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The Pepsi Paradox: A review

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ABSTRACT

The Pepsi Paradox refers to the observation that Pepsi is preferred to Coke in blind taste tests, despite Coke being regarded as the more successful brand. We begin by describing the origins of the Pepsi Paradox. We then outline a neural hypothesis for why it occurs. Next, we carefully assess the published behavioural studies related to the Pepsi Paradox, and on people's ability to distinguish colas by taste. We conclude that the existing research has failed to provide sufficient evidence for the existence of the Pepsi Paradox. In fact, there does not even seem to be a consistent taste preference for either beverage in the reviewed studies.

1. Introduction

In 1975, PepsiCo launched the Pepsi® Challenge (PepsiCo, 2005). Two unlabelled glasses of cola were presented side-by-side (one containing Pepsi and one containing Coke®), and people were asked to indicate their preferences for each cola following a taste test. PepsiCo noted that people tended to choose Pepsi as the preferred cola. Here, the Pepsi Paradox relates to the issue of being unable to gain a market advantage over a rival's less preferred product. In this paper, we carefully review the existing experimental research on the Pepsi Paradox (hereafter, the Paradox). We begin by reviewing a neural hypothesis for why it occurs, followed by an examination of the available behavioural evidence. Although the existing studies that claim to have demonstrated empirical support for the Paradox have been widely cited in the neuroscience, neuromarketing, and taste perception literatures,[1] we argue that not a single one has provided adequate evidence for its existence.

2. A neural hypothesis of the Pepsi Paradox

Koenigs and Tranel (2008) proposed a neural hypothesis of the Paradox, in which the ventromedial prefrontal cortex (vmPFC) plays a causal role. The hypothesis starts by assuming that there exists a default preference for Coke in the population, and that a network involving the vmPFC plays a critical role in *tagging* Coke as the higher value brand. Hence, when brand information is available, people tend to prefer Coke. Accordingly, it is hypothesised that damage to the vmPFC causes this default preference for Coke (i.e., the preferred brand) to shift in favor of Pepsi (i.e., the preferred product). In other words, people with lesions to the vmPFC should demonstrate a preference for Pepsi despite the availability of brand information, whereas brand information typically overrides taste information.

3. Experimental work assessing the Pepsi Paradox

In experimental research, the Paradox has been defined in terms of two criteria: (1) Pepsi is preferred to Coke in blind taste tests, and (2) Coke is preferred to Pepsi in branded taste tests (Koenigs & Tranel, 2008).

3.1. On people's preferences for colas

McClure et al. (2004) first claimed to provide experimental evidence consistent with the Paradox. They tested a sample of 67 participants by having them complete two-alternative forced-choice preference tasks using de-carbonated[2] forms of the beverages under four conditions. In the two 'blind' conditions (Group 1: blind, n = 16; Group 2: blind, n = 17), one cup contained Coke, the other contained Pepsi, and both cups were unlabelled. In the Group 3 'semi-blind' condition (n = 16), both cups contained Coke, and one cup was labelled "Coke" whereas the other cup was unlabelled. In the Group 4 'semi-blind' condition (n = 18), both cups contained Pepsi, and one cup was labelled "Pepsi", whereas the other cup was unlabelled. The results did not indicate that Pepsi was preferred over Coke in the absence of brand information, and therefore the first criterion of the Paradox was not met. In relation to

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[1] Over 1200 articles according to Google Scholar.

[2] The sodas were 'decarbonated' for technical reasons (i.e., carbonation built up in delivery tubes causing unreliable delivery whilst participants were lying down in an fMRI scanner).

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the second criterion, the authors found that Coke consumed from a labelled cup was preferred over Coke from an unlabelled cup. However, people did *not* show a discernible preference for either labelled or unlabelled Pepsi. The observation that preferences for labelled Coke in Group 3 were more pronounced than the preferences for labelled Pepsi in Group 4 was taken to support the second criterion of the Paradox.

There are two caveats concerning the conclusion that these data are consistent with the Paradox. First, only the 'blind' conditions (i.e., Groups 1 and 2) directly assessed cola preferences in a way that allows testing for the existence of *one* of the components of the Paradox, such that a preference for Pepsi over Coke in this condition would provide support for criterion one. Second, the semi-blind conditions appear to be mis-specified: the Paradox pertains directly to preferences for one beverage over the other. Therefore, rather than presenting the same beverage with and without a label and comparing preferences for labelled Coke and Pepsi from two separate conditions, labelled Coke and labelled Pepsi should have been presented side-by-side. As such, the first criterion was not supported, and the second criterion was not properly addressed.

Koenigs and Tranel (2008) tested the aforementioned hypothesis that the vmPFC plays a causal role in the Paradox in a sample of 44 participants with and without brain lesions (vmPFC lesion group, n = 12; brain-damaged comparison group, n = 16; normal comparison group, n = 16). In a series of 'semi-blind' taste tests (consistent with the 'semi-blind' conditions in McClure et al.'s study), they found that vmPFC patients preferred the labelled Pepsi to the unlabelled Pepsi, but did not show a preference for either labelled or unlabelled Coke. Furthermore, the other groups did not demonstrate a clear preference. Thus, they reported that damage to the vmPFC abolishes the Paradox, despite failing to find evidence for the existence of either criterion of the Paradox in the control groups. Relatedly, the vmPFC group did *not* prefer Pepsi to Coke in the blind taste test. Although the authors did not design a condition where labelled Coke and Pepsi were compared directly, in a separate study (n = 15), Kühn and Gallinat (2013) paired the same amalgamated beverage (an admixture of Coke, Pepsi, and River Cola) with each brand's logo over many trials, and did not find evidence for a difference in people's preferences for "Coke" and "Pepsi" (elicited using subjective liking ratings).

Finally, Yamada et al. (2014) instructed participants (n = 66) to provide reasons for (dis)liking Coke or Pepsi in blind taste tests. They found that (i) people who were administered a taste test without additional instruction (control condition) preferred Coke to Pepsi, (ii) those who were administered a taste test and asked to provide reasons for disliking each beverage (negative analysis condition) showed no clear preference for either beverage, and (iii) people who were administered a taste test and asked to provide reasons for liking each beverage (positive analysis condition) preferred Pepsi to Coke. The authors suggested that people in the positive analysis condition preferred Pepsi because people perceive Pepsi to taste sweeter than Coke and sweetness provides "a more plausible basis for experienced pleasantness" (Yamada et al., 2014, p. 3). One problem with this conclusion is that, rather than being taken *prima facie*, the explanation that sweetness equates to preference should be demonstrated empirically. It is, after all, also plausible that people might disfavour a beverage because it is perceived to taste *too* sweet. Nonetheless, these findings do not appear to be directly relevant to the Paradox: in order to address the first criterion of the Paradox, the authors should have averaged across all conditions (i.e., reported the within-subjects main effect of 'brand preference'), however this was not done. Finally, given that participants in Yamada and colleagues' experiment were only administered blind taste tests, nothing can be said about the second criterion of the Pepsi Paradox (i.e., labelled preferences).

3.2. On the identification of colas

A series of seminal papers addressed whether people are able to distinguish colas by taste (e.g., Bowles & Pronko, 1948; Pronko & Herman, 1949; Prothro, 1953; Thumin, 1962). In the first of these studies, Bowles and Pronko (1948) had participants blindly and consecutively drink (i) three name brands of cola (i.e., Coke, Pepsi, or Royal Crown [RC]; Part 1; n = 96), or (ii) three glasses of the same brand of cola (Part 2; n = 60). Participants were no better than chance at identifying the correct brand of cola in either condition.

In a follow-up study, Pronko and Bowles (1948) used the same procedure to address whether people were able to distinguish three little-known colas (i.e., Hyde Park, Kroger, or Spur). In a series of blind, consecutive taste tests, Pronko and Bowles (i) alternated between the brands (Part 1; n = 96), or (ii) administered the same cola three times (Part 2; n = 60). Not a single participant, in either condition, was able to identify any of the colas. In fact, the colas were always identified as one of Coke, Pepsi, or RC.

Pronko and Herman (1949) then assessed whether narrowing the response options improved performance, by instructing participants that they were being asked to distinguish between Coke, Pepsi, or RC cola. In Part 1, participants (n = 105) blindly drank three different brands of cola consecutively. In Part 2, participants (n = 60) blindly drank the same cola three times consecutively. Although participants were no better than chance at identifying Pepsi or RC, they were able to identify Coke at above chance levels when it was presented as one of three colas (Part 1), but not when it was presented three times in a row (Part 2). About a decade later, Thumin (1962) replicated and extended this work, finding that people (n = 79) can often discern between Coke and Pepsi when the following conditions are met: (i) when the range of response options is restricted (i.e., when participants are explicitly told that they must distinguish between Coke, Pepsi, or RC), and (ii) when using the method of paired comparisons (i.e., participants are presented with two *different* cups of cola). However, using a method similar to Pronko and Herman (1949), Prothro (1953) found that a Lebanese cohort (n = 60) was unable to identify Coke or Pepsi at above chance levels. Instead, the Lebanese participants were able to identify the product of a then-popular local cola brand (Williams Champagne) in blind taste tests, suggesting that local factors may play a role in taste perception, product identification and, possibly, preference (see Section 4).

Finally, Kappes, Schmidt, and Lee (2007) administered a series of blind taste tests and found that Coke and Pepsi were not rated as being different in terms of various "mouthfeel" attributes (i.e., bite, burn, numbing, carbonation, body, and mouthcoating).

4. Study design and ecological validity

In the present review, we assessed the existing research on the Pepsi Paradox in terms of two criteria: (1) Pepsi is preferred to Coke in blind taste tests, and (2) Coke is preferred to Pepsi in branded taste tests (Koenigs & Tranel, 2008). Alternatively, the Paradox can be conceptualized as the conditional probability of preferring Pepsi over Coke in a series of blind (or, preferably, double-blind) forced-choice taste tests, given a preference for Coke over Pepsi in a series of branded forced-choice taste tests. We think this constitutes a stronger experimental statement of the Paradox. After all, if the individual does not prefer Coke to Pepsi in branded taste tests (or, at least, does not state a preference for Coke), then there is no contradiction.

Nonetheless, the preferences that are revealed in the laboratory are not necessarily the same as those that are revealed in the markets. It has been argued that Coke outperforms Pepsi in terms of sales (Zmuda, 2011), and that the Coca-Cola® company outperforms PepsiCo in its approach to advertising and branding its namesake beverage (Jensen, 2014). The latter includes historical approaches to marketing that span the last century. For example, two notable marketing campaigns were the introduction of the iconic 'Santa Claus' advertisement in the 1920s (The Coca-Cola Company, 2012), and when the Coca-Cola Company shipped its namesake beverage to American troops during World War II

(Mooney, 2008). Pepsi, on the other hand, took more recently to stressing the importance of the taste of its product in its advertising (e.g., the Pepsi Challenge). Therefore, it has been argued that the Coca-Cola Company's longstanding, superior approach to marketing has been responsible for creating a numerous and loyal following that other cola companies find difficult to compete with (Jensen, 2014; Weiner, 1996). The fact that Coke may be preferred to Pepsi in the marketplace despite people's inability to distinguish the products by taste in the laboratory is striking, but that does not necessarily imply that it constitutes a paradox that can be resolved with laboratory taste tests, because people may tend to purchase Coke for reasons other than taste.

Although laboratory studies offer the advantage of experimental control, they may differ from plausible, real-world situations in important ways. For example, it would be unusual for people to take a solitary sip of Coke or Pepsi out of a small disposable cup. People tend to imbibe larger quantities of these beverages in several, possible ways (e.g., from cans, plastic, or glass; with or without ice, and at various temperatures) that may influence their preferences (see Gladwell, 2007; Yglesias, 2013, for similar arguments).[3] Relatedly, the differing modes of consumption vary in their visual appearance, texture, and weight, which have been found to influence taste perception independent of branding (see Barnett, Velasco, & Spence, 2016; Spence & Van Doorn, 2017). In the real world, cola brand preferences may also depend on their associations with other companies. For example, if the individual typically consumes cola with a meal at McDonald's®, then the cola of choice will be Coke by default. More generally, the alignment of Coke and Pepsi with other popular name brands, critical to the success of these companies, may itself depend (today or historically) on variables that are unrelated to taste (e.g., distribution, price).

Other variables may influence people's preferences for these soft drinks. For example, there may be geographic variation in the formulation of Coke: in the USA, Coke is made with high-fructose corn syrup, whereas in Mexico it is made with cane sugar (Glusker, 2015). Incidentally, many markets in the USA now sell Mexican Coke (usually in glass bottles) due to apparent demand for this version. The formulation of Coke and Pepsi has also changed over time. For example, in the USA, Coke and Pepsi were not made with high-fructose corn syrup until the 1980s (Daniels, 1984). Nonetheless, despite variation in the formulation of these beverages, the whole of the available empirical evidence on cola identification and preferences reviewed in this paper, spanning four countries (USA, Germany, Lebanon, and Japan) and 70 years, is largely consistent: People are often unable to identify colas by taste, and show no clear preference for Pepsi or Coke in blind taste tests.

People may not hold static preferences either. For example, people tend to think that within-category alternatives (here, an alternative brand of cola) will better satisfy their craving for a member of that category (here, one's preferred brand of cola) than between-category alternatives (here, other types of beverages). However, consumption of a within-category alternative turns out to be experientially less satisfactory than anticipated (Huh, Vosgerau, & Morewedge, 2016). Therefore, people with a strong default preference for one brand's product (e.g., Coke) may turn out to develop a stronger sense of loyalty for that product upon attempting to fulfil their craving with a competing brand's similar product (e.g., Pepsi) (Morewedge, Gilbert, Myrseth, Kassam, & Wilson, 2010). Although the consumption of Coke and Pepsi may not often occur under such conditions, these findings illustrate that the strength of people's preferences for Pepsi or Coke may change, depending on their baseline preferences and the conditions under which they seek out or consume these beverages.

5. Conclusions

In this paper, we reviewed the purported evidence for the widely cited "Pepsi Paradox". Notwithstanding issues associated with companies conducting research that supports the supremacy of their product over their leading competitor's product in the marketplace,[4] none of the published studies were designed appropriately so as to directly address the Paradox. We show that, in most cases, problematic methodological approaches render these studies as invalid tests of the Paradox. In the few conditions that directly addressed at least one of the criteria of the Paradox, there was no clear evidence in the hypothesized direction. In fact, the literature fails to demonstrate that there exists a consistent preference for one beverage in any condition, and further suggests that people are unable to distinguish colas by taste.

Conflicts of interest

The authors declare no conflicts of interest.

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[3] Neuroimaging studies that require participants to sip decarbonated forms of these beverages while lying supine in an fMRI scanner (therefore making the beverages difficult to swallow and minimizing retronasal aroma) diverge in perhaps more important ways.

[4] Parenthetically, the Pepsi Challenge has been criticised by others (see Gladwell, 2007; Yglesias, 2013).

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