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The neuroscience of consumer choice

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We review progress and challenges relating to scientific and applied goals of the nascent field of consumer neuroscience. Scientifically, substantial progress has been made in understanding the neurobiology of choice processes. Further advances, however, require researchers to begin clarifying the set of developmental and cognitive processes that shape and constrain choices. First, despite the centrality of preferences in theories of consumer choice, we still know little about where preferences come from and the underlying developmental processes. Second, the role of attention and memory processes in consumer choice remains poorly understood, despite importance ascribed to them in interpreting data from the field. The applied goal of consumer neuroscience concerns our ability to translate this understanding to augment prediction at the population level. Although the use of neuroscientific data for market-level predictions remains speculative, there is growing evidence of superiority in specific cases over existing market research techniques.

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Introduction

At the heart of all commercial and economic activities is the consumer, whose preferences and choices heavily influence a host of decisions and actions by entrepreneurs, firms, and governments [1]. These choices range from weighty ones such as purchasing a home to routine ones such as grocery shopping. Scientifically, theories of consumer choice are foundational to a number of fields in the social and biological sciences [1–3]. In applied settings, governments and companies expend considerable sums to forecast individual-level and aggregate choices and to shape preferences [4].

In recent years, researchers working in different fields, including psychology, economics, neuroscience, and marketing, have sought to systematically examine neurobiological mechanisms underlying consumer preferences and choice processes. These findings have been reviewed in a number of journals from both neuroscience and consumer research perspectives [4•,5–8], including how pricing, branding, and advertising affect consumer choice, as well as attempts of both academic and industrial researchers in translating this neural understanding to improving accuracy of market-level forecasting based on existing techniques.

Therefore, rather focusing on past findings, we will discuss some important open questions that are only beginning to be addressed in the literature. Using an ordinary grocery-shopping trip as a motivating example, we consider two sets of questions at the intersection of consumer research and cognitive neuroscience. First, how are consumer preferences formed and represented in the brain? In particular, how do we characterize the complex interaction and contribution of social, cultural, and developmental processes to preference formation? Although we know much about the developmental trajectory of consumer preference formation on the one hand, and those of neurocognitive processes on the other, there is as of yet little attempt to understand how the latter serves to shape and constrain the former.

Second, what are the roles of attention and memory processes in translating preferences to choice behavior, particularly in naturalistic settings (Figure 1)? For example, how do consumers and their brains respond to complex communications and marketing stimuli in modern societies (e.g., ads, websites, packaging), and how do they engage in specific tasks (e.g., search, choice, usage)? Here too, despite ample documentation of the importance of consumer attention and memory in real-world behavior, we know little about the underlying neurocognitive processes involved. Finally, we then turn our attention to issues surrounding the commercial application of the neural-level knowledge to forecast aggregate consumer behavior at the market level, including questions related to its feasibility and impact.

The science of consumer choice

Over the past decade, we have learned an immense amount about how the brain weights costs and benefits associated with acquiring goods to satisfy preferences, and how it responds to factors such as the delays associated with the arrival of goods and the uncertainty with which these goods arrive [9,10,11••]. An integral part of

Figure 1

(a) Typical laboratory consumer choice paradigm and **(b)** typical consumer choice scenario.
(a) Adapted from [4•].

this effort has been the application of functional neuroimaging techniques to a simple yet powerful framework where people make decisions by evaluating and maximizing subjective value associated with competing alternative [12–14]. However, it remains challenging for this knowledge to provide a mechanistic account of even relatively simple acts such as purchasing a breakfast cereal.

Where do preferences come from?

First, existing studies have largely avoided addressing the complexity and richness of consumer preferences and choice in contemporary culture. That is, how are preferences for products and brands represented and organized by the brain, how they are shaped by external forces, and how do they develop and change over the course of the lifespan?

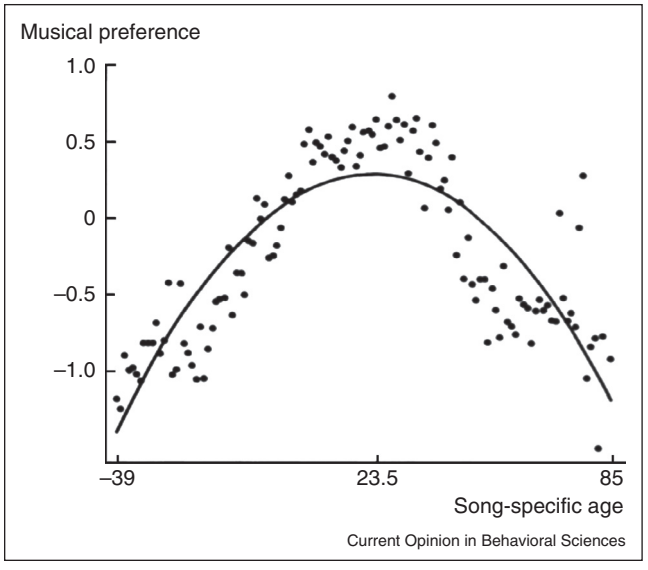
This omission in part reflects an inherent limitation of standard models of decision-making, which impose strong conditions on the ordering of preferences and provide little insight into the actual contents of the preferences or how they are organized at the neural level [15]. For example, so long as the consumer is consistent in her choices of breakfast cereals, current models would have little to say about the specific cereal a consumer might buy, and similarly find nothing odd if the consumer were to pour orange juice on her cereal. Ironically therefore, current advancements in understanding valuation and choice processes have resulted in only modest advances in understanding the actual content of preferences.

An early example demonstrating the powerful effects of cultural and social influences on the brain came from a laboratory version of the Pepsi Challenge, where it was shown that knowledge of the brand biased behavioral preferences away from Pepsi and in favor of Coca-Cola [16]. At the neural level, behavioral preferences were found to be correlated with activity in ventromedial prefrontal cortex [16–18], and that furthermore damage to this region abolished the biasing effects of brands [19]. Since then, a number of studies have additionally documented the influence of value representations to factors such as price [49••,48], as well as the cognitive processes that might give rise to abstract intangible characteristics such as brands [50,51,52••].

In addition, consumer researchers and developmental researchers have long noted the importance of developmental processes in the formation of preferences. Children, for example, appear to develop quite early on sophisticated knowledge of environmental stimuli such as brand logos, and are able to recognize them by as early as three years old [21]. This is even so for products that they are unlikely to have direct experience in consuming, such as cigarettes [22]. Furthermore, underscoring the interaction between developmental and social processes, some consumption domains, such as musical taste, are strongly related to an individual's age at the time a song was popular, with the strongest relationships for pieces that were hits when the respondent was in late adolescence or early adulthood (23.5 years of age) [23] (Figure 2).

These findings correspond well to what is known about the neurodevelopmental trajectory of motivational systems in humans and model organisms, particularly the importance of certain crucial windows during adolescence and early childhood [24]. Reward-related regions of the brain and their neurocircuitry, for example, is known to undergo particularly marked developmental changes during adolescence, and their disturbances have profound

Figure 2



Relationship between song-specific age and musical preference.Adapted from [23].