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# Unconscious Origins of the Spreading Effect

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Unconscious Origins of the Spreading Effect

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## Abstract

After choosing, people exhibit a spreading of alternatives whereby the chosen alternative is rated more positively and the rejected alternative is rated more negatively than they were previously rated. People are assumed to reassess their attitudes to reduce cognitive dissonance—discomfort that stems from considering the negative features of the chosen alternative and the positive features of the rejected alternative. Whereas most dissonance research has examined its possible conscious origins, surprisingly little research has examined the possibility that dissonance is due to unconscious processes. We tested whether the act of rejecting an alternative might engender response inhibition toward the stimulus, which would suggest the spreading of alternatives is due to an unconscious process. Research participants made choices between equally liked stimuli and completing a go/no-go reaction time task with the chosen and rejected stimuli before re-rating those stimuli. Although we did not find response inhibition for the rejected alternatives or response facilitation for the chosen alternatives, we did find evidence that the presence of the chosen and rejected stimuli influenced the ease with which the go/no-go signals were processed by the participants, supporting the assumption that an automatic process may play some role in the spreading of alternatives.

## Introduction

Often people assume that their preferences guide their choices, but sometimes their choices guide their preferences too. When making difficult choices, people exhibit a spreading of alternatives: They value the chosen alternative more positively and the rejected alternative more negatively than originally indicated. Because spreading does not occur when people are assigned an alternative, this effect is believed to be a direct result of the choice (Harmon-Jones, Brehm, Greenberg, Simon, & Nelson, 1996). This phenomenon has been typically attributed to higher-order cognitive processes involved in the reduction of cognitive dissonance, the feeling of psychological discomfort that occurs when one's actions are in conflict with one's beliefs or when one holds two or more conflicting beliefs (Festinger, 1957). Recent research has challenged this assumption. We tested whether a possible unconscious cognitive process—response inhibition resulting from negative priming—plays a role in the dissonance process.

In Brehm's (1956) original study demonstrating the spreading of alternatives, housewives were asked to rate the attractiveness of several different household appliances and then were given a choice between two of the appliances they rated to take home as compensation for participation. Brehm found that when the participants rerated the appliances after making this choice, they rated the chosen appliance more positively and the rejected appliance more negatively than they had originally indicated, and that the effect was stronger when the participants were presented with a difficult choice (two items of similar liking) than when they were presented with an easy choice (two items of dissimilar liking). According to cognitive dissonance theory, these spreading effects are due to the cognitive dissonance aroused by forgoing the attractive features of the rejected alternative and accepting the unattractive features of the chosen alternative (Festinger, 1957). To reduce this dissonance, people change their

attitudes towards the chosen and rejected alternatives to make them more in line with their actions: They will evaluate the chosen alternative more positively and the rejected alternative more negatively than they had before, justifying their choice.

A popular alternative to cognitive dissonance theory that attempts to explain the spreading effect in terms of consciously processing is self-perception theory. In self-perception theory, it is assumed that people do not think very carefully about their attitudes, but rather infer their attitudes by observing their own behavior (Bem, 1965; Bem, 1967). In the case of the spreading effect, people observe the fact that they have willingly chosen one alternative over the other, and from this action infer that they must like the chosen alternative more than the rejected alternative. In this case, cognitive dissonance theory and self-perception theory make the same prediction involving choice: that when one makes a choice between two equally attractive alternatives, an attitude change will occur where people evaluate the chosen alternative as more attractive and the rejected alternative as less attractive than originally indicated. Indeed, the predictions of cognitive dissonance theory and self-perception theory are frequently identical; however, cognitive dissonance theory has the additional stipulation that people experience feelings of negative tension or arousal in response to the dissonance, whereas self-perception theory does not. Although subsequent research has confirmed the experience of arousal in situations that cause dissonance (Zanna & Cooper, 1974; Kiesler & Pallak, 1976), self-perception theory remains one of the main alternative explanations for dissonance effects such as the spreading of alternatives. Also, self-perception theory requires that both the dissonance-inducing event and one's behavioral response to that event be explicitly recalled and attended to, and although the mechanisms behind the spreading effect are typically thought to involve

deliberate processing, evidence suggests that this may not be the case (Egan, Santos, and Bloom, 2007; Lieberman, Ochsner, Gilbert, & Schacter, 2001).

One of several proposed amendments to cognitive dissonance theory that suggests the involvement of high-level or deliberate processing posits that dissonance reduction will only occur when there is the possibility of aversive consequences (Cooper & Fazio, 1984): It requires the cause of the dissonance to be explicitly remembered and attended to. Several studies, however, have demonstrated that dissonance reduction occurs even where there is no possibility of aversive consequences for maintaining the conflicting cognition (Harmon-Jones, 2000; Harmon-Jones et al., 1996). For example, Harmon-Jones and his colleagues had participants drink a pleasant- or unpleasant-tasting beverage, write a statement on a piece of paper saying they liked the taste of the beverage, crumple the paper and throw it away, and then rate their liking for the beverage. Participants were either given a choice to write down a statement saying they liked the beverage or they were instructed to write a statement saying they liked the beverage regardless of whether or not it was true. Although there was no possibility of aversive consequences (no one would see their counterattitudinal statement because they threw it away), participants who were in the low choice condition experienced more of a positive change in attitude toward the unpleasant beverage than participants in the high choice condition. More important in demonstrating the unconscious origins of the spreading effect, a study by Lieberman et al. (2001) showed that amnesic participants exhibit the same level of dissonance-reducing behavior as did a control group of non-amnesiacs even when they were unable to explicitly recall the dissonance-inducing event. These findings suggest it is unlikely that dissonance reduction occurs as the result of a higher-level conscious process.

Further evidence that dissonance reduction occurs as a result of high-level processing is demonstrated in a recent study by Egan, Santos, and Bloom (2007). Egan and colleagues had young children choose between stickers they had previously rated to be of equal liking, and capuchin monkeys choose between different colored M&Ms (assumed to be of equal liking). When given a choice between the item rejected in the first round and a novel, third item (also originally of equal liking), the majority of the subjects in both the experiment with children and the experiment with monkeys chose the novel item. This pattern of choice indicates that the rejected item was devalued after making the initial choice, making the novel item more attractive in comparison. Both children and monkeys thus appear to display clear signs of cognitive dissonance induction and reduction.

Because both children's and capuchin monkeys' brains lack the ability to engage in many of the high-level processes that adult humans can perform, these results suggest that dissonance reduction is not due to a higher-order mechanism, but more basic, unconscious processes. Furthermore, although the children used in Egan et al.'s study were beyond the age where children are known to develop a sense of self-awareness (Lewis & Brooks-Gunn, 1979; Siegler, DeLoache, & Eisenberg, 2003), there is evidence showing that capuchin monkeys are unable to fully attain a sense of self-awareness, ruling out self-perception and consistency theories. In de Waal, Dindo, Freeman, and Hall's (2005) study on self-awareness in nonhuman primates, capuchin monkeys (like those used in the Egan et al. study) exhibited signs of confusion and distress when they viewed their own images in a mirror. Although their reactions to their reflections were distinct from the reactions exhibited when viewing either familiar or unfamiliar monkeys of the same sex from behind a glass barrier, the capuchin monkeys still failed to exhibit any clear signs of self-recognition. Because capuchin monkeys are unable to develop a concrete

sense of self-awareness but still experience a post-decisional spreading of alternatives, self-perception and consistency theories cannot account for the spreading effect.

Rather, it is possible that dissonance might be due to simple associations: Perhaps the mere association of a stimulus with rejection is what causes the attitude change observed in the spreading of alternatives. For example, in the negative priming paradigm people show more difficulty responding to a stimulus that had been previously ignored (May, Kane, & Hasher, 1995). By ignoring the stimulus (a form of rejection), the stimulus is associated with rejection and becomes negatively primed.

This delay in response times and reduced accuracy to previously ignored stimuli observed in the negative priming paradigm is evidence of automatic response inhibition, an indicator of unconscious processing. According to Shiffrin (1988), interference with the performance of an attended task despite a one's attempts to eliminate that interference is an indicator that the source of that interference is being automatically processed. Pratto and John (1991) posit that when attentional resources are directed elsewhere, negative stimuli attract more cognitive resources than positive stimuli and thus cause a slow in response times, which, according to Shiffrin, is indicative of automatic processing. We propose that a stimulus that was previously rejected will also become negatively primed, and that the stimulus's association with rejection is what causes the subsequent response inhibition. Therefore, if dissonance is truly an unconscious process, then items that were previously rejected as a result of dissonance reduction should be automatically inhibited during a simple response task. In this study, we attempt to identify whether automatic response inhibition is responsible for this phenomenon.

*The Present Research*

In our study we needed to induce a spreading of alternatives in our participants in order to gauge its effects on the unconscious processing of chosen and rejected stimuli. We chose to create these spreading effects by using the free choice paradigm. In the free choice paradigm, people choose between two equally valued stimuli and subsequently demonstrate a spreading of alternatives (Brehm, 1956). Studies using the free choice paradigm have also shown that when stimuli of equal liking are presented to a participant, the item rejected in the first round is usually also rejected in the second round in favor of the novel third item (Egan et al., 2007). This is thought to be the result of dissonance reduction; the participant's attitude toward a stimulus changes to fit with his/her previous decision. Because the stimulus was rejected in first round, the participant's liking for that stimulus decreases and it is viewed as less desirable than the novel stimulus. In our study we had participants rate their liking for a set of stimuli, engage in a free choice task by choosing between stimuli that they had previously rated to be of equal value, and then reassess their liking for these stimuli at the end of the study.

To assess whether automatic response inhibition occurs for the rejected stimulus, we used a go/no-go association task, which is designed specifically to measure implicit attitudes towards various target stimuli. The go/no-go task required participants to push a button (go) when presented with one cue, and to refrain from pushing a button (no-go) when presented with different cue. This go/no-go association task an accepted method of gauging automatic response inhibition, and it has been found that people are slower and to "go" when the stimulus has been previously inhibited or rejected, and that they are less accurate in their go responses than in their no-go responses for rejected stimuli (Nosek & Banaji, 2001; Verbruggen & Logan, 2008).

We propose that unconscious, automatic processes as opposed to explicit processes are responsible for the spreading of alternatives. Unconscious processes such as inhibition may be responsible for the diminished preference for rejected alternatives following difficult decisions: Perhaps the act of choosing associates an implicit rejection tag with the rejected alternative that inhibits favorable responses to that alternative. In line with this hypothesis, we predicted that participants would experience response inhibition for the rejected alternatives in the free choice task. This means that they will respond more accurately when a no-go signal is paired with a rejected stimulus than with the chosen or control stimuli, and that they will respond less accurately when a go signal is paired with a rejected stimulus than with the chosen or control stimuli. If response inhibition occurs, participants should also be slower to respond to a rejected stimulus during the go task than to the chosen stimulus or control stimuli.

Furthermore, we predicted that participants would experience response facilitation for the chosen alternatives in the free choice task. In other words, that they will respond more accurately when a go signal is paired with a chosen stimulus than with the rejected stimulus or control stimuli, and that they will respond less accurately when a no-go signal is paired with a chosen stimulus than with the rejected stimulus or control stimuli. Participants should also be quicker to respond during the go task to a chosen stimulus than to the chosen or rejected stimuli.

## Method

*Participants.* Participants were recruited via a posting on the Center for Behavioral Decision Research at Carnegie Mellon's experiment scheduling website. Participants were 37 male and 14 female adults from Carnegie Mellon University and surrounding Pittsburgh

communities, and were on average 25 years old ( $SD = 9.071$ ). Every participant was given \$5 for participating.

*Stimuli.* Stimuli used in this experiment were 61 images of cats, an image of a green circle on a transparent background, and an image of a red square on a transparent background. All images were 400 x 400 pixels. All cat images were taken from [www.kittenwars.com](http://www.kittenwars.com), and the green circle and red square were created using Adobe Photoshop CS3.

*Procedure.* Participants were seated in front of a computer screen and asked to rate the cuteness of an image of a cat on a 9-point scale with endpoints, *Not at all* (1) and *Extremely* (9). The image was displayed in the center of the screen. After rating the cuteness of that anchor stimulus, participants were asked to rate how cute they thought each of 60 other cats were relative to the anchor cat on a 7-point scale with endpoints *Much less* (-3) to *The same* (0) to *Much more* (3). During this segment, the anchor cat was always presented on the center-left of the screen and the cat being rated was always presented on the center-right of the screen. For each participant, the 60 additional cats were presented in a randomized order.

Once all 60 images were rated, two sets of three equally attractive stimuli were randomly selected by the computer (set A and set B). Participants were shown two randomly selected images from set A and asked to indicate which they preferred. Which image appeared on the right of the screen and which image appeared on the left was randomly determined by the computer. After choosing the preferred image, participants were shown the rejected image and the remaining novel image from set A. Once again, participants were asked to choose which image they preferred. The purpose of this task is to induce feelings of dissonance in the participants. The purpose of the three stimuli in set B is to serve as a control, since none of these images were chosen or rejected by the participant.

Next we employed a go/no-go response task to evaluate the automatic response inhibition for each stimulus. Participants were instructed to press the spacebar as quickly as possible when they saw a cat paired with a green circle (go signal), and to refrain from pressing the spacebar when they saw a cat paired with a red square (no-go signal). Reaction times for each trial were recorded in milliseconds. Each trial lasted for 2 seconds, and the cat and the signal were presented on randomly determined sides of the screen. Between each trial, there was a half second pause during which a fixation cross was displayed to return the participant's focus to the center of the screen. During the go/no-go task, participants were presented with 10 different images: the chosen and rejected stimuli from set A, the three control stimuli from set B, the two lowest rated stimuli, and the two highest rated stimuli. Each stimulus was paired with the go signal for 5 trials and the no-go signal for 5 trials. All stimulus/signal combinations were presented in random order.

After completing the go/no-go phase of the study, participants were again asked to re-rate their liking for the anchor cat on a scale identical to that used at the beginning of the experiment, and all 60 additional cat images relative to the anchor cat. After re-rating all the stimuli, participants were asked to report their age and sex.

## Results

One participant was excluded from analysis due to failure to discriminate between the go signal and the no-go signal during the reaction time task.

*Manipulation Checks.* Before we can determine the effects of cognitive dissonance on response inhibition and facilitation, we must first confirm that dissonance was actually induced in the participants. One method of determining this is to see whether the image rejected in the

first round of free choice was also rejected in the second round. If a significant number of participants reject the same image twice, this indicates that a spreading of alternatives has occurred. To determine whether this effect was present in our data, we ran a binomial t-test with rejection as the test variable. Indeed, the majority of participants rejected the same stimulus in the second round of choice as in the first round of choice ( $M = .64$ ,  $SD = 0.49$ ),  $t(49) = 9.33$ ,  $p < .0005$ ).

Recently there has been some doubt as to whether this method is a valid way of determining the presence and resolution of cognitive dissonance. Chen & Risen (in press) correctly claim that, assuming there are implicit differences in affect between stimuli, in a free choice task it is more probable that participants will reject the same stimulus in both rounds than it is that they will reject different stimuli in each round. However, assuming that there are no differences in affect between stimuli, this counterargument does not apply. Our expanded rating system was designed to eliminate any differences in liking between stimuli: We first had participants rate the attractiveness of an anchor stimulus and then had them rate all additional stimuli relative to that anchor. This method results in more finely calibrated ratings, and should hopefully eliminate any slight differences in affect between stimuli.

However, there is another method of checking the assumption that the stimuli were of equal liking and that cognitive dissonance was induced. If two stimuli are of equal liking, after choosing between them the participant should experience a change in attitude to reduce the dissonance caused by rejecting a stimulus with equally attractive features and accepting a stimulus with equally unattractive features. In other words, participants should experience an increase in liking for the stimulus they chose and a decrease in liking for the stimulus they rejected. To analyze the spreading of alternatives, we submitted reports of liking for the stimuli

presented in the first choice to a 2 time (before choice vs. after choice) x 2 choice (chosen vs. rejected) repeated-measures ANOVA. Our results suggested that choice induced the spreading of alternatives. There was no main effect of time,  $F(1, 49) < 1, p = .871$ , a main effect of choice,  $F(1, 49) = 28.14, p < .0005$ , and more important, a significant time x choice interaction,  $F(1, 49) = 28.14, p < .0005$ . There were no differences between the stimuli when they were initially rated relative to the anchor, but there was an increase in liking for the chosen stimulus and a decrease in liking for the rejected stimulus after they were chosen between.

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Insert Figure 1 about here

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We repeated this analysis with the second chosen and rejected alternatives, and found a main effect of time,  $F(1,49) = 4.88, p = .032$ , a main effect of choice,  $F(1,49) = 10.50, p = .002$ , and a significant time x choice interaction,  $F(1,49) = 10.50, p = .002$ . Again there were no differences between stimuli when they were initially rated relative to the anchor. In the second round of the free choice task, the rejected alternative decreased relative to its initial rating; however, the liking of the chosen stimulus stays approximately the same relative to its initial rating. Because the spreading effect was not bi-directional in the second round of the choice task, we chose to use the first chosen and first rejected stimuli in all subsequent analyses.

*Response Inhibition and Facilitation.* We predicted that the choice task would induce response inhibition for the rejected alternative. This prediction suggests that participants should be (1) more accurate when a no-go signal is paired with a rejected stimulus than with the chosen or control stimuli, (2) less accurate when a go signal is paired with a rejected stimulus than with the chosen or control stimuli, and (3) slower to respond (i.e., in the go task) to a rejected stimulus than to the chosen or control stimuli.

Conversely, we also predicted that choice task might induce response facilitation for the chosen stimulus. This would lead to three predictions with regards to the chosen stimulus. Participants should be (1) more accurate when a go signal is paired with a chosen stimulus than with the rejected or control stimuli, (2) less accurate when a no-go signal is paired with a chosen stimulus than with the rejected or control stimuli, and (3) quicker to respond to a chosen stimulus than to the rejected or control stimuli.

As a test of the first and second predictions, we compared the accuracy rate of go and no-go responses for the chosen and rejected stimulus in a 2 choice (chosen, rejected) x 2 accuracy (go task, no-go task) repeated measures ANOVA with go and no-go response rates for the control stimuli as covariates in the analysis. This analysis yielded a main effect for choice  $F(1,49) = 9.179, p = .004$ , no main effect for accuracy  $F(1,49) = 1.20, p = .279$ , and a significant choice x accuracy interaction  $F(1,49) = 20.82, p < .0005$ . Overall, participants were more accurate when presented with a chosen stimulus ( $M = .982, SD = .077$ ) than with a rejected stimulus ( $M = .974, SD = .094$ ). However, contrary to our hypothesis, when participants were presented with a chosen stimulus they were *less* accurate when it was paired with a go signal ( $M = .980, SD = .083$ ) than when it was paired with a no-go signal ( $M = .984, SD = .089$ ). Similarly, when participants were presented with a rejected stimulus they were *more* accurate when it was paired with a go signal ( $M = .976, SD = .096$ ) than when it was paired with a no-go signal ( $M = .972, SD = .107$ ).

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Insert Figure 2 about here

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As the predicted pattern of motor responses did not emerge, we then tested whether the choice task might affect the overall accuracy of responses to the chosen and rejected stimuli ( $d'$ ). We conducted a repeated measures ANOVA on  $d'$  scores for the chosen and rejected stimuli

with  $d'$  scores for control stimuli included as a covariate in the analysis. This revealed a significant main effect of  $d'$  for the chosen and rejected stimuli,  $F(1, 48) = 10.16, p = .003$ , whereby participants were more accurate discriminating go and no-go signals for chosen ( $M = 4.441, SD = .796$ ) than for rejected stimuli ( $M = 4.306, SD = 1.112$ ).

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Insert Figure 3 about here

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To test our third prediction, we applied a square root transformation to response times and examined how quickly participants responded to a go signal when it was paired with the chosen and rejected stimuli in a repeated-measures ANOVA, with response times for go signals paired with control stimuli included as a covariate in the analysis. This analysis revealed no significant effect of choice on response time,  $F(1,48) < 1, p = .440$ . Participants were equally quick to respond to go signals when they were paired with the chosen ( $M = 21.555, SD = 3.246$ ) and rejected stimulus ( $M = 21.476, SD = 3.516$ ).

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Insert Figure 4 about here

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*Exploratory Analyses.* To see whether the aforementioned results were due to the positivity of the chosen and rejected stimuli or the choice task itself, we conducted exploratory analyses with the highest and lowest rated pairs of stimuli of equal liking. We first compared the accuracy rates of go and no-go responses for the high and low rated stimuli in a 2 liking (high, low) x 2 accuracy (go task, no-go task) repeated measures ANOVA with correct go and no-go response rates for the control stimuli as covariates in the analysis. There was a main effect for liking  $F(1,49) = 17.46, p < .0005$ , no main effect for accuracy  $F(1,49) < 1, p = .84$ , and a significant liking x accuracy interaction  $F(1,49) = 15.23, p < .0005$ . Interestingly, participants responded *less* accurately overall when presented with a stimulus of high liking ( $M = .972, SD = .112$ ) than when presented with a stimulus of low liking ( $M = .977, SD = .077$ ). Also, participants

were *less* accurate in responding when the stimuli of high liking were paired with go signals ( $M = .970, SD = .105$ ) than when they were paired with no-go signals ( $M = .974, SD = .143$ ), and when the stimuli of low liking were paired with no-go signals ( $M = .976, SD = .129$ ) than with go signals ( $M = .978, SD = .091$ ).

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Insert Figure 5 about here

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To determine whether there were any differences in overall accuracy of responses to the high and low rated stimuli, we used a repeated measures ANOVA on  $d'$  scores for the high and low rated stimuli with  $d'$  scores for the control stimuli as a covariate. The analysis revealed no significant main effect of  $d'$  for the high and low rated stimuli  $F < 1, p = .983$ . Participants were no more accurate in discriminating go and no-go signals for the stimuli of high liking ( $M = 4.250, SD = 1.120$ ) than they were for the stimuli of low liking ( $M = 4.313, SD = .815$ ).

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Insert Figure 6 about here

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Next we applied a square root transformation to response times and used a repeated measures ANOVA to determine whether the response times on the go task were quicker for the high rated stimuli or for the low rated stimuli. The analysis yielded a significant main effect for liking  $F(1,48) = 8.64, p = .005$ . Participants were quicker to respond to go signals when they were paired with stimuli of high liking ( $M = 21.043, SD = 3.042$ ) than when they were paired with stimuli of low liking ( $M = 21.290, SD = 4.048$ ).

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Insert Figure 7 about here

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## Discussion

Although we did replicate the spreading of alternatives, we did not find evidence suggesting that response inhibition was responsible for the spreading of alternatives. Even

though participants responded more accurately to the chosen than rejected stimuli, they were more accurate when the chosen stimuli were paired with no-go signals than with go signals, contrary to the pattern of results we'd expect to find with response facilitation. Similarly, participants responded more accurately when the rejected stimuli were paired with go signals than with no-go signals, whereas we would expect the opposite to be true in the case of response inhibition. Participants were also more accurate in discriminating between the go and no-go signals for chosen stimuli than for rejected stimuli; however, this has no direct bearing on response inhibition and facilitation as the value of  $d'$  cannot discriminate between accuracy for the go and no-go trials. Furthermore, participants were not significantly quicker to respond to the chosen stimuli than to the rejected stimuli, indicating that neither response inhibition nor response facilitation had occurred. In sum, the results demonstrated post-choice spreading of alternatives, but did not support our focal hypothesis.

In our exploratory analysis, we found that participants responded more accurately overall to the stimuli of low liking than to the stimuli of high liking. This is a bit counterintuitive, as one would expect participants to respond similarly to stimuli of high liking as they would to chosen stimuli, and stimuli of low liking as they would to rejected stimuli. In terms of accuracy of responses to specific signals, stimuli of high and low liking showed the same perplexing pattern of results as the chosen and rejected stimuli: Participants responded more accurately when stimuli of high liking were paired with no-go signals than with go signals, and when the rejected stimuli were paired with go signals than with no-go signals. Unlike the chosen and rejected stimuli, there were no significant differences between participants' abilities to discriminate between go and no-go signals. However, participants were significantly quicker to respond to stimuli of high liking than they were to stimuli of low liking.

Although we did not find clear evidence that response inhibition and facilitation occur when choices are made between equally liked stimuli, there is some evidence that information is being inhibited as a result of this choice. In our study we found that participants were more accurate overall in responding to the chosen stimuli and were better able to discriminate between the go and no-go signals for the chosen stimuli than for the rejected stimuli. Because we did not obtain the same results for stimuli of high and low liking, this suggests that these findings are unique to choice. This might indicate that that, although the rejected alternative does not necessarily inhibit responses, it might be causing inhibition at the perceptual level. In other words, the presence of the rejected alternative makes it harder for participants to recognize and encode the go and no-go signals. Perhaps this is due to a form of repression known as perceptual defense, whereby participants' reactions to the attended task were slowed due to the cognitive effort required to keep negative stimuli from entering the consciousness (Holmes, 1974; Pratto & John, 1991). However, the perceptual defense perspective generally assumes that the stimuli are significantly aversive or threatening in nature, which does not fit the nature of the stimuli used in this experiment.

*Study Limitations.* One concern is that participants were extremely accurate in responding in general during the go/no-go task ( $M_{\text{accuracy}} = .976$ ,  $SD = .004$ ). One way to get a better idea of the differences in accuracy and signal detection for the chosen and rejected stimuli would be to make the go/no-go task more difficult. This could be accomplished by shortening the trial lengths, switching the signals (red square means go, green circle means no-go), adding an additional condition to the interpretation of the signals (for example, one combination of signals means go, while another combination means no-go), etc. By making the task more difficult,

general accuracy rates would decline and we might get a clearer idea of the differences between the chosen, rejected, high-liking, and low-liking stimuli.

Another concern is that we used images of cats as our stimuli for this study. In order to get a greater spreading of alternatives, it may have been better to use stimuli that had greater personal relevance to the participants. In other words, the choice would have more of an impact if it were actually relevant to the participant's outcome. One way we could solve this problem would be to have participants rate their liking for attractive prizes, and then make choices between prizes of equal liking. We would then tell participants that for each prize they chose, their name would be entered into a raffle to win that prize. This method would add some weight to the participant's decisions during the choice task, and the personal relevancy of the outcome would likely increase the strength of the spreading effect.

*Future Directions.* Although this study reveals some interesting perceptual effects concerning chosen and rejected alternatives, there is still no concrete explanation for why participants would respond more accurately to no-go signals than to go signals for chosen and high-liking stimuli, and more accurately to go signals than to no-go signals for rejected and low-liking stimuli. Perhaps future research could tease apart these counterintuitive results and provide insight into the way that we perceive and respond to chosen, rejected, high-liking, and low-liking stimuli. Also, although it was not the effect we were originally investigating, the perceptual inhibition of rejected alternatives should be researched in greater detail. Now that we have found evidence of dissonance-induced perceptual inhibition, studies designed around this concept would provide even greater insight into how cognitive dissonance is processed.

### Conclusion

The purpose of this study was to gain greater insight into the way that cognitive dissonance and dissonance reduction is processed in the brain. Although competing theories posit that dissonance effects are due to higher-order processes, we hypothesized that these effects are due to more fundamental, automatic processes. To test this theory, we had participants identify several stimuli of equal liking, which they were then forced to make choices between. We then employed a go/no-go response task to see if there was response inhibition for the rejected stimuli or response facilitation for the chosen stimuli, which would be indicative of automatic processing of these stimuli.

Our hypotheses were that participants would be more accurate in responding when a chosen stimulus was paired with a go signal and when a rejected stimulus was paired with a no-go signal, and less accurate in responding when a chosen stimulus was paired with a no-go signal and when a rejected stimulus was paired with a go signal. Interestingly, our data indicates the opposite pattern is true. We also hypothesized that participants would be quicker to respond to chosen stimuli than rejected stimuli during the go trials. However, we found no significant differences between the response rates to chosen and rejected stimuli.

Although our hypotheses were not supported in this study, there is still evidence of inhibition and facilitation of chosen and rejected stimuli. We found that participants were generally more accurate in responding to chosen stimuli than rejected stimuli, and that they were better able to discriminate between go and no-go signals for the chosen stimuli than for the rejected stimuli. These results indicate that participants might experience perceptual inhibition for the rejected stimuli, making it harder to recognize and encode the signals they are paired

with. Future research concentrating on these perceptual effects might be able to confirm whether or not cognitive dissonance is truly an automatic process.

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Figure Caption

*Figure 1.* Liking for the chosen and rejected stimuli in the first round of the free choice task before and after choice

*Figure 2.* Accuracy rates during the go and no-go tasks for the chosen and rejected stimuli.

*Figure 3.* D' scores for the chosen and rejected stimuli.

*Figure 4.* Response times for the chosen and rejected stimuli during the go task.

*Figure 5.* Accuracy rates during the go and no-go tasks for the high- and low-liking stimuli.

*Figure 6.* D' scores for the high- and low-liking stimuli.

*Figure 7.* Response times for the high- and low-liking stimuli during the go task.













