Abstract

Frederick, Lee, and Baskin (2014) have recently presented evidence showing that the attraction effect can only be observed in choices where the options have numerical attributes. This claim have sparked a debate in the decision making literature about the real-world relevance of the attraction effect and the conditions under which it can be elicited. Part of this discussion have focused on the methodological shortcomings of Frederick et al.'s study, which casts doubt on the validity of their findings. Contributing to this debate, we present the first experiment that uses a rigorous methodology to test for the attraction effect in choices involving naturalistic, real-world objects. We find no evidence for the attraction effect in choices between movies. We argue that exploring the boundary conditions of this decision bias helps us to understand the cognitive mechanism underlying the attraction effect.

1 Introduction

Imagine that you are facing a choice between two hotels for a weekend city break: Hotel A has an excellent central location but is fairly expensive, whereas Hotel B is located in the outskirts of the city, but has a very favourable price in comparison to Hotel A. You are torn between the two hotels, when you spot a third option: Hotel C is situated right next to Hotel A in the city centre, but is slightly more expensive. Which one would choose?

Decades on decision-making research suggests that the presence of Hotel C (decoy) in the choice set makes you more likely to choose Hotel A (target) over Hotel B (competitor). This phenomenon is called the attraction effect (also known as asymmetric dominance effect), and it is one of the most widely researched decision biases in consumer decision making. In essence, it states that when the decision maker is indifferent between the target and the competitor (Hotel A and Hotel B in the example), the addition of an inferior decoy option that resembles the target (Hotel C is similar to Hotel A, but is slightly worse) increases the likelihood that the target will be chosen.

The real-world relevance of the attraction effect in consumer decisions has recently become a contentious issue in the decision-making literature. In their study, Frederick et al. (2014) present a thorough investigation of the boundary conditions of the attraction effect based on 38 experiments with various stimuli types. These stimuli types include choice options with numerically represented attributes as well as complex, real-world stimuli (e.g., fruits, bottled water, apartments, etc.), and in some of these experiments participants could even sample the choice options (e.g. squash, mints, popcorn). The overall conclusion of this study is that while the presence of the decoy seems to affect decisions when the option attributes are represented numerically, it is absent in experiments with more complex, naturalistic stimuli. In light of these results, Frederick et al. posited that the psychological processes underlying decisions that involve options with numeric attributes are fundamentally different from those employed in decisions where the stimuli has a naturalistic representation. This conclusion was also supported by Yang and Lynn (2014), who reported difficulties replicating the attraction effect when the stimuli were pictorial, as opposed to when attributes were presented numerically.

These two studies sparked considerable interest amongst decision making researchers, and led to the re-examination of the boundary conditions of the attraction effect. Huber, Payne, and Puto (2014) discussed five critical conditions that can inhibit the attraction effect, and argued that many of these are present in the experiments reported by Frederick et al. and Yang and Lynn. These are the following: (1) strong prior preferences over the target and competitor, (2) inability to identify the inferiority of the decoy, (3) heterogeneity in prior preferences over the target and competitor, (4) an undesirable decoy and (5) a too desirable decoy. Simonson (2014) further stressed the importance of the detection of the dominance relationship in observing the attraction effect, and also pointed out several other smaller, specific methodological shortcomings of the studies by Frederick et al. and Yang and Lynn.

We believe that understanding how the strength of the attraction effect is modulated by stimulus presentation would not only inform us about its real-world prevalence in consumer decisions, but more importantly, it could also provide us with invaluable insights about the relationship between attribute characteristics and the cognitive mechanism underlying the comparison process that takes place during choice. This bears significant relevance to a wealth of areas in decision-making research concerned with developing formal models of choice.

In this article, we describe our attempt to test the attraction effect with complex, naturalistic choice options, using an experimental methodology that addresses the issues raised in connection with the work of Frederick et al. and Yang and Lynn. Using a choice task where we ask people to choose between movies, we find no evidence for the attraction effect, that is, the presence of the decoy does not affect preferences between the target and the competitor. We discuss the implications of our findings for understanding the boundary conditions of the attraction effect.

2 Testing the attraction effect with real-world stimuli

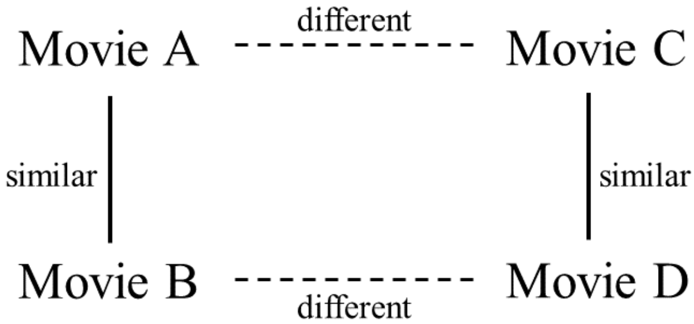
The goal of this experiment was to test the attraction effect with naturalistic stimuli. We chose to use the most popular movies on IMDb as stimuli for several reasons. First, since movies are an integral part of Western culture, we can reasonably expect that most our participants will be sufficiently interested in the choice options. Second, choosing between movies is a realistic, everyday task, and this way we can mimic real-world decision making. In addition, the movie space is rich enough so that we can create a wide range of unique choice triplets to test the attraction effect.

When the stimuli has numerical attributes, it is straightforward to construct choice triplets with a target, competitor and decoy. However, with naturalistic stimuli, this task is significantly more complicated. Frederick et al. have also used movie stimuli in two of their experiments: they chose pairs of movies that are part of the same sequel or are starring the same actor (but have distinctly different genres) to create target-decoy pairs (they used eight distinct movies overall). In the movie sequel version, they assumed that the second part of the sequel is the decoy, and the first part is the target, whereas in the movie actor experiment it is unclear how they decided which movie of the same actor should be the target and the decoy. We believe that this experimental approach has a significant flaw.

Specifically, there is no guarantee that the participants perceived the triplets as they were intended by the authors: whether *Grease 2* will be perceived as inferior to *Grease* (or the other way around) is completely up to the decision maker's preferences, which they did not control for. Individual heterogeneity in preferences can severely alter the perception of real-world choice triplets, thus, it is imperative to take it into account in the choice triplet selection.

Our novel experimental design takes individual preferences into account and ensures that decision makers are indifferent between the target and competitor and that the inferiority of the decoy is clearly identified. In addition, to increase the statistical power of our test, we used a within-subjects design as well as both A, B, A' and B, A, B' triplet pairs (where X' is the dominated option), as suggested by Huber et al. (2014). We created ”quadruplets” (each made up of two attraction effect choice triplets), using two distinctly different target-decoy pairs. Figure 1 shows the structure of one such quadruplet, where Movies A-B and Movies C-D are the two target-decoy pairs.

Figure 1: A quadruplet made up of two attraction effect triplets. Triplet 1 consists of Movie A (target), Movie C (competitor) and Movie B (decoy to Movie B), while Triplet 2 consists of Movie C (target), Movie A (competitor) and Movie D (decoy to Movie C).



2.1 Method

2.1.1 Candidate choice set selection

We first retrieved the most popular 40 movies from each of 10 distinct genre categories (romance, drama, sci-fi, thriller, comedy, horror, animation, fantasy, crime, action) from IMDb, so that we had 400 movies overall. We chose a wide range of genres to obtain a sufficiently rich stimuli space.

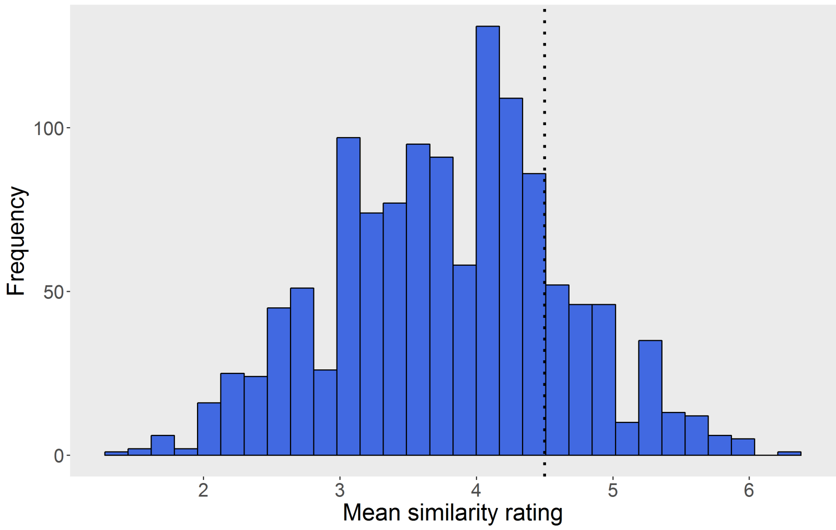
Owing to the multidimensional nature of the stimuli, one of the main difficulties in creating attraction effect choice triplets from real-world objects is establishing a criterion for matching up similar objects. We used genre and sub-genre information from allmovie.com on each of the 400 movies to create target-decoy and target-competitor pairs from movie pairs that are likely to be perceived as similar/different, respectively. We conjectured that it will be harder to find movie pairs that will be perceived as similar, and for this reason, we started the quadruplet creation with selecting potential target-decoy pairs.

The genre information on allmovie.com is very rich: compared to the 18 genre categories on IMDb, there are 156 genre and sub-genre categories, capturing many important aspects of the movies. Using this rich genre information, we created a movie by movie (400 x 400) matrix, where each cell was the number of overlapping genre categories between the two movies.

We then paired up movies that were both scoring highest in each other's genre score distribution, creating 2,271 target-decoy candidates. We also added 806 movie pairs obtained from the mutually closest 10% of movies based on a latent semantic analysis[1] that were not already in our list of target-decoy candidates. The rationale behind using semantic proximity as an additional criterion was to capture movie pairs that are very close to each other in terms of the story themes, but are not the closest on the genre dimension. Overall, we had 3,011 unique target-decoy candidate pairs at this point.

We then reduced the size of this list by selecting the most similar movie pairs. This was done manually by two researchers, who gave a similarity rating between 1-7 for each movie pair (1-least similar, 7-most similar). We only kept the movie pairs that had a similarity rating above 1, resulting in 1,242 target-decoy candidates. We then divided the 1,242 pairs into six groups of 207 pairs and ran an independent pilot study where we asked 60 participants to rate the similarity of a randomly chosen group of movie pairs, obtaining 10 independent similarity ratings for each of the 1,242 target-decoy candidates. Participants rated the similarity of each movie pair on a 1-7 scale, where 1 is the least and 7 is the most similar, and a ”Don't know” option was also available. Figure 2 shows the distribution of the average similarity ratings for each movie pair.

Figure 2: Distribution of the average similarity rating for each target-decoy candidate pair (N = 1242).



We decided to only use movie pairs with ratings that are equal to or higher than 4.5, which corresponds to the upper 20% of the similarity rating distribution (253 movie pairs). We hoped

[1]The latent semantic analysis assesses the similarity of two items based on the text associated with them. For this analysis, we used the summary text about the movies as well as plot keywords, actor and director names, all retrieved from IMDb.

this procedure will ensure that our target-decoy candidate pairs will be perceived as similar by most people.

Once we had a sufficient number of movie pairs that we believed were reasonably similar, the next step in creating the quadruplets was to create target-competitor pairs. Since each quadruplet essentially consists of two target-decoy pairs (Movie A, B and Movie C, D on Figure 1), we decided to pair up the 253 target-decoy pairs to create the quadruplets.

To do this, we first created a target-decoy pair by target-decoy pair matrix (253x253), where each cell was the number of overlapping genre categories between the two movie pairs. For example, considering the comparison between target-decoy candidate 1 (consisting of Movie A and Movie B) and target-decoy candidate 2 (consisting of Movie C and Movie D), we summed the number of genre overlaps between movies A-C, A-D, B-C and B-D. We then selected the unique target-decoy pairs that had no genre overlap with each other. This resulted in 20,022 quadruplets, each of which is a combination of four movies, created from 231 unique movies.

2.1.2 Experimental Procedure

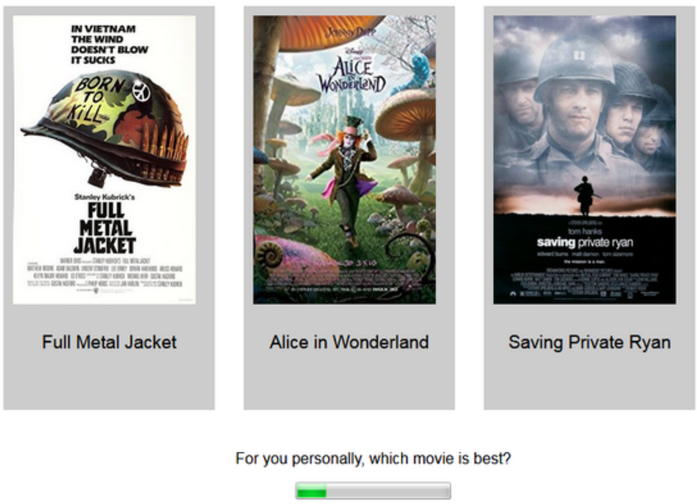
The experiment consisted of three stages: preference rating stage, choice stage, similarity rating stage. In the preference rating stage, we asked for participants' subjective evaluations over the 231 movies ("How do you personally rate this movie?") on a scale from 1 (worst) to 7 (best). We also asked whether the participant had seen the movie before. The 231 movies were presented in a random order for each participant. The rating stage took about 15-20 minutes on average.

Before the choice stage, we created choice triplets for each participant using the ratings they gave in the preference rating stage. This selection process can be described as follows. First, based on the ratings from the first stage, we identified the subset of quadruplets where: (a) the target and competitor were both rated 4,5,6 or 7, and (b) the two decoy movies were rated at least 3 points lower than the two decoy candidates. Note that we did not require the two decoys in the quadruplet to have the same rating as it would have severely limited the number of quadruplets we could use (e.g., we allowed for quadruplets with ratings 7,7 for the two targets and 4,1 for the two decoys), but we controlled for this difference in our analysis.

We then selected the subset of quadruplets where all of the movies had been seen or none of the movies had been seen, to make sure that choice behaviour will not be governed by differences in familiarity with the movies. The result was a bespoke subset of quadruplets for each participant where the target/competitor movies had the same rating and the decoy movies were rated worse. However, we did not want the same movie to appear twice as a target/competitor for one participant, and for this reason we used a sequential elminiation techinque: we first chose the quadruplet with the highest combined target-decoy similarity rating, then eliminated all quadruplets with the same target/competitor movies. We repeated these steps until we had a set a of quadruplets with unique target/competitor movies.

We then only invited those participants back for whom we could create at least three unique quadruplets this way (corresponding to at least six attraction effect choice triplets). In the choice task, people were presented with the selected movie triplets in a random order and were asked to choose the one they liked the most (see Figure 3).

Figure 3: Choice stage.



In the final, similarity stage, we asked participants to rate the similarity of all target-decoy and target-competitor pairs on a scale from 1 (least similar) to 7 (most similar), where a ”don’t know” option was also included. Information collected in this similarity rating stage was important to ensure the validity of the test. Because we had to invite people back after the first stage, we collected data in batches of 50 until we had choice data for at least a 100 participants (after all the exclusion criteria had been applied, see section 2.1.3). At most a few days passed between the preference rating and choice stage.

We recruited 297 participants from Prolific Academic who were paid £8 per hour. Out of the 297 participants that completed the preference rating stage, we could create at least one quadruplet that included movies that had either been all seen or not seen for 249 participants, and for 179 of these participants we could create at least 3 unique quadruplets. Out of the 179 participants who were invited back, 152 took part in the choice stage of the experiment.

2.1.3 Exclusion criteria

To conduct a rigorous test of the attraction effect, it is crucial that people take the task seriously and reveal their true preferences. Given that individually rating 231 movies can seem somewhat mundane, we specified a set of exclusion criteria to filter those people out who did not take the rating task sufficiently seriously. These were the following. We excluded people who fell into the fastest 5% of the reaction time distribution, the lowest 5% of the entropy distribution and the upper and lower 5% of the autocorrelation distribution. Entropy refers to the diversity of the ratings, while autocorrelation takes into account the temporal pattern and measures the extent to which a response depends on previous responses. Thus, this measure aimed to filter out response patterns where people 1) spent an unusually short time completing the task or 2) did not use the whole of the ratings scale or 3) often gave the same ratings for consecutive movies or 4) were giving ratings randomly.

This exclusion criteria was validated by a pilot study, where we collected repeated participant ratings for a set of books and found that the participants with a low correlation between repeated ratings ($r < 0.8$) were almost exactly the ones who were filtered out by these three criteria. After we applied these exclusion criteria to our sample of 152 people, we had choice data from 135 participants.

The study design, exclusion criteria and all the analyses were planned and registered before we collected any choice data. The pre-registration can be accessed at

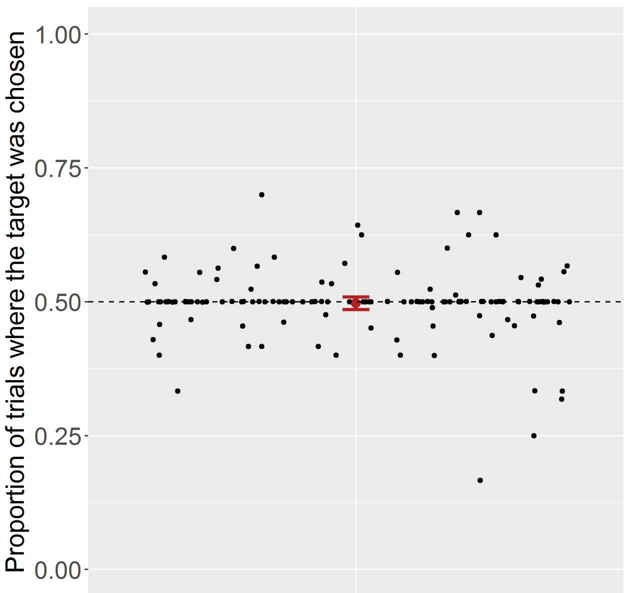
2.1.4 Results

The average number of choice trials per participant was 16 (the lowest being 6 and the highest 54), and 84% of participants were presented with at least 8 choice trials.

The decoy was only chosen in 4.3% of the trials. In addition, 72% of the participants have never chosen it, and only 2% of people have chosen it in more than 25% of the trials. This indicates that people were able to identify the dominated decoy in the choice stage.

To test for the presence of the attraction effect, we first excluded all trials where the decoy was chosen and then conducted a one-sample t-test to test the hypothesis that the mean of the proportion of trials where the target was chosen is above 0.5 (indicating an increased likelihood of choosing the target item). We found no evidence for the attraction effect (M = 0.5, SD = 0.07), t(134) = -0.44, p = .669. Figure 4 shows the distribution of the proportions of trials where the target was chosen, which shows that participants were almost perfectly indifferent between the target and the competitor, M = 0.5, 95% CI [0.49, 0.51].

Figure 4: Proportion of trials where the decoy was chosen. Each dot is a participant and the red dot and error bars show the bootstrapped mean and 95% CIs.



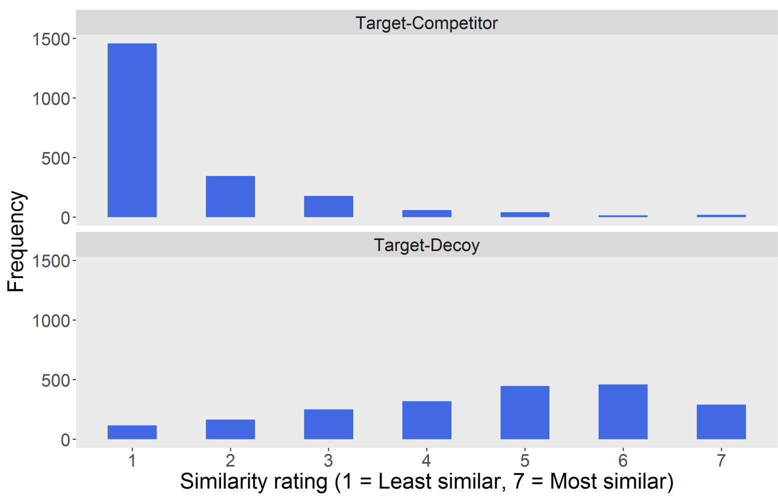
As specified in our pre-registered analysis plan, we also ran a mixed effects logistic regression with subject-specific intercepts to investigate how the target-decoy and target-competitor similarity ratings and familiarity of with the movies affect the likelihood of choosing the target. Table 1 shows the results from this regression, where contrary to our expectations, none of the explanatory variables seem to modulate the strength of the attraction effect.

Table 1: Odds-ratios and 95% CIs from a mixed-effects logistic model with subject-specific intercepts. (T - Target, C - Competitor, D - Decoy)

	Dependent variable:
	Target chosen
Seen all	1.122 (0.731, 1.729)
TC similarity rating	0.967 (0.872, 1.073)
TD similarity rating	0.926 (0.835, 1.027)
TD rating difference	0.935 (0.837, 1.044)
Intercept	1.062 (0.598, 1.882)
Observations	1,541
Log Likelihood	−1,064.822
Akaike Inf. Crit.	2,141.644
Bayesian Inf. Crit.	2,173.686
Note:	*p<0.1; **p<0.05; ***p<0.01

While we crated the choice triplets very carefully to ensure that they actually represent an attraction effect choice situation where the target-decoy pairs are perceived as similar and the target-competitor pairs perceived as different, individual heterogeneity and malleable preferences can still affect the results. Therefore, we find it instructive to plot the target-decoy and target-competitor similarity rating distributions. Figure 5 shows these distributions, and we can see that the overwhelming majority of target-competitor pairs were perceived as not similar, while the majority of target-decoy pairs were perceived as similar, as we hoped.

Figure 5: Distribution target-competitor and target-decoy similarity ratings.



3 Discussion

We tested for the attraction effect in consumer decision making using naturalistic stimuli. We found that the presence of the decoy in the choice did not alter preferences over the target and the competitor, as participants remained indifferent between the two dominating options. We believe that our study is the first rigorous investigation of this research question. We designed our study carefully to address all the criticisms raised in connection with the study by Frederick et al., where they used similar stimuli.

First, our experimental design ensured participants' indifference between the target and the decoy, maximising the probability that choices will be constructed on the spot (rather than through relying on strong prior preferences) and an attraction effect will occur. While one could argue that mnemonic processes arising from familiarity with the stimuli can alter preferences in the choice stage, we still did not detect an attraction effect when participants were not familiar with the movies.

Second, we have strong evidence that the dominance relationship was perceived in our experiment. The target-decoy similarity ratings confirmed that our careful target-decoy selection process indeed managed to produce movie pairs that were perceived as similar. In addition, we ensured that the decoy was always rated at least 3 units lower than the target (and the competitor). Consequently, the decoy was only chosen in 4.3% of the trials, which clearly shows that participants were able to spot and avoid the dominated alternative.

Third, by creating bespoke choice triplets based on preference ratings, we avoided individual heterogeneity in preferences to act as a potential confound. In addition, we ensured that the decoy is not too desirable in comparison to the target. We also used a strict exclusion criteria to filter out participants who did not take the task sufficiently seriously, and with an average of 16 choice trials per participant we avoided participant fatigue.

Finally, in our analysis we controlled for familiarity with the choice options, perceived similarity of the target-decoy and target-competitor pair, and relative preference between the target and the decoy, but we found that none of these modulated the attraction effect.

To conclude, our results corroborate the findings of Frederick et al. and Yang and Lynn in that we did not find evidence for the attraction effect with complex stimuli.

Contrary to Frederick et al., we do not think that this null result undermines the importance of the attraction effect in decision making research. On the contrary, exploring the relationship between attribute characteristics and the strength of the effect can help us understand how the interaction of the attribute dimensions affect the comparison process which bears important implications for formal models of choice.

write about how it is not only present in decisions that involve options with numerical attributes

and then try to conclude that when there are only two distinct/salient dimensions (need not be numerical) that **can be processed independently** it is more likely to appear

however, when the dimensions interact such that independent processing is not possible we don’t see the effect

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