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A neural predictor of cultural popularity

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Abstract

We use neuroimaging to predict cultural popularity — something that is popular in the broadest sense and appeals to a large number of individuals. Neuroeconomic research suggests that activity in reward-related regions of the brain, notably the orbitofrontal cortex and ventral striatum, is predictive of future purchasing decisions, but it is unknown whether the neural signals of a small group of individuals are predictive of the purchasing decisions of the population at large. For neuroimaging to be useful as a measure of widespread popularity, these neural responses would have to generalize to a much larger population that is not the direct subject of the brain imaging itself. Here, we test the possibility of using functional magnetic resonance imaging (fMRI) to predict the relative popularity of a common good: music. We used fMRI to measure the brain responses of a relatively small group of adolescents while listening to songs of largely unknown artists. As a measure of popularity, the sales of these songs were totaled for the three years following scanning, and brain responses were then correlated with these "future" earnings. Although subjective likability of the songs was not predictive of sales, activity within the ventral striatum was significantly correlated with the number of units sold. These results suggest that the neural responses to goods are not only predictive of purchase decisions for those individuals actually scanned, but such responses generalize to the population at large and may be used to predict cultural popularity.

Keywords: fMRI; Neuroeconomics; Neuromarketing; Music; Prediction

Introduction

How can we predict popularity? Although superficially a trivial question, the desire for popularity consumes a great portion of the lives of many youths and adults. More than the superficial teenager's quest for popularity, being popular is a marker for social status. Consequently, popularity would seem to confer a reproductive advantage in the evolution of the human species, thus explaining its importance to humans. Such importance extends to economic success as well because goods and services that are popular command higher prices. Although there are good economic and evolutionary rationales for pursuing popularity, predicting who or what becomes popular is a challenging problem. Even so, the ability to predict popularity is a valuable skill that also can translate into economic success.

In the domain of economic goods, traditional approaches to forecasting popularity rely on standard marketing techniques. These include focus groups, questionnaires, simulated choice tests, and market tests. More recently, however, the widespread use of neuroimaging has raised the possibility of using functional magnetic resonance imaging (fMRI) in the marketing process (Ariely & Berns, 2010). Neuroeconomic research suggests that activity in reward-related regions of the brain, notably the orbitofrontal cortex and ventral striatum is predictive of future purchasing decisions of the individuals who are scanned (Hare, O'Doherty, Camerer, Schultz, & Rangel, 2008; Knutson, Rick, Wimmer, Prelec, & Loewenstein, 2007; Plassmann, O'Doherty, & Rangel, 2007; Plassmann, O'Doherty, Shiv, & Rangel, 2008). For neuroimaging to be useful in either a marketing or branding application, however, these neural signals would need to generalize to a larger group of individuals who themselves were not the direct object of

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brain scanning. Currently, it is unknown whether the neural signals of a small group of individuals are predictive of the purchasing decisions of the population at large.

Neuroimaging is often touted as a hot new tool for branding (Lindstrom, 2008). Although branding and advertising have been considered in a few neuroimaging papers (Kenning & Plassmann, 2008; Lee, Broderick, & Chamberlain, 2007; Yoon, Gutchess, Feinberg, & Polk, 2006), it is still unknown whether neuroimaging can prospectively reveal whether a particular ad or brand campaign will be effective. In a well-known Coke–Pepsi study, participants who described themselves as Coke-drinkers showed significant activation in the hippocampus and right DLPFC when they were cued about the upcoming drink of Coke (McClure et al., 2004). Self-described Pepsi-drinkers did not have this response. In the absence of brand information, there was no significant difference in preference during a test-taste. This study suggested that any differences in the neural response to the two brands must be culturally derived. Although these results demonstrate that branding does affect brain responses to nominally similar goods, the question of whether brand effectiveness can be predicted in advance remains an open question.

To demonstrate the efficacy of an fMRI study for branding, three conditions must be met. First, the study participants—i.e. the cohort of individuals who are actually scanned—should be representative of the population that is the target of a brand campaign. Second, to truly test whether the neural signals are predictive of brand effectiveness, the scanning must be done before the campaign is launched. Third, metrics of brand effectiveness must be readily available for the target population. For example, these might include sales data, web page views, downloads, internet searches, etc. Finally, although not strictly a condition, it is an open question as to what should actually be scanned during fMRI. If the product can be consumed in the scanner, then the product itself becomes the target. Alternatively, an ad or branding campaign might be presented in the scanner, in which case an abstract association between an ad and a product becomes the scanned target.

One product that meets these requirements is music. Everyone has musical preferences, and most people spend money on this product. Thus, it is straightforward to find people to scan who are representative of the music-consuming public, which is almost everyone. Second, the rise of sites like myspace.com has created a large repository of music which is largely unadvertised and unbranded. Because much of this music is provided directly by the artist, it can be used well in advance of any ad campaign; moreover, the band is the brand. Third, metrics of music success are simple and straightforward: downloads, sales, and ticket receipts. Finally, music is ideally suited to scanning because the act of listening to it is the same as consuming it. Thus, imaging the neural response to music is a direct measure of the consumption experience. Subsequent success is then a combination of quality, branding, and marketing.

In a previous study of adolescents, we measured the interaction of social influence in the form of popularity ratings with the consumption experience of music (Berns, Capra, Moore, & Noussair, 2010). Using fMRI, we found that although an individual's musical preferences were strongly correlated with activity in the caudate nucleus, the effect of social information varied between participants. The tendency to change one's evaluation of a song was positively correlated with activation in the anterior insula and anterior cingulate, two regions that are associated with physiological arousal and negative affective states. While this earlier study examined the effect of popularity information on individual preferences, here we report a longitudinal analysis in which we examine the relationship between brain responses and popularity of music from the other direction: do neural responses to music in an fMRI study predict subsequent commercial success of the song and artist?

Material and methods

A total of 32 adolescent participants were studied. Five were excluded from the fMRI analyses due to either excessive movement or susceptibility artifacts. Although this was a relatively high exclusion rate compared to adult studies, it was comparable to previous fMRI studies in children and adolescents, who tend to move more than adults (Galvan et al., 2006). Prior to the experiment, they were screened for the presence of medical and psychiatric diagnoses, and none were taking medications. There were 14 female and 13 male participants between the ages of 12 and 17.9 (mean 14.6). Fifteen were Caucasian, eight were African-American, one was Hispanic, and three were "Other." The primary stimuli used were 15-s clips from songs downloaded from MySpace.com. Songs were downloaded between October 23 and November 8, 2006. In order to minimize the possibility that participants would recognize the artists, songs from unsigned musicians or relatively unknown artists were used. A total of 20 songs were downloaded in each of the following genres: Rock, Country, Alternative/Emo/Indie, Hip-Hop/Rap, Jazz/Blues, and Metal (identified by the MySpace category). At the time of download, the number of times each song had been played was recorded, and this was used to calculate the popularity of each song among MySpace users. Each song was converted from MP3 to WAV format and a 15-s clip was extracted that included either the hook or chorus of the song. These 15-s clips were subsequently used in the experiment.

At the beginning of each session, individuals' rankings of musical genres were elicited. Participants were provided with a list of the six musical genres, and were instructed to rank the genres from 1 ("the type you like the best") to 6 ("the type you like the least"). Each participant's top three genres were subsequently used in the experiment. Emory University's Institutional Review Board approved all procedures. Individuals then entered the scanner, and the total scan time was approximately one hour. The scanning was performed on a Siemens 3T Trio. Each subject received a T1-weighted structural image (TR=2600 ms, TE=3.93 ms, flip angle=8, 224×256 matrix, 176 sagittal slices, 1 mm cubic voxel size), a DTI scan (TR=6500 ms, TE=90 ms, flip angle=90, FOV=220 mm, 128×128 matrix, 34 axial slices, 1.7×1.7×2.5 mm voxel size,