

# State Space Grids

Tom Hollenstein

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Depicting Dynamics Across Development

 Springer

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# Preface

It began in 1989. I had just graduated from the University of Massachusetts full of ideas and contemplating my future. Like many people, I had been captivated by James Gleick's book *Chaos: The Making of a New Science*. I immediately could foresee that the systems concepts emerging from physics and mathematics were applicable to psychology and human behavior. Here was a new way of thinking about causation in biological systems that fit more parsimoniously to my experiences as a person of the world and a student of psychology. That thoughts, emotions, and actions emerged or self organized simply from the interactions among lower-level components was beyond a theoretical model. It was almost metaphysical, like seeing the true nature of existence after only viewing Plato's shadows on the cave wall. My disappointment with the business of psychology I had felt as a student now gave way to hope and promise and excitement. I was turned on by this very large idea.

I went to the library to see if anyone had made the connection between psychology and chaos, fractals, or self-organization. Admittedly, my search was not exhaustive, but there was little research at the time and almost all of that was focused on physical action—finger wagging and such. Hence, I found no obvious champions that could possibly guide me through a graduate program in areas of psychology I found compelling, one of the possible futures I was considering at the time. Instead, I kept reading popular science books but left the hallowed halls of academia to travel and pursue other learning experiences. However, the seeds were sown and took more than a decade to germinate.

By September of 2000, I had been working at the Oregon Social Learning Center (OSLC) for over 4 years. I had advanced through the ranks to become the observational data analyst for the whole center. Sometimes I was extremely busy, and at other times the requests for analyses were not frequent or demanding. During these lulls, I was free to pursue other analytical techniques with the data. OSLC had a mountain of coding data from over 20 years of research on parent-child and peer interactions. I had actually first been hired as an observational coder applying the Interpersonal Process Code to the behaviors of parents and children. While watching hundreds of different families, the ideas of complexity, self-organization, and fractals resurfaced. Now, as an analyst, I was free to explore. As it turned out, several senior researchers at OSLC were familiar with and interested in applying

systems approaches to better understand the family dynamics that led to behavior problems in childhood and adolescence. So, for about a year, I had periodic meetings with Jerry Patterson, Mike Stoolmiller, and Tom Dishion where I would present my latest attempts with the data, evaluate its success, and devise the plan for the next attempts. Although I thoroughly enjoyed the process, everything I tried in that year from Lyupanov exponents to fast Fourier transformations failed to achieve a viable analytical solution. That September, however, the germinating seed broke the surface of the soil.

That September, I first met Isabel Granic after the first session of a seminar course taught by Holly Arrow on complex and dynamic systems. She had just arrived for her post-doc with Tom Dishion and was hoping I could help her with access to the observational data at OSLC. When we met in my office later that afternoon, Isabel gave me something that changed my life: a copy of her doctoral dissertation. She was the first to use state space grids for parent–child interactions and, as soon as I saw it, I knew, this was it. This was what we were looking for in our meetings at OSLC. This was the realization of the vague idea I had over a decade earlier. It captured the complexities of human interaction with a simple elegance. It opened a world of possibilities. Isabel phoned her husband Marc Lewis, the person who first developed state space grids on sabbatical at the University of Oregon, and we met at a pub to discuss state space grids. We closed the place 8 hours later and had embarked on what has become a rich collaboration and friendship that continues to this day.

Within the year, we submitted five state space grid manuscripts together. The following year, I began my doctoral training in Toronto under Marc’s supervision. My methodological interests, combined with Marc Lewis’ shift into neuroscience, made me the de facto inheritor of the state space grid methodology. Over the next few years, I worked with Alex Lamey—the brilliant programmer who first developed grids with Marc Lewis—to develop GridWare. We launched the website [www.statespacegrids.org](http://www.statespacegrids.org) in 2004 to distribute GridWare for free.

Since that time, I have continued to develop GridWare and the state space grid technique. In 2009, with the help of student programmers at Queen’s University (Shawn Drape, Ji Cho, and Vishnu Nair), I launched a new website with an upgraded version of GridWare (version 1.15a with entropy and transitional propensity measures) and the new GridWare File Converter. This past year, I upgraded the web site again to include a user forum to facilitate the growing network of state space grid users around the world.

Over the past decade, I have conducted dozens of state space grid workshops in North and South America and Europe. This has been a fantastic opportunity for me to see a range of data formats and research questions. These experienced have pushed me toward more creative solutions and a better understanding of the range of possibilities that state space grid analysis holds. I am deeply indebted to the hundreds of people in these workshops and those whom I have helped on line. Each vexing problem, odd data format, unique research question, and technical issue has helped in some way to the creation of this book. In a way, this book reads like a 4-day workshop on state space grids.

The objective of this book is to provide the reader with a comprehensive understanding of state space grids and how to conduct state space grid analysis. The book is organized so that each chapter provides the necessary information for comprehending the next chapter. It begins with a comprehensive description of dynamic systems and the foundational concepts from which state space grids were derived in Chap. 1. It is important to note that adopting a dynamic systems approach is not necessary to be able to use state space grids. Often users just want to explore their dynamic data or test more direct hypotheses unrelated to systems concepts. This is perfectly reasonable—we purveyors of dynamic systems are not necessarily a dogmatic lot. Still, I think that one of the great benefits of this technique is to facilitate *thinking systemically*. As described in Chap. 1, there are deep and profound implications for how we think of causation, especially in terms of development. So, you may start out using state space grids for very pragmatic reasons, but the act of working with this technique may in fact inspire greater resonance with systems thinking.

Chapter 2 is a conceptual description of state space grids culminating in the review of all state space grid studies to date. I also include examples from currently unpublished projects to provide as wide a range of project ideas as possible. In the next chapter, I introduce GridWare, the software for creating state space grids. This is a free Java-based program I distribute via the internet at [www.statespacegrids.org](http://www.statespacegrids.org). This is followed by Chap. 4 which provides the nitty-gritty details of how to create a project in GridWare for state space grid analysis. Most of these issues have to do with the formatting of the data files and basic considerations of data and variable types. The remaining chapters cover the analyses that can be conducted using state space grids, starting with the most basic in Chap. 5, between-grid analyses in Chap. 6, and culminating with advanced analyses in Chap. 7.

As with my workshops, there is a cyclic redundancy across chapters. Concepts first introduced abstractly are then fleshed out in greater detail and eventually become the focal point for analyses. By the end of the book, and if you try the examples provided here, you will be an expert in state space grid analysis. The book should also continue to serve as a reference resource for any further analytical circumstances.

Happy gridding!

Melbourne, Australia  
February 2012

Tom Hollenstein

# Contents

<b>1</b>	<b>Dynamic Systems</b> .....	1
	Features of Dynamic Systems .....	3
	Multistability and Attractors.....	6
	Phase Transitions .....	7
	Conclusion.....	9
<b>2</b>	<b>State Space Grids</b> .....	11
	From Continuous to Categorical .....	11
	State Space Grids .....	14
	A Review of Studies Using State Space Grids.....	16
	Variability and Flexibility.....	18
	Variability, Flexibility, and Developmental Psychopathology .....	20
	Developmental Phase Transitions.....	22
	Group Dynamics.....	24
	Summary Grids.....	25
	State Space Grid Studies: Unpublished or in Preparation.....	26
	Conclusion.....	33
<b>3</b>	<b>GridWare</b> .....	35
	Getting Started with GridWare.....	36
	Exploratory Data Analysis with GridWare.....	39
	Measures .....	44
	Whole-Grid Measures .....	45
	Cell or Region Measures .....	47
	Transitional Measures.....	49
	Missing Values.....	49
	Preferences .....	50
	Exporting Measures .....	51
	Run Log Window .....	53
	Conclusion.....	54

<b>4 Starting Your Own Project in GridWare</b> .....	55
What Is the System?.....	55
Are My Data Appropriate for State Space Grids?.....	57
Starting a New Project .....	60
Trajectory Files.....	62
GridWare File .....	63
Opening a GridWare Project.....	65
Saving a Project.....	65
Conclusions .....	65
<b>5 Within-Grid Analyses</b> .....	67
Analyzing Exported Data.....	67
Whole-Grid Analysis.....	70
Cell Range .....	70
Dispersion.....	71
Visits and Transitions .....	71
Duration Per Visit (Average Mean Duration).....	72
Visits/Events (or Events/Visits) Ratio .....	72
Entropy .....	73
Attractor Analysis.....	73
Empirically Derived Attractors.....	74
Attractor Strength Measures.....	76
Attractors Over Time .....	77
Transition Analysis.....	78
Single-Dimension Analysis.....	80
Summary Grids .....	81
The Special Case of Ordinal Time Series .....	82
Filter or State Variable?.....	84
<b>6 Between-Grid Analyses</b> .....	85
Profile Analysis .....	86
Intergrid Distance and Cluster Analyses .....	88
Intergrid Distance .....	88
Cluster Analyses .....	90
Conclusions .....	92
<b>7 Advanced Analyses</b> .....	93
Beyond Two Dimensions .....	93
Color for the Third Dimension .....	93
Collapsing Dimensions.....	95
Using Continuous Variables.....	105
Complementary Analyses.....	108
Continuous State Space Analysis .....	108
Sequential Analyses.....	109



Inertia.....	109
Identifying Multistep Sequences with T-Patterns.....	109
Visualizing Simulation Data.....	110
Recurrence Quantification Analysis.....	110
Event History Analysis.....	111
Conclusions.....	111
<b>Erratum</b> .....	E1
<b>Epilogue</b> .....	113
<b>References</b> .....	115
<b>Index</b> .....	123

## About the Author

**Dr. Tom Hollenstein** is the leading expert on state space grids and heads the project to further develop software for state space grid analysis, GridWare ([www.statespacegrids.org](http://www.statespacegrids.org)). He was trained in observational data analysis at the Oregon Social Learning Center and received his doctoral training at the University of Toronto under the supervision of Dr. Marc Lewis, the originator of the state space grid method. Dr. Hollenstein is currently an Associate Professor of Psychology at Queen's University in Kingston, Ontario.