (ABiALS 2002) during the conference. The organizers were Bridget Hallam, Dario Floreano, John Hallam, Gillian Hayes, and Jean-Arcady Meyer. Special thanks go to Gillian Hayes for taking care of the workshop organization. The book emerged out of the workshop. It includes revised workshop contributions and further contributions in response to a second call for papers and a review process.

We are more than grateful to our program committee for providing us with careful reviews of the diverse contributions. Due to their hard work, we were able to provide at least three reviews for each contribution, significantly improving many. Due to the wide variety of contributions it was not always easy to judge the significance and impact of the studies in a review. However, we believe that all accepted contributions provide new insights into the realm of anticipatory behavior, and while some of the studies might be preliminary, all of them strongly suggest further research in the area of anticipatory behavior.

Organizing Committee

Martin V. Butz	University of Illinois at Urbana-Champaign, IL, USA University of Würzburg, Germany
Olivier Sigaud	Université de Paris VI, Paris, France
Pierre Gérard	Université de Paris VI, Paris, France

Program Committee

Emmanuel Daucé	Université de la Méditerrannée, Marseille, France
Ralf Möller	Max Planck Institute for Psychological Research, Munich, Germany
Wolfgang Stolzmann	University of Würzbug, Germany
Jun Tani	Brain Science Institute, RIKEN, Saitama, Japan
Stewart W. Wilson	Prediction Dynamics, MA, USA