Process vs normative modeling

In neuroscience, psychology, and economics, we often see a clash of approaches used to understand human behavior in the form of normative or process modeling.

A normative model, as the name implies, sets a *norm* for behavior: it asks what the answer to a problem *should be*, or in other words, tries to find an *optimal solution* to the question at hand. As an example, consider the an agent that has limited memory capacity but needs to make decisions in a toy world that involve remembering how valuable things are in order to make good choices when faced with them. How should this agent allocate its limited memory resources to items in memory so that they can maximize their return?

A process model, on the other hand, provides a mechanistic answer in the form of *how* the problem is solved. More often than not, there are a myriad of ways of solving the problem. While a normative model aims to find the best possible solution, a process model will come up with different answers based on the particular question at hand. Following our earlier example, a limited-capacity agent could follow a simple heuristic such as acting randomly when it doesn't affect the outcome. The agent could then adjust this degree of randomness to the problem at hand given their memory capacity.

A little bit of rambling here (might scrap):

> *Decades of research in neuroscience, psychology, and economics shows that humans really just do what they do. So one might rightly ask the question of whether we should be looking at the questions of optimality at all when studying human and animal behavior. This is in and of itself a long and ongoing debate, and there are merits of both approaches. If all assumptions are well-accounted for, normative models indeed allow us to quantify biases in our behavior. However, knowing the very complex web of human decision-making processes and the biological machinery available creates a totally new normative model, since we now have to take all of these into account.*

However, one can argue that process and normative models are two sides of the same coin. One can ask *What is the normative thing to do given that you will be using a given process?* Thus, every process model implies a normative answer. But similarly, every normative model is an optimization under assumptions. Those assumptions are often not stated, but they still pertain. Thus, every normative model says something about the underlying process.

In this article, we compare and contrast two approaches for our example in question. We first show that they are behaviorally indistinguishable from each other across a variety of tasks. Next, we show how they can be cast in the same theoretical framework to analyze their differences further. Finally, we reflect on the implications for neuroscientists studying decision-making and trying to decode how values might be encoded in the brain.

References:

- Herbert Simon's bounded rationality
- Baron 2004
- David Redish on process vs normative modeling