



"There is no handwaving allowed in the **STELLA** software! It forces me to be explicit about my mental models, which always teaches me something new."

-- Greg McHugo, Dartmouth College

Barriers and Opportunities

Psychology is built on a tradition of rich behavioral hypotheses. Often competing, these hypotheses usually offer an explanation for some observed dynamic phenomenon.

Although psychologists, like their colleagues in the physical sciences, have increasingly come to rely on the techniques of mathematics and statistics, the great majority of the hypothesis advanced in psychology continues to be expressed in qualitative terms. Human behavior simply is less amenable to treatment via the strict formalisms of mathematics than is the behavior of physical systems.

However, the fact that human behavior can rarely be reduced to precisely specified, mathematically-expressed laws, does not mean that highly rigorous thinking (and quantification) need be abandoned as viable options. Qualitative relationships can be quantified, even if they can't be measured or specified as precise "laws."

The **STELLA**® software is a powerful tool that enables qualitative relationships to be captured with great rigor, but without the need for precise numerical measurement. The relationships making up a hypothesis can be expressed by piecing together a set of simple building blocks. The **STELLA** software automatically generates the basic equation infrastructure needed to simulate these relationships as you create your diagram. The other equations, needed to flesh out the infrastructure, can be sketched on. This means that psychologists, or their students, need not be mathematicians in order to take advantage of the benefits of simulation as a means for checking the internal consistency of their behavioral and structural hypotheses.

Case Study

The Setting: An Introductory Psychology course

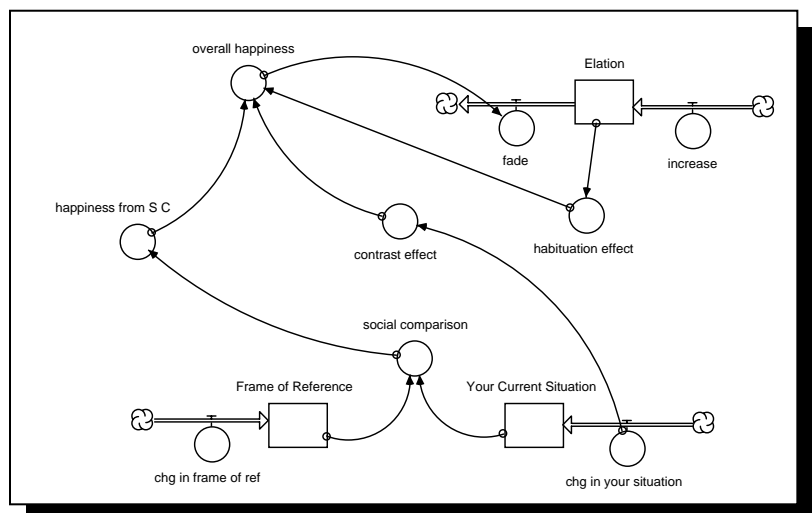
The Topic: The psychology of emotion

The Challenge: Treating emotion in a rigorous manner

Background: One of the most interesting topics in any Intro Psych course is emotion. Students have experienced emotions since their earliest years. They know it's real and generally have a great interest in understanding more about "how it works." Many theories offer explanations for various kinds of emotional responses. Sometimes these theories are in conflict, and often they are expressed in abstract terms – which makes it more difficult for students to grasp the underlying concepts. The **STELLA** software can help.

Step 1: Map. When using the **STELLA** software, the first step in getting a grip on the underlying relationships generating a particular dynamic phenomenon is to lay out the accumulations, flows, and associated relationships that make up the system of interest. Even though this activity requires rigorous thinking, it is not fundamentally quantitative in nature. It has more to do with structure than "numbers."

In the case of a theory of happiness, one of the more interesting emotions, a simplified map might look like the one that appears below. Much of the existing theory argues that happiness is based on some sort of "social comparison." To this is added an "adaptation dynamic," which introduces a



“contrast effect” and a so-called “habituation effect.” These latter two effects have been used to explain why, for example, when someone wins a lottery, they don’t seem to remain in their elated state for very long.

Step 2: Model. Once the basic plumbing of a system is laid out, the next step is to outfit the diagram with assumptions. In this case, this means including things like how long it takes for elation to fade and how much happiness results from a given favorable social comparison. One convenient way to incorporate assumptions, particularly if they’re nonlinear, is via the **STELLA** software’s graphical function (illustrated at right). The relationship shown depicts the “contrast effect.” That is, once you’ve had an elevating experience, you need to continue to have them just to “stay even.” This effect produces the so-called “happiness treadmill.”

Step 3: Simulate. After the diagram is outfitted with your assumptions, it’s time to play out over time the patterns of behavior implied by those assumptions. You can animate your diagram, choose from either time series or scatter plot graphs, or generate tabular output. In this illustration, a time series plot is used to show what happens to the happiness of three psychologically different lottery winner’s over time. As the plot indicates for person two, following the windfall event, happiness surges, then fades relatively quickly. It then undershoots the initial level of happiness in two of the three cases, but to very different degrees. The return to “steady state” is also quite different. Enabling students to experiment with the model to discover, for example, why such differences occur, is an excellent way to develop their intuition for the dynamics of psychological processes.

Step 4: Celebrate! As this brief case study suggests, even psychological concepts like emotion can be handled in a highly rigorous manner. The relationships involved can be expressed in clear, operational terms. Abstractions can be made more concrete. And, dynamic behavior patterns can be investigated. In addition, through simulation, it’s possible to examine a wide range of individual behavior within the context of a generalized theory of behavior. Individual uniqueness can be preserved, while allowing for development of broad generalizations about human behavior. Through simulation, with tools like the **STELLA** software, the study of human behavior can become an even more effective laboratory science!

