

Yair Neuman

# HOW SMALL SOCIAL SYSTEMS WORK

From Soccer Teams to  
Jazz Trios and Families



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*This book is dedicated to my son, Yiftach, and his wife, Shir—a small, happy system that I hope will play jazz by carefully attuning to each other's perspective.*

# Preface

When I was a graduate student, chess was considered the ultimate expression of intelligence and the real benchmark for testing artificial intelligence. However, in what may retrospectively be considered an act of heresy, I proposed a new criterion for game intelligence and wrote an “insight” paper explaining why soccer is a much more intelligent game than chess. I shared the paper with one of my esteemed professors, who described it as “wise” but was highly critical of its thesis. At that time, soccer was considered to be no more than a “group of hooligans kicking a ball” (see Chap. 2) and the idea of studying soccer in the academy was not welcomed to say the least. The best analogy I can use to explain this past *Zeitgeist* in which the study of soccer was not welcomed may be a gentleman participating in a bareknuckle fight—an unthinkable scenario that contradicts the essence of a civilized person. Soccer was seen as the ultimate entertainment of the mob and no more.

It took me more than 20 years to return to soccer as a case study for a complex adaptive system. Through this case study, I have realized how little we really understand small systems, from soccer teams to families, and this awareness has sparked my interest in understanding small social systems. Our deficiency in understanding small systems may seem surprising, but think about sport commentators. If you listen to sport commentators, you may be entertained by their interpretations, insights, “understanding,” and “knowledge”—all expressed with high confidence and amusing rhetoric. However, when you pay close attention to the commentaries, you learn that they are no

more than entertaining chats that add nothing to our understanding of the match.

Surprisingly, you may also find the same shortcoming in our understanding of other small systems, such as families. This shortcoming is expressed in the effectiveness or more accurately in the lack of evidence, supporting the effectiveness of couples and family therapy (see, e.g., Rathgeber et al., 2019). From a scientific perspective, real understanding cannot be separated from the world and a real understanding of family dynamics should be implemented in an effective family therapy. Regardless of the theories, models, and insights developed and gained in marital and family therapy, the bottom line is that families are probably understood to the same extent as soccer teams. It therefore seems that beyond intuition and insights, family and marital therapists fail to scientifically understand families, just as sport commentators fail to scientifically understand soccer teams. There is nothing wrong with being a commentator or in working with intuition, but if we would really like to understand small systems, then a different approach is required.

The quest for this understanding motivated me to write this book. While the book has no pretensions to provide the silver bullet for understanding small social systems, it seeks to point to a different way of thinking about small systems. The book should therefore be read with this approach in mind and with the vision of moving from being a commentator to the possibility of grounded understanding, with all its real-world implications.

Beersheba, Israel

Yair Neuman



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## About the Author



**Prof. Yair Neuman** (b. 1968) is the author of numerous papers and eight academic books published by leading publishers. He has been a visiting professor at various universities, such as Oxford, Toronto and MIT, and holds a full professorship at the Department of Cognitive and Brain Sciences, Ben-Gurion University of the Negev, Israel. His most recent book, dealing with mathematics and literature, appeared in a new book series published in collaboration with the Fields Institute for Research in Mathematical Sciences.

# Part I

## The Foundations of Small Social Systems



# 1

## Introduction: On Unhappy Families, Unsuccessful Soccer Teams, and Grandmothers' Intuition

*Science does not try to explain; it hardly even interprets; science places models above all.*  
*John von Neumann*

In this introductory chapter, I explain why small social systems, such as families and soccer teams, are much more complex than we might assume; briefly present the main thesis of the book; explain my general approach and my emphasis on both theoretical understanding and scientific modeling; justify the style of the book; and invite readers both expert and non-expert.

In his famous opening to the novel *Anna Karenina*, Tolstoy writes that “all happy families are alike” but that “each unhappy family is unhappy in its own way” (Tolstoy, 1877/2002, p. 1). When I shared this opening with a friend who is a scientist, he disagreed with Tolstoy and argued that the opposite is true. He said that most unhappy families he had encountered were much more alike than unlike, as they shared a simple common denominator, such as a missing parent. The opening statement of *Anna Karenina* is therefore debatable or, in the worst-case scenario, scientifically invalid. In this context, it is not quite clear why this opening is still cited after so many years. After all, Tolstoy’s observation could have been formulated and empirically tested as a research hypothesis—which we could call the “Anna Karenina hypothesis.” Either supporting or refuting this hypothesis could lead us to a better understanding of families (and happiness).

To the best of my knowledge, the Anna Karenina hypothesis has not been scientifically confirmed or refuted. So, what makes the opening of *Anna Karenina* so memorable in contrast with the findings of numerous studies on families that regularly pop into the public awareness through the mass media just to be lost in a sea of oblivion the day after? To answer this question, we may turn to another one of Tolstoy's observations, which is not about families but about art.

Tolstoy suggests that the business of art, to include literature, is in making us understand that which is "incomprehensible and inaccessible in the form of argument" (Tolstoy, 1897/1995, p. X). This is a very interesting observation. First, it explains to us that the opening of *Anna Karenina* should not be considered a hypothesis that can be empirically tested and, second, it indicates that the opening expresses some kind of "artistic understanding" different from that gained via science and reason (i.e., as a form of argument). The fact that there has been no definitive conclusion regarding Tolstoy's observation may lead us to suspect that some systems, such as families, are much more difficult to understand than we might have naïvely assumed and that we still cannot fully understand them "in the form of argument." This is precisely where art comes into the picture, at least according to Tolstoy. Therefore, one possible reason that the opening of *Anna Karenina* is cited after all these years is that beyond intuition and artistic understanding, both of which I deeply respect, families are to a large extent still incomprehensible and inaccessible "in the form of argument."

If we accept von Neumann's thesis (cited at the start of this chapter) that science is about modeling, then we may conclude that we still cannot successfully model the behavior of families. In this context, Tolstoy's opening is important because it presents us with a quandary rather than an argument: Why do we debate such a trivial and simple issue as happy and unhappy families? Isn't the answer clear? And if not, why? Is it so difficult to model and understand small systems such as families?

The opening of *Anna Karenina* inevitably raises our awareness of the difficulty of understanding a family, which is a system that the overwhelming majority of us have experienced firsthand. Small social systems, such as families and soccer teams, might be misleading in their familiarity and apparent simplicity. However, to date, we lack a general, firm, and basic scientific understanding of them, and we are still short of methodologies for modeling their behavior. By this I don't mean that small social systems, such as families and soccer teams, are totally incomprehensible or that we have no knowledge of them. Such an argument is both an invalid generalization and a *straw man fallacy* that should be clearly avoided. We all know how to identify unhappy



families or unsuccessful soccer teams, for instance. However, while a scientific understanding may *emerge* from common sense and deep intuition, it is supposed to go *beyond* the realm of common sense and intuition and to gain valid generalization beyond particular instances of (for example) small social systems.

As a graduate student, I took several advanced courses in psychological measurement and research methodology. One of my professors, a sharp-minded and highly critical person, used to say that the results of psychological research are either things his grandmother already knew (e.g. poor, broken, unhealthy families are probably unhappy) or results gained in the lab with no ecological validity or relevance to the real world where real human beings live, think, and act. I have all respect for grandmothers' knowledge and common sense. However, when pointing to the difficulty of understanding small systems, such as families, it seems justified to enrich our understanding and to go beyond what my wise late grandmother already knew. It is also justified to go beyond the limited scope of lab findings and beyond the study of small systems in their specific manifestations (e.g. families or soccer teams). If we seek to better understand small systems then we have to understand the general logic of small systems, the logic transcending their particular instances, whether in sport or in music. This suggestion invites us to inquire into the nature of small systems from the broadest and deepest scientific perspective.

The aim of the current book is therefore to address the challenge of progressing our understanding of small social systems by laying some theoretical scientific foundations and by proposing novel theoretical ideas that can explain what is unique about small social systems and why understanding them is still an open challenge. Beyond understanding, the book proposes several ways in which interesting aspects of small systems can be *modeled*, from the synergy of soccer players to the chemistry of romantic couples. The book therefore deals both with understanding and modeling but it has no pretension to provide a single "principle" to explain the behavior of small systems—just some theoretical thoughts, challenging speculations, and possible methodologies that may enrich our modeling and understanding of small systems across several domains.

The first part of the book presents the complexity, uniqueness, and scientific foundations of small systems. In this part, I first bring to our awareness how complex these small systems are. I also explain why such systems are unique and different from big systems, which have been intensively and successfully modeled, mainly by physics. The main thesis of the book is that small systems are specifically suited to *improvising* or creatively using and

adjusting patterns in order to respond in real time to challenges by producing *tailor-made solutions*. I deeply discuss the “how” and “why” of this thesis by incorporating references to “large” systems that have been studied in physics.

One point that I present in this part of the book is that the unique aspect of small systems that I would like to *theoretically* expose is the same as the one that *intuitively* evokes our curiosity and joy in observing their behavior, whether as observers of a soccer match or as the audience of a family drama as presented in the theater or on TV. We enjoy observing *tailor-made solutions formed in a flexible, adaptable and creative manner to address real-time and real-world challenges*. I explain why this behavior is observed in small systems that occupy a unique position between the behavior of populations, such as the population of gas molecules or those composing a species, and the free and anarchistic but extremely limited behavior of the individual “particle.”<sup>1</sup>

In addition, I explain why the behavior of small systems is grounded in foundational physical–cognitive aspects of the world, mainly the need to “harvest” entropy in an irreversible world, which is deeply connected with cognitive processes characterizing all living creatures. In a nutshell, the idea is that all creatures must have the ability to reason backward in order to learn abstract patterns and use them to instigate adaptive *behavior*. However, acquiring this ability in a world governed by irreversibility is a challenging task. Memory is the solution to the lack of reversibility, and memory and (no less important) forgetting are best formed through interactions between a small number of particles that form *abstract patterns* that later must be used for *concrete actions*. The real secret sauce of small social systems is therefore the ability of a small number of particles/individuals to use abstract representations, albeit in a highly flexible and adaptive manner, through their mutual interactions. This idea is intensively discussed and explained in the later parts of this book.

I must emphasize again that while the first part of the book lays some theoretical foundations, it has no pretensions whatsoever to identify the ultimate and single “principle” through which the complexity of small systems may be resolved. The theoretical foundations aim to locate our understanding within some basic scientific ideas and commonsensical hypotheses, and they are accompanied by open questions, speculations, and provocative ideas that have a legitimate place in an academic book. What I propose is an approach rather than a principle, and the theoretical foundations aim to serve as a source of inspiration for developing hypotheses and modeling methodologies rather than as a picture of the world as it is. The main benefit of adopting this

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<sup>1</sup> I use the term “particle” as a synonym for the individual in order to frame the discussion in the broadest context possible, beyond that of the humanities and social sciences.

perspective is that the way in which a small number of particles collaborate to address real-world challenges may provide us with some new directions for studying the behavior of small systems, from soccer teams to families. Indeed, the published papers from which this book has emerged cover a variety of topics from modeling the behavior of soccer teams (Neuman & Vilenchik, 2019) to modeling significant interactions in *Sex and the City* (Neuman et al., 2020).

While the first part of the book lays the theoretical foundations, the second part of the book presents various aspects of understanding and modeling particular behaviors of small systems, from a new way to model the importance of constraints in soccer to a new way of identifying unique interactions as they are expressed (for instance) in the film *As Good as It Gets* (1997), a romantic comedy featuring Jack Nicholson and Helen Hunt. The modeling approach doesn't pretend to teach us how small systems *really* work, as such a move would require us to fully understand the causal networks through which a system operates. I have no tools that would allow me to enter the mind of a soccer team or the minds of a couple during a romantic date. The modeling part aims to serve the limited task of representing and analyzing the behavior of small systems with the minimal hope of gaining some insights into the behavior of small systems.

My emphasis on a modeling approach deserves some explanation as models necessarily simplify and distort. Their benefit is in providing us with a simple map that we can use to address simple questions, rather than in offering us a full understanding. The map of the London Underground may nicely illustrate this point. This map is a model, a representation, but the model doesn't pretend to represent the *real* network of the Underground. If you are a passenger seeking to find his way in London, the map may be extremely helpful. However, if you are the chief engineer of the Underground's sewer system, the map may have little value for you in reaching the location of a leak.

In contrast with some oversimplistic perspectives, scientific models are maps that should be judged by their pragmatic rather than their "transcendental" value or logical coherence. They are modest and local, and as such of great potential value. Whether you are a confused tourist seeking his way in London, a sewer engineer directing her staff to the source of a leak, or a bacterium navigating toward tasty glucose, your maps and models, whether mental or concrete, are judged only by practical considerations and by whether they help you or not. While this emphasis might be considered overly fussy, it reveals some important nuances that—unless one is aware of