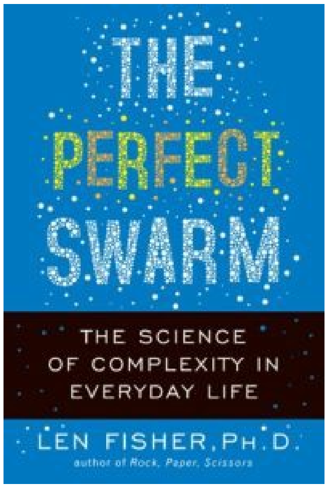

Book The Perfect Swarm

The Science of Complexity in Everyday Life

Len Fisher
Basic Books, 2009
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Recommendation

As its title suggests, this lively book often makes its points with humor and wit. Physicist and author Len Fisher draws on laboratory experiments, observations of the natural world, well-known historical events, contemporary cases and examples from his own life, making a complex subject accessible. His book covers some ground that will be familiar from other books on group intelligence, collaboration and the wisdom of crowds, but the material on "swarm intelligence" is new. Fisher's numerous examples from all facets of nature provide highly fascinating case studies of group behavior. *BooksInShort* recommends this book to professionals in marketing and strategy, and to trainers and readers who are interested in new ways of thinking.

Take-Aways

- As demonstrated by swarms of locusts and schools of fish, groups possess the power of "self-organization."
- Order can emerge out of chaos without any guiding intelligence.
- Groups often know things that individuals don't. This is called "swarm intelligence."
- Certain phenomena, such as "positive feedback" and "chain reactions," can throw a group into chaos.
- Conversely, "negative feedback" is a self-correcting force, which stabilizes the group.
- A swarm has no leader, but it can arrive at its goal without knowing its destination.
- A group uses one of three tactics to reach consensus: it can decide by majority vote, it can debate the issue until it reaches a consensus, or it can use swarm intelligence. A group as a whole outperforms its individual members in making tough decisions.
- Similarly, a group of experts outperforms individual experts.
- When you face many options, look for patterns in information, but test them to make sure they are reliable.
- Decide on a solution that surpasses your expectations.

Summary

The "Science of Complexity"

Have you ever watched a swarm of insects and wondered why the individual flies do not collide? They avoid one another and work better together than they could alone because they follow certain rules. The science of complexity studies these rules, analyzing the patterns and processes of "self-organization." These rules allow complex structures and relationships to emerge out of chaos, without any "central director" or single intelligence guiding the process.

"Swarm behavior becomes swarm intelligence when a group can use it to solve a problem collectively in a way that the individuals within the group cannot."

Chaos turns to order at different rates of speed depending on the system: Think of the difference between the swirling pattern in your coffee after you add the cream and changes throughout an entire ecosystem following a temperature rise. Systems exhibit two types of "dynamic patterns":

1. **"Cycles"** – These sequences repeat themselves over and over, going nowhere, like a family quarrel.
2. **"Adaptive systems"** – The elements in these systems adjust according to changes in circumstances, for example, when a cheering audience begins to applaud in unison.

"Crowd self-organization is an example of complexity theory, self-organization and collective intelligence."

Certain kinds of relationships among the individual components characterize adaptive systems. Each actor responds to the actions of others. As they do, they produce "swarm intelligence," in which the group solves problems that individuals could not. Swarms have no leaders, but members can pass information to one another through observation and rules. For example, a scientist studying how schools of fish move as a group boiled down their actions to two controlling rules: "Follow the fish in front," and "keep pace with the fish beside you."

"Crowds have emergent complex structures that arise from physical and social forces between individuals."

Certain phenomena throw the swarm back into chaos. "Positive feedback" is what happens between a microphone and an amplifier: the amplifier receives an initial sound from the mike and amplifies it; the mike picks up the amplified sound; the amplifier makes it even louder, and finally the cycle results in a sound that is so loud it crashes the system. Similarly, investors who distrusted Washington Mutual withdrew their money, causing more investors to lose trust and withdraw their money, until the bank collapsed.

"Two wrongs may not make a right, but many wrongs can come pretty close."

"Chain reactions" also cause systems to fall apart. Among locusts, biochemical triggers cause swarming: When locusts are close to other locusts they produce serotonin, which triggers group activity and more serotonin production, and attracts more locusts. This chain reaction can lead to swarms of up to 100 billion locusts. In his autobiography, American author James Thurber described a human chain reaction among the residents of Columbus, Ohio, in which one person running down the street was joined by another and another, until everyone in the neighborhood was running in the street, convinced that a tidal wave was descending upon them.

"One way to achieve consensus is to follow the example of others who appear to know what they are doing."

"Negative feedback" balances destabilizing forces. Classical economist Adam Smith's "invisible hand" theory says that negative feedback stabilizes prices following a period of instability or disturbance.

Flight of the Bumblebee

In city streets, humans move randomly in relation to one another until a certain population density is reached. Then, "self-organized rivers of pedestrians," in which everyone walks at the same pace, begin to flow. Bees do something similar, swarming according to three principles:

1. **"Avoidance"** – Bees don't collide with others.
2. **"Alignment"** – Rather, they move the same way as the bees closest to them.
3. **"Attraction" (or "cohesion")** – They simultaneously move toward other nearby bees.

"The idea that a critical mass of 'early adopters' is needed to start a cascade of acceptances isn't just confined to crazes."

However, bees add another complication: They can move toward a target. The bees who know the way fly straightest and fastest toward that target, and others just end up following. Experiments show that humans behave similarly. You can lead a crowd even when the crowd has no idea that it has a leader, who its leader is or what its target is. Social psychologist Stanley Milgram conducted an experiment in which he had people stand on the sidewalk and stare up at a window. If one person stood and stared, 40% of pedestrians stopped to join in. If two people stared, 60% joined, and if five people stared, 90% joined – even after the original starer left.

The Way of the Ant

Ant colonies have a problem common to many human communities: With limited knowledge, they must find the shortest route to and from scarce resources. How do they achieve this? Each ant secretes pheromones, which it deposits on every trail. The first ant to return to the colony has clearly chosen the shortest trail. The other ants alter their course and follow that trail. The shortest trail gets the most traffic and the pheromones marking it are the strongest, drawing more ants to follow and eventually turning it into an ant highway. This sort of community interaction happens among humans at the Web site Digg.com, where readers rate stories as interesting. This raises their visibility and draws more hits. Use this phenomenon to succeed in the market: If another company does what you do, only better, follow its lead and imitate it.

"When we don't have an expert available, we must fall back on the diversity of the group."

In many ways, people move like ants, establishing distinct lanes of pedestrians as they're walking. At a certain population density, this establishes and maintains the flow of traffic. Above that level, traffic clogs. Individuals who attempt to go faster slow the traffic down. When you're caught in such a clog, the best thing to do is to hang back to let the blocked path or exit clear out. However, that's only moderately efficient. A better solution is for urban designers to take the rules of traffic flow into account, by widening crowded areas or placing pillars strategically in buildings to make people step sideways.

"Tallying is one of the simplest ways we can use a large number of cues to guide our decisions."

In a panic, neither following nor fighting the crowd works. Instead, follow the swarm about 60% of the time and search for an alternative means of escape about 40% of the time. People caught in panics often instinctively try to find and save their loved ones. However, a better solution is first to find your own way to safety, then to look for family and friends. Making such a decision in the heat of the moment is difficult; plan emergency strategies in advance.

The Whole Is More than the Sum of Its Parts

To make decisions in a group, you can either vote or generate "some sort of average opinion" that will guide the group. Which of these methods you should use depends on the sort of question you're trying to answer. If you're estimating something, such as the number of beans in a jar, ask each individual to come up with a number on his or her own, then average the responses. The average will be more accurate than any individual estimate.

> "If we can distinguish patterns within the depths of complexity, we may be able to use them as paths to guide us through the maze."

In contrast, if you're answering multiple-choice questions and the group is pretty well informed, vote and go with the majority. Studies show that a group will outperform most of its members. However, it won't surpass the judgment of an expert trained in the field. A group of experts does even better; it outperforms a solo expert. Experts are most useful when dealing with problems at the intersection of "knowledge and initiative."

Reaching Consensus

Groups often have trouble figuring out how to move from the many diverse opinions among their members to a decision. They have three choices: follow the will of the majority, debate the issue until they reach consensus or use swarm intelligence.

> "Groupthink is everywhere, and it is especially virulent in its ability to affect our attitudes toward each other."

Both humans and animals make decisions by doing what others are doing and following the majority – the "quorum response." Voting is quick and easy: everyone votes, and the majority rules. However, voting is subject to the "voting paradox": When voters have three or more choices, a minority can determine the outcome. Voting and following the crowd are vulnerable to manipulation. For example, a restaurant owner might park cars outside the restaurant to make passers-by think the place is busy. Improve the results of voting or following the crowd by adding independent action, such as gathering information.

> "Recognition...can be a two-edged sword when it comes to using it as a cue to choose between alternatives."

Debating the issue poses the danger of groupthink, in which group members reach a shared conclusion, then hold to it regardless of the evidence to the contrary. Groupthink can be exceedingly perilous; powerful groups have held onto their world views even when these endangered them or others. In groupthink, members overvalue the group's ethics and insight. To avoid groupthink, have group members gather information independently, work through its implications and then present what they've discovered to the group for evaluation.

> "Life is complex and...emergent patterns can't always be predicted from simple rules, even though such rules lead to them."

Swarm intelligence emerges when individuals spontaneously and voluntarily interact to solve problems, for example, when a business offers an innovation challenge on its Web site and people around the world respond. The collaborative reference work Wikipedia is a great example of swarm intelligence. Individuals in a swarm see themselves differently from individuals in a group. They resemble stakeholders, who wish to see the problem solved, more than shareholders, who "own" the problem. Swarms are more likely than other kinds of groups to share their power or even give it away.

Networks

Order emerges among people through networks: sets of items and connections that you can represent with dots and lines. The dots, or "nodes," represent the individuals or items in the network; the lines represent the connections among them. Networks are either deliberately planned or completely random; most networks combine qualities of the two.

> "Simple rules, patterns and formulae can often help us steer our way through, but in the end it is the complexity that rules. OK?"

Network connections are not evenly distributed. They tend to cluster according to a "power law," so that a few nodes have many more connections than most others. These "hubs" stabilize the network; you can remove many connections and the network can still function. The links in a network can run one way or two ways.

Networks are like geographical entities, with some elements of the network functioning like isolated "islands." Understanding the hubs and "shortcuts" that link one part of a network to another is crucial in everything from public health to marketing. For example, diseases tend to spread through hubs, so you must focus your efforts on these to prevent infection. To spread news of your new product through a network, the best way is to identify and inform the hubs. However, these well-connected few have many demands on their time. Instead, you may need to contact many people to pass your message along.

Too Much Information

You're awash in data. It's coming at you from all sides, all the time. How do you decipher what's really important? Borrowing an approach from gold miners, do three things:

1. Pick up the obvious gems on the surface.
2. Sift through the data until nuggets emerge.
3. Step away and "look for patterns in the unsorted mass of data."

However, the emergence of a pattern doesn't necessarily mean anything: Patterns emerge naturally and spontaneously in all areas of life. Check to see whether patterns are meaningful by doing experiments and evaluating them statistically.

One longstanding assumption about information – that more is better – is not always true. You can often make good, quick decisions by using "heuristics," or rules of thumb, that simplify complex situations. Follow these five heuristics:

1. **"Recognition"** – Between two choices, select the one you recognize.
2. **"Fluency"** – If you recognize more than one, go with the one with which you are most familiar.
3. **"Tallying"** – Quickly list the positive and negative aspects of a choice and decide on the one with the highest total. If both choices seem roughly equivalent, choose the one that will lead to your goal most directly.
4. **"Take the best"** – Evaluate the characteristics of each option. Choose the option that has more of the attributes that are important to you.
5. **"Satisficing"** – Opt for the solution that surpasses your expectations.

About the Author

Len Fisher, Ph.D., wrote *How to Dunk a Doughnut*, *Weighing the Soul* and *Rock, Paper, Scissors.* He is a visiting fellow of physics at the University of Bristol.