Understanding the forbidden fruit effect: people's desire to see what is forbidden and unavailable

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Abstract

Curiosity - the drive for information - is often perceived as a dangerous trait. This is exacerbated by the perception that when something is forbidden, curiosity towards it increases. Surprisingly little is known about the mechanisms by which this *forbidden fruit effect* occurs. In a series of five experiments (total N = 2,141), we used a novel card selection task with an arbitrarily forbidden card to demonstrate the forbidden fruit effect across a broad age range (5 to 79 years). All of the experiments controlled for uncertainty of forbidden card, and the effect remained when we controlled for visual saliency, potential item selection bias, and even when participants were aware that the prohibited card had been selected randomly. These results suggest that people's attraction to unavailable options is not only driven by their beliefs about importance or scarcity but also by lower-level cognitive mechanisms such as memory availability.

Understanding the forbidden fruit effect: people's desire to see what is forbidden and unavailable

Curiosity - the drive for information - is often perceived as a dangerous trait. One reason for this is that curiosity is thought to lead people to engage in risky or forbidden behavior, from smoking to substance abuse. This is exacerbated by the perception that when something is forbidden, curiosity towards it increases. This theme is prevalent in myth and literature in which forbidden knowledge is irresistible and the protagonist pays a terrible price for it (cf. Eve, Pandora, and Orpheus). The *forbidden fruit effect* describes just this – that items become more attractive simply because they have been forbidden. People are known to be curious about unpleasant or risky stimuli (Hsee & Ruan, 2016; Oosterwijk, 2017). However, surprisingly little is known about the mechanisms by which prohibition and inaccessibility affect curiosity.

Curiosity can be considered as the motivation for uncertainty reduction (Golman & Loewenstein, 2018; Gottlieb, Oudeyer, Lopes, & Baranes, 2013; Loewenstein, 1994). More specifically, the literature indicates that people ascribe inherent rewarding value to acquiring new knowledge or information, motivating decisions or behavior that reduce uncertainty (Murayama, FitzGibbon, & Sakaki, 2019). Forbidden options are frequently associated with a lack of information – they are often perceived to be more uncertain than other freely-available options. Thus, motivation to resolve uncertainty provides a viable account of the forbidden fruit effect.

Another possibility is that forbidden options make people infer hidden value – there must be a reason why the item is forbidden. For example, a forbidden option may signal the possibility that the information is concealed due to its importance or scarcity, bolstering the subjective value of the uncertain information (e.g., the Striesand effect;

see Hagenback & Koessler, 2017; and the scarcity effect; see Brock, 1968; Lynn, 1989).

The current study shows that curiosity behind the forbidden fruit effect is also supported by a simpler mechanism --- people are curious about a forbidden option simply because it was inaccessible. In the 'Lovely Pictures Task', participants selected card decks that could be turned over to reveal attractive photographs (e.g. of puppies and kittens). One of the decks was randomly selected and prohibited. After participants had revealed three decks, the prohibition was lifted. On their final choice, participants could then select either the previously prohibited deck or one of the other remaining available decks. This simple design equates the uncertainty between the previously prohibited and non-prohibited decks, allowing us to examine the forbidden fruit effect after controlling for uncertainty. In later experiments, we explicitly made the designation of the prohibited option completely arbitrary – thereby minimizing the role of inference-based mechanisms.

Method

Participants

A total of 2,141 participants (57% female, 2% unspecified; age range = 5 to 79) were included for the statistical analyses across five experiments. Participants were recruited from a science museum (Experiments 1 and 2; N = 933 and 281), a school (Experiment 3; N = 87), and an online recruitment platform (Prolific.co; Experiment 4 and 5; N = 415 and 425). Additionally, data from 104 participants were excluded before the main data analysis. Detailed demographic information and exclusion criteria in each experiment can be found in the Supplementary Online Materials.

For Experiments 1 – 3, we simply recruited as many participants as possible within the time limit imposed by the participating museum and school. In Experiment 4, we conducted a priori power analysis to the determine the minimum sample size required to detect a difference from the chance level (0.3333) if participants selected the prohibited card deck on .42 trials at 95% power (we expected a small reduction in prohibited responses from Experiments 2 and 3 because of the change from 'forbidden' to 'locked'). This target sample size of 407 was repeated in Experiment 5 which, due to the change of chance level (0.1428), gave us 95% power to detect an effect if participants chose the prohibited outcome on .21 trials.

The study was approved by the University of Reading Research Ethics Committee (UREC).

Procedure

The core design of the Lovely Pictures Task remained the same across the five experiments. The online tasks are available on the Open Science Framework (see Supplementary Online Materials). Here we first describe the procedure of Experiment 1, and then explain the changes made in each of the subsequent experiments (also summarized in Table 1). In Experiment 1, the hypothesis that people experience curiosity about prohibited items was tested in a large community sample of museum visitors. The Lovely Pictures Task consisted of one practice trial and one test trial, after which participants could choose to complete one further test trial. Each trial consisted of four choices of cards from an array of card decks. On each trial, participants were presented with an array of six card decks, randomly distributed on the computer screen (see Figure 1). Participants could click on these decks to reveal attractive photographs

(lovely pictures) selected from a large pool of color photographs (see Supplementary Online Materials). However, one card was randomly selected to be forbidden - it had a red ‘STOP’ sign on it and participants were told that this deck was ‘forbidden’. If the participant clicked on this card, the pictures would not be revealed. However, on the fourth and final choice, the ‘STOP’ sign was removed, and the participant was free to select any of the remaining decks. The critical dependent variable was whether participants chose the previously prohibited deck, or one of the previously available decks for their final choice. Importantly, each of the decks was equally uncertain because each deck revealed a different, unknown, category of pictures.

Each time a card deck was selected, an animation was shown of six cards being drawn from the deck and then turned over to reveal six images from one of 16 categories (e.g. puppies, see Supplementary Online Materials). The photographs were displayed for 5000ms. After seeing the pictures, participants were asked to rate how much they liked them by clicking one of five face icons that went from a very unhappy face on the left to a very happy face on the right (coded 0 to 4, higher value indicates happier feeling). After the rating participants returned to the array of decks. Each deck could only be selected once: after a deck had been selected it was desaturated and would not reveal pictures if it was clicked. If participants clicked the prohibited card before the final selection, nothing happened. On the fourth and final choice, the prohibition was lifted, the ‘STOP’ sign was removed, and the participant was then free to select any of the remaining decks. Importantly, when participants made the final – critical – choice, there was no visual cue to inform the participant which deck had been forbidden. The pictures that were revealed when the participant picked the previously

forbidden deck were selected from the same pool of images as the other decks; in other words, pictures from the forbidden deck did not differ qualitatively from the rest of the pictures in the task.

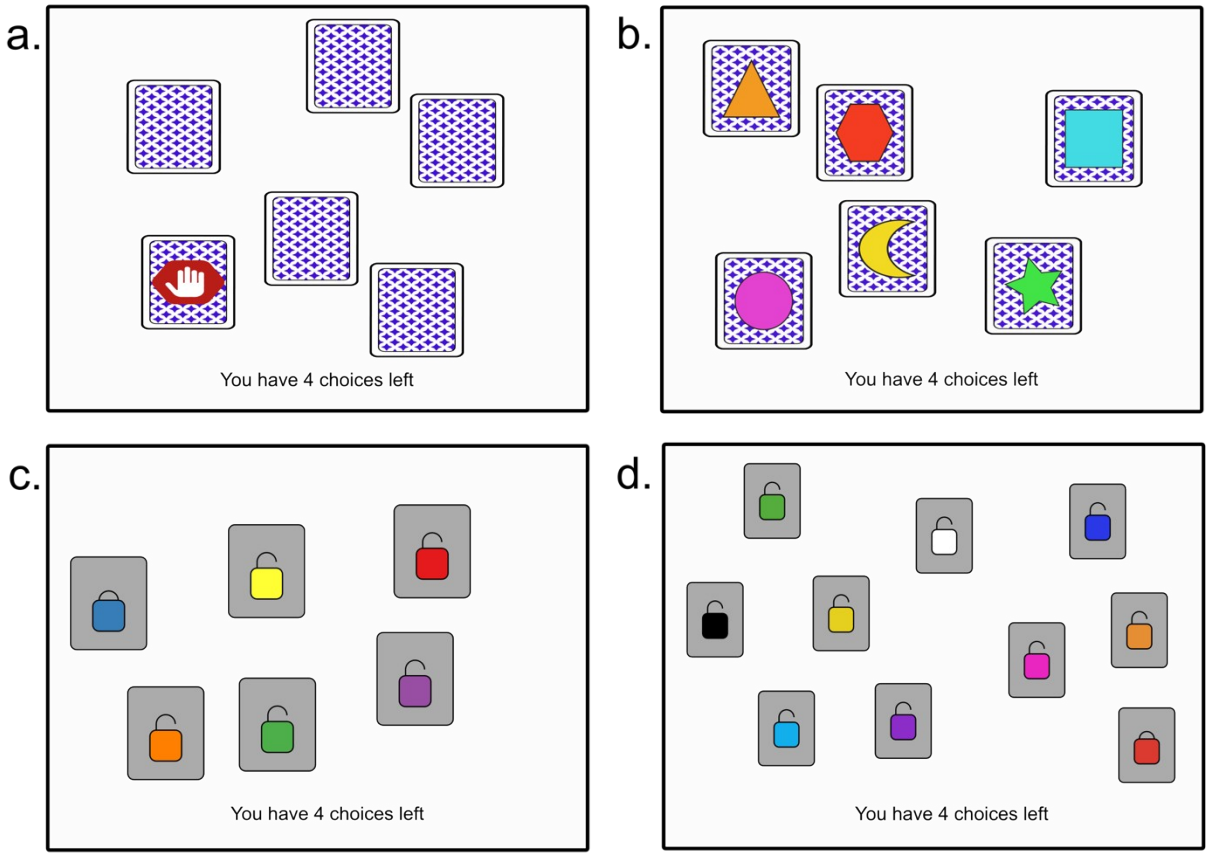

Figure 1. Example arrays of card decks before the first selection from a. Experiment 1, b. Experiments 2 & 3, c. Experiment 4, d. Experiment 5. The prohibited card had a red hexagonal 'STOP' sign in Experiments 1 to 3, and a 'locked' padlock in Experiments 4 and 5 (blue in Panel c and red in Panel d).

Practice trials were identical to test trials except that clicking a card revealed one picture rather than six pictures; messages appeared when the mouse hovered over the

cards saying, ‘Click a card to see a lovely picture’ or ‘This card is forbidden! You can’t choose it yet’; on the final choice, when the prohibition was lifted, a message appeared next to the previously forbidden card saying, ‘This card is not forbidden anymore!’. Children younger than 8 years were accompanied by a researcher who read the instructions to them and read the messages aloud during the practice trials.

In Experiment 2, to address the possibility that selection of forbidden card was driven by the visual salience of ‘STOP’ sign (see Shimojo, Simion, Shimojo, & Scheier, 2003), the visual salience of the prohibited deck was reduced by adding a different symbol to each card deck. The procedure was identical to Experiment 1 except that every card had a different colored symbol (e.g. a pink circle, a green star, and a red octagon; see Figure 1b). Experiment 3 replicated Experiment 2 in a non-museum (high school) sample. Additionally, to address the possibility that the forbidden card may have been chosen because it was in a more prominent (central) position than the other remaining cards, the spatial positions of the cards were recorded in Experiment 3 so that they could be controlled for in the analysis of critical choices.

In Experiments 4 and 5, we sought to emphasize the fact that the prohibited card was designated completely at random. To this end, we changed the prohibition status from ‘forbidden’ to ‘locked’, so that participants’ inferences about the reasons for such prohibition would be limited. The symbols were replaced with colored padlocks, one of which was ‘locked’, and the rest were ‘open’ (see Figure 1c). Further, at the start of the trial, the selection of the locked padlock was made by a spinner that the participant stopped with a mouse click. We also removed the optional second trial for the remaining

experiments because we found that there was no effect of prohibited choice on participants' decisions to continue to a second trial.

In Experiment 5, we sought to deal with a potential artefact of the design. Specifically, if participants selected the first three cards that were preferable based on some subjective, idiosyncratic factors (e.g., the position of the card or color preferences), the two remaining 'available' cards may have been perceived as less preferable than the prohibited card due to these idiosyncratic factors. Then, one can argue that participants were more likely to choose the prohibited card at the final choice not because it was prohibited, but because it possessed these preferable properties more than the remaining available cards (e.g., a better position). Because this "selection effect" can be mitigated by increasing the number of available cards before the final choice, in Experiment 5, the number of card decks was increased from 6 to 10 while participants still had to make the final choice in their fourth choice. We also included a memory test for the location of prohibited card after the final choice to examine whether participants remembered which card was previously forbidden. In the memory test, participants were shown all the cards again, returned to full saturation and with the locks open (i.e. no indication of which cards were selected) and asked to click on the deck that had been locked.

Results

Choice of prohibited card deck

As noted above, in Experiments 1 – 3, after the first trial was completed, participants were given the option to do another trial if they like (Experiments 4 and 5 did not have that option). Unless otherwise noted, we focused on the choice of the first

of these trials. Exploratory analysis on the extra trial is reported in Supplementary Online Materials and Tables S4 and S5.

Across all of the five experiments, the proportion of choices of the prohibited deck at the final choice was more than the chance level (1/number of available decks; see Table 1). The odds of choosing the prohibited deck against the chance level are at least 1.49 times higher than would be expected by chance (see Table 1 for the odds ratios of each experiment). Participants chose prohibited decks more frequently than distractor decks once prohibited decks were available. The results were not reliably moderated by gender or age (see Supplementary Online Materials; Table S2).

One explanation for this finding is that participants might have a preference for cards located at the center of the screen (Christenfeld, 1995; Shaw, Bergen, Brown, & Gallagher, 2000). If this is the case, then participants might have selected cards around the center of the screen before the critical trial. Consequently, at the time of the critical trial, prohibited card would be more likely to be located at the center relative to the other remaining cards, and thus be a more attractive choice. In Experiments 3, 4 and 5 we recorded prohibited decks' spatial positions and calculated their spatial distance from the center for each trial. We examined if there is any relationship between prohibited card's distance from the center and its selection. Logistic regression analysis showed that the distance between the prohibited decks and the center of the screen did not have a significant relation with its selection at the final choice (*p*s = .159, .142, .460 in Experiments 3, 4, and 5 respectively).

Table 1. Overview of key experimental features and critical card deck choices. The *p*-value relates to the proportion of prohibited card choices against the chance level for each experiment from a binomial test.

Experiment	*N*	Type	*N* card decks	Memory test	Optional 2nd trial	Chance level	Prohibited choices [CI]	*p*	Odds ratio
1	933	F	6	✘	✓	.33	.55 [.52, .59]	<.001	2.47
2	281	F	6	✘	✓	.33	.44 [.38, .50]	<.001	1.56
3	87	F	6	✘	✓	.33	.44 [.33, .55]	=.052	1.55
4	415	L	6	✘	✘	.33	.43 [.38, .48]	<.001	1.49
5	425	L	10	✓	✘	.14	.30 [.25, .34]	<.001	2.53

Note. CI = 95% confidence interval. N = Number of participants, Type: F= Forbidden – stop sign; L= Locked – locked padlock and deck assigned by spinner. Odds ratio is computed against the chance level.

Effects of prohibited card deck choice on picture liking

We also explored the possibility that the status of prohibition caused attitudinal change to the pictures under the prohibited deck as predicted by cognitive dissonance theory (Festinger, 1957). Specifically, we compared participants' ratings of the pictures at the critical/final choice. Remember that pictures were randomly selected, regardless of the deck choice. In short, there is little evidence that participants liked or disliked the pictures in prohibited decks more than the ones in the distractor decks in any of the experiments. Participants' ratings of the pictures did not differ according to whether they

chose the prohibited or distractor card decks (*p*s = .267, .348, .759, .790, and .661 in Experiments 1 to 5 respectively; see Table S3 in Supplementary Online Materials). We also examined the relationship between the ratings of the decks selected before the critical choice and the choice of prohibited deck; but we did not find any statistically significant effects (see Supplementary Online Materials).

Memory Test

Because there were many card decks, Experiment 5 employed a surprise memory test presented at the end of the test trial (see Method) to see whether or not participants remembered the prohibited deck. Overall 72% (95% CI = 67%, 76%) of participants correctly identified which deck was prohibited. The memory accuracy was significantly more than the chance level (10%), $p < .001$. Importantly, the choice of prohibited deck was significantly greater for participants who remembered which deck was prohibited ($M = .35$, $SD = .48$) compared to those who did not ($M = .15$, $SD = .36$), $\chi^2 (1) = 16.24$, $p < .001$. In fact, participants who did not remember the location of prohibited deck chose the prohibited deck no more frequently than the chance level (.14), $p = .794$.

Discussion

Across five experiments, participants chose to look at the pictures that were previously unavailable more often than would be expected by chance, even though the uncertainty of the options was controlled for. This forbidden fruit effect pattern was observed across different age groups and was not affected by gender. It remained when we controlled for visual saliency and potential item selection bias, and even when participants were aware that the prohibited card had been selected randomly. These

results suggest that people's attraction to unavailable options is driven by more than their beliefs about importance or scarcity.

One potential explanation for the current findings is memory availability (Schwarz et al., 1991; Tversky & Kahneman, 1973). When a particular option is prohibited, that option may be encoded in memory more than other options. The heightened accessibility of the forbidden option makes it more likely for participants to choose the option when it is no longer prohibited. This idea is also consistent with the ironic process theory on thought suppression (or "white-bear effect"), which argues that suppression of thoughts ironically increases the accessibility of that thoughts (Wegner & Zanakos, 1994). In fact, in Experiment 5, the effect was observed only for the participants who correctly remembered the location of the forbidden option. This idea also fits with our observation that subjective ratings of the images did not differ between prohibited and distractor images: Participants chose the forbidden option not because the previously prohibited status imbued the pictures with added value, but because the option was simply available in their memory.

The current findings also provide alternative perspectives for related phenomena. For example, attempts to dissuade young people from accessing potentially harmful media or behavior can in fact increase their engagement (e.g., Sussman, Grana, Pokhrel, Rohrbach, & Sun, 2010; Varava & Quick, 2015). This so-called boomerang effect (Brehm, 1966) has been accounted for by psychological reactance, but future research should also examine the role of lower-level factors such as memory availability in the context of persuasion.

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