

Overwhelmed by Choices

M. Castillo, *Editor-in-Chief*

It is our choices that show what we truly are, far more than our abilities.

J.K. Rowling, *Harry Potter and the Chamber of Secrets*

What should I choose? Pizza or Chinese? The blue or the white one? We wish all choices in life were this simple. "Choice" is defined as the ability to exercise control, and whether we are able to truly choose is greatly affected by the initial perception of being able to do so. If one believes in having choices, there is a personal benefit even in the absence of exercising them. In a Capitalist economic system like ours that emphasizes individualism, choosing is an extremely important aspect of everyday life. Our perception of choices is directly influenced by the myriad products available (which in reality are made by a dwindling number of corporations in the same place by using the same raw materials, resulting in actually fewer choices). The concept of "choice" as we now know it started in the 17th and 18th centuries in Western Europe. Ironically, Collectivism (which offers fewer choices) also started in Europe (by Karl Marx) as a reaction to the Industrial Revolution and the idea of Individualism.

In the West, our desire to choose separates us at an early stage from our parents, whereas in other cultures, particularly Asian, younger family members always consider their parents' opinions when making a choice. It is now said that between 18 and 25 years of age, we pass through a period of self-discovery and choice. This period of life is becoming more important and obvious as our children stay at home later until they finally choose what to do with their lives. Today, the countries where choice is considered a most important human right are the United States, Australia, and Great Britain. In the United States, choice is a matter of principle and practice, while in the rest of the world, Collectivism diminishes its importance. The only country where perhaps Collectivism and Capitalism coexist is Japan, and even there Collectivism takes precedent like it does in most Asian countries.

In the United States, we take "freedom of choice" as an undeniable right. This even extends to spirituality, and in 2009, a Pew Institute survey showed that 50% of Americans chose to change religions at least once during the lives!¹ Similarly, the right to choose whom we marry is probably overemphasized and finally not that important. When American couples were asked 20 years later how they felt about each other, nearly all stated that "love" was no longer present in the relationship. However, when Indians, for whom a spouse was chosen and unknown before the wedding, were asked the same question, 60% stated they loved each other.¹ Of course, this can also reflect what we understand as "love." Although choices such as religion and marriage are influenced by endless variables, neuroimaging provides a glimpse into how the brain makes simpler choices.

Brain activity before making a choice begins in either the prefrontal or parietal cortex.² These parts of the brain achieve their

final size between 20 and 30 years of age, and that is perhaps why most young adults really cannot choose "wisely" until about 25 years of age (vide supra). Most choices involve motor elements. The prefrontal cortex basically makes a cost/benefit analysis before telling the basal ganglia to plan a movement. One of the most common daily choices we face is which hand to use. In this situation, the posterior parietal cortex initiates competitive but parallel impulses for both hands, and once one process reaches a threshold, the corresponding hand does the reaching. The more ambiguous the target is, the greater the preparation time the parietal lobes need. A study using fMRI showed that there may be up to a 7-second delay between cortical activation and the final push of a button.³ These studies bring up 2 important aspects: The brain always has a plan B, and often there is time to avert an action. Because choosing is directly related to evolutionary adaptation and keeps us being the supreme animal on earth, it is worth taking some time to explore other aspects related to how we choose. The subspecialty that investigates how we choose is called "decision neuroscience," and as expected, economists and business managers are very interested in it.

Before making a decision, the brain must learn to predict when and where rewards based on choice will occur.⁴ This ability is basically acquired by observation. The accumulated information is processed in several parts of the brain (mainly the orbitofrontal cortex and amygdalae, which makes sense because these are very primitive parts of the brain) that assign value and relevance to our choices. It is thought that wanting something is mediated by dopamine, while liking something depends on opioid neurotransmission that occurs mostly at the nucleus accumbens. Finally, reversal-learning, planning, and avoiding impulsive choices lead an individual to select the best choice. Compulsive gamblers seem to have a problem at this last level. Some drugs and mood disorders also affect choosing at this last stage. Each choice is assigned a different value, and on the basis of these values, we humans choose. If one learns that regret accompanies a choice, this specific choice ceases to be selected.⁵ If one chooses the same option over and over again, satiation takes place and we lose our interest in that particular choice.

Mental priming is a prerequisite to choosing. A "prime" is an item of information or implicit memory stored in our brains that is enhanced because of a particular stimulus. The industry uses advertisements to create these primes that later predispose customers to make certain choices when shopping. Even words are not free of priming. Free-association word activities are not entirely "free" because one word always primes a link between it and the subsequent one (the word "dog" usually primes the word "cat" and vice versa). This is called "semantic priming," but priming can also be perceptual and conceptual.⁶ An example of perceptual priming is being asked to complete a word. If you are shown "airpl . . .," you can easily guess the rest of it ("airplane"). Conceptual priming is seen when 2 concepts belong to the same category, such as "table" and "chair." Priming can be positive (it increases the speed with which we choose) or negative (slows it). Positive priming occurs by a spread of brain activation, but negative priming has not been explained. Repetition reinforces posi-

tive priming and leads to faster choosing. As we become more primed to respond to something, less neural processing is involved.

When neuroimages are interpreted, clinical information and previous knowledge of radiology help us first to choose the areas of the brain likely to be involved by a particular disease (called “top-down instruction”). Nonphysicians do not choose these same specific areas of an imaging study but look everywhere (called “bottom-up salience”). Using top-down methods, experienced mammographers can detect cancers within 1.0 second of being shown a study.⁷ Repetitive priming results in a “look-detect-scan” pattern rather than the “scan-look-detect” pattern. In radiology, we talk about the importance of “Gestalt” recognition and interpretation of findings (equivalent to “look-detect-scan”). In one study, neurologists who were shown a series of brain CT scans with infarctions often stared at an anterior cerebral artery territory infarct for an average of 11.5 seconds before choosing their diagnosis.⁸ This study done by neurologists claims that this delay occurs because head CT studies are much more complex than, say, mammograms (I do not agree with this claim). We interpret imaging studies by narrowing down our choices to offer a credible differential diagnosis.

Similarly when faced with an immense number of products on a supermarket shelf, we narrow down our choices and disregard all other products. Economists know this well: You can only put so much stuff on a shelf before humans begin to ignore most of it (this is called the “more is less” principle). For unknown reasons, humans choose in sets of 3. At the grocery store, you will probably narrow down your choices to 3 and end up buying 1 of these. I do the same when presenting unknown cases to our trainees and ask them to give me the 3 most important differential diagnoses and finally to choose 1. Because we never provide thousands of differential diagnoses, choosing may not be as difficult as going to your local supermarket, which carries an average of 39,000 items.⁹

What makes the most difference between these 2 choosing situations is expertise. I have the expertise to offer you the 3 most likely diagnoses but not the expertise to choose among dozens of dishwashing detergents. The expert mind works at a more granular level and develops the ability to exclude unwanted choices rapidly. Because we are not experts in everything, we must heed the advice of other experts. For example, how do you know that a

certain article in the *American Journal of Neuroradiology* is the best choice for you? We now provide a rating system with which expert readers can rate articles so that when you search for articles on “penumbra imaging,” others will probably have already rated these, letting you know which are best, and thus you will not be overwhelmed by choices. **Recommendations and categorizations make choosing easier and wiser, and restrictions lead to choosing correctly within a framework.** Famous jazz player, composer, and overall musical ambassador Wynton Marsalis said: “You need to have some restrictions in jazz. Anyone can improvise with no restrictions, but that’s not jazz. Jazz always has some restrictions. Otherwise it may sound as noise.”¹ I would like to extend this concept to our daily image interpretations: Without restrictions, categorizations, recommendations, and a narrow focus, we may overwhelm our colleagues and our choices may be interpreted as just noise.

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