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Choosing to Choose: The Effects of Decoys and Prior Choice on Deferral

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Sellers are often more interested in inducing buyers to make a choice—any choice—than in influencing which option they choose. For example, many retailers are more concerned about maximizing customer purchases within categories than influencing which brand is purchased in any particular category. Although this issue is important to researchers and practitioners, research on how contextual factors, such as decoys and prior decisions, affect whether consumers will "choose to choose" is scarce. We propose a reference-dependent model to fill this gap. This model unites several streams of research and leads to novel predictions that are tested and supported in four experiments. The paper concludes with a discussion of the theoretical and practical implications of the findings.

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Introduction

A key decision retail managers often face is determining which products to offer for sale. A large body of literature documents that beyond buyers' intrinsic preferences, both their prior choices and contextual factors, such as the presence of decoys, influence their choice. Prior research has shown that buyers' previous decisions affect their subsequent preferences by changing their decision criteria (Hedgcock et al. 2009), a result consistent with Bem's (1967) observation that individuals' preferences are not well formed but rather are learned by observing their own past behaviors. Similarly, asymmetrically dominated, subjectively inferior, compromise, and dominating but unavailable decoys can all change individual preferences in ways that violate common normative choice model assumptions (Highhouse 1996, Huber et al. 1982, Huber and Puto 1983, Simonson 1989). Given these results, managers should consider how contextual factors, such as prior choices and the effects of decoys, affect individuals' preferences when deciding on product offerings.

Most context effect studies force respondents to choose from a list of options (Dhar and Simonson 2003); however, in real-world choice situations, people often defer choice. Therefore, implications from this stream of research are difficult to translate to managerial decision making because decision biases may change when individuals can defer decisions (Dhar and Simonson 2003), and choice deferral itself is an important decision that managers often try to influence. In other words, many managers are often just as concerned with motivating customers to choose *something* as they are with getting them to choose *something specific*. For example, retailers may be more interested in maximizing the number of products purchased than in which specific brand is purchased.

The importance of understanding whether people will defer choice is not limited to retailing. Product managers need to consider how product line extensions affect both decision bias and choice deferral. Healthcare professionals and financial planners often face situations in which patients and clients defer choice even when choice deferral is worse than selecting an inferior alternative. Politicians are concerned with choice deferral because it is easier to increase voter turnout (i.e., decrease choice deferral) than to change political preferences. An overwhelming narrative in the 2012 U.S. elections is that Democrats managed to win presidential election largely through their superior ground operations, which focused on getting their supporters to the polling booths (Mason and Johnson 2012). Therefore, simultaneously examining the effects of decoys and prior choices on decision biases and the choice to choose is of interest to researchers and practitioners in a variety of domains.

The remainder of this paper proceeds as follows: We first review the streams of literature on context effects, choice deferral, and sequential decisions. Then, we use the findings from this literature to formulate a simple model. Next, we demonstrate that the model, which can account for prior findings, generates novel predictions that are supported in four experiments. Finally, we discuss the theoretical and practical implications and present limitations and future research directions.

Literature Review

A large body of literature in psychology, economics, and marketing has explored the normative and positive underpinnings of choice (e.g., Greenleaf and Lehmann 1995). We focus on three realms of literature that are most pertinent to our study: (1) studies of decoys, (2) sequential decision making, and (3) forced choice and choice deferral.

• *Decoys.* In their pioneer work on the effects of decoys on choice, Huber et al. (1982) demonstrate that the addition of an asymmetrically dominated decoy increases the choice share of the dominating option. The so-called attraction effect created by an asymmetrically dominated decoy violates the regularity condition central to most normative choice models, in which the choice share of one option cannot be increased by adding another option to a choice set. The attraction effect also violates the similarity hypothesis (Tversky 1972), according to which an item added to a choice set should take more shares away from the most similar item; in this case, the asymmetric dominated decoy is more similar to the target than to the competitor, but the decoy actually increases (rather than decreases) the choice share of the target. Huber and Puto (1983) demonstrate a similar attraction effect for subjectively inferior but nondominated decoys. Simonson (1989) subsequently extends this line of research to decoys that change the target to a compromise and increase the choice share of the target. Research has also shown similar attraction effects for dominated and dominating decoys that are not available (i.e., "phantom" decoys; Doyle et al. 1999, Highhouse 1996; for reviews, see Farquhar and Pratkanis 1993, Pratkanis and Farquhar 1992).

Multiple explanations have been offered for these decoy effects. Simonson (1989) suggests that both the attraction effect and the compromise effect can be explained by consumers choosing an option that is easy to justify. That is, the compromise effect is magnified when people are asked to justify their decisions to others. Bhargava et al. (2000) explain these context effects by arguing that the relative value of an option changes with the introduction of a decoy. Highhouse (1996) attributes the attraction effects of asymmetrically dominated decoys and asymmetrically dominating phantom decoys to loss aversion. Hedgcock et al. (2010) suggest the attraction effect may be caused by nonconscious, rather than conscious, processes. Pettibone and Wedell (2000) attribute the attraction effect of asymmetrically dominated decoys to value shifts (i.e., changes in the dimensional value of alternatives) and emergent values (e.g., justification) and credit the compromise effect to emergent values, but they find that none of these mechanisms can explain the phantom decoy effect.

• *Sequential Decision Making.* Several studies suggest that prior choices affect preferences. Bem's (1967) self-perception theory claims that people do not have well-formed internalized attitudes; rather, they infer their preferences by observing their own past behaviors. Similarly, Brehm (1966) claims that people ascribe more desirability to the chosen alternative to reduce the dissonance of considering two equally desirable alternatives (for a recent debate on this issue, see Chen and Risen 2009, Sagarin and Skowronski 2009).

Other research has examined how decoys and sequential decisions interact to affect preferences. For example, Hedgcock et al. (2009) find that the initial choice of a superior decoy biases preferences, even when the superior decoy is unavailable in a later decision. They attribute this effect to an increase in the perceived importance of the attribute on which the superior option excels. Researchers have also shown that even superfluous initial decisions can bias subsequent choices (Muthukrishnan and Wathieu 2007) and choice deferral (Dhar et al. 2007).

• *Forced Choice and Choice Deferral.* Although most context effect studies force respondents to choose, a separate stream of research has examined the effect of the freedom not to choose—that is, choice deferral. Dhar (1997b) highlights several factors that can affect choice deferral, such as perceived attractiveness of the alternatives, decision difficulty, decision strategies, and time pressure. For example, Dhar (1997a) finds that choice deferral increases as perceived difference in option attractiveness decreases. Tversky and Shafir (1992) suggest that deferral increases for difficult choices, such as when decision sets are large. Iyengar and Lepper (2000) show that people's deferral increased when decision sets were enlarged and that people were less satisfied with their decisions when choosing from the larger choice set. Dhar and Nowlis (1999) find that time pressure can decrease choice deferral by increasing the use of noncompensatory decision processes.

Another line of research has demonstrated that choice deferral can interact with decoys to affect consumer preferences. For example, Ge et al. (2009) find sold-out alternatives can decrease deferral. Dhar and Simonson (2003) suggest that the choice of compromise and deferral options is associated with high decision uncertainty and that dominated decoys are associated with low decision uncertainty. Therefore, the option to defer decreases the size of the compromise effect and increases the size of the attraction effect.

A third line of research that is related to choice deferral is the literature on search. Choosing when to choose is tied to the cost-benefit analysis of continuing search (Stigler 1961, McCall 1970, Varian 1980). Therefore, search may exhibit an inverted-U relationship with experience as the least experienced do not see the need to search, whereas the most experienced do not have the incentive to search (Moorthy et al. 1997). More pertinent to our context, consumers' tendency to search may be a function of the number of options in a choice set. For example, Mochon (2013) finds that consumers are more likely to search (i.e., more likely to defer) when a product is presented alone (versus with another product) because of their increased desire to search when faced with a single option.

As we explain in the following section, we take our inspiration from this rich literature to build a simple model that allows us not only to rationalize many of the findings from the past research but also to formulate new propositions that we subsequently validate using empirical data.

Model

The considerable support for different explanations for context effects has led researchers to suggest that context effects are robust because they are multiply determined (Huettel et al. 2009). Therefore, to simultaneously account for the effects of decoys and prior choices on decision biases and deferral, one approach is to model all the previously documented drivers of these effects, including justification (Simonson 1989), changes in relative value (Bhargava et al. 2000), loss aversion (Highhouse 1996), trade-off aversion (Hedgcock and Rao 2009), value shifts (Pettibone and Wedell 2000), dissonance reduction (Brehm 1966), weight shift (Hedgcock et al. 2009), decision difficulty, reference dependence (Dinner et al. 2011), decision uncertainty, sense of urgency (Ge et al. 2009), momentum (Dhar et al. 2007), and perceived difference in option attractiveness (Dhar 1997a, Dhar and Simonson 2003, Ge et al. 2009, Tversky and Shafir 1992). The resulting model, however, would be mathematically intractable and difficult to interpret. Another approach, which we take in this research, is to rely on a more parsimonious reference-dependent model that allows us to (1) account for prior findings in this area and (2) make novel predictions that can be empirically tested.

Specifically, in our model we rely on prospect theory and the notion of a shifting reference point. The model is consistent with the prior (but somewhat limited) formal literature in this area (e.g., Kivetz et al. 2004, Rooderkerk et al. 2011, Tversky and Simonson 1993). The prior models are designed to explain a single context effect with forced choice (Rooderkerk et al. 2011 is a notable exception). In this research, we extend Tversky and Simonson's (1993) framework and simultaneously model the effects of (1) three types of commonly studied decoy and (2) the presence and disappearance of the decoy, on choice deferral *and* decision biases. In our model, the introduction of a decoy affects people's reference points, which subsequently affect both deferral rates and the choice share of the focal options. These effects linger even during a subsequent choice when the decoy becomes unavailable, producing significant variations in the share of the choice and nonchoice options. We now present the details of this model.

General Framework

Consider a choice set S with N options (labeled $1, 2, \ldots, N$) with each option consisting of K *vertical attributes* (labeled $1, 2, \ldots, K$). The total deterministic value (utility) of an option x in a choice set consists of three components as detailed below.

1. The *context-free value* of option x: this is the summary measure of aggregate utility as in the standard economic models of a vertically differentiated product line.
2. The total valuation of the *context effects* for option x in the context of choice set S, which depends on the attractiveness of the other options in the choice set.
3. A *screening rule* whereby an option receives a high disutility if it is clearly dominated by one or more better alternatives.

We describe the parametrization of each of these in more detail below (see Table 1 for a summary of the symbols used).

The context-free value of an option x is given by a linear combination of the values placed on all the attributes of the product (price and quality):

$$v(x) = \sum_{k=1}^{K} v_k(k_x). \tag{1}$$

Table 1 **List of Symbols**

Symbol	Description
$v(\cdot)$	Context-free utility
$g(\cdot)$	Context effect
θ	Relative weight placed on context effects
S	Choice set
p	Price
q	Quality
k	Attribute
λ_k	Loss aversion parameter associated with attribute k
T	Target
C	Competitor
N	No-choice option
D_c	Decoy that makes target a compromise option
D_{ad}	Decoy that is strictly dominated by target but not by competitor
D_{sup}	Decoy that strictly dominates target but not competitor
R	Disutility associated with a dominated option
$S - \{D_i\}$	Choice set after the disappearance of decoy i
ψ	Lingering effect of a disappeared decoy

We model the context effects by the position of an attribute in relation to a reference point formulation on each attribute that, in turn, derives from the choice set. Consistent with prior research (e.g., Kivetz et al. 2004), we formulate the average of the values associated with the levels of a specific attribute in a choice set as the reference point for that attribute. This parsimonious formulation allows us to capture the context effects wherein an option can affect other options in a choice set even if this option itself is dominated. We code the value of an attribute above the reference point as a gain and otherwise as a loss and consistent with prospect theory (Kahneman and Tversky 1979), the losses weigh more than the equivalent gains. Mathematically, we can write the context effect part of a consumer's utility for option x in choice set S as

$$g(x,S) = \sum_k \big[(v_k(k_x) - v_{kR}(S))(1(v_k(k_x) \geq v_{kR}(S))\big] + \big[\lambda_k(v_k(k_x) - v_{kR}(S))\big(1(v_k(k_x) < v_{kR}(S))\big], \quad (2)$$

where

$v_k(k_x) =$ the intrinsic valuation of attribute k that has level k_x for option x,

$v_{kR}(S) =$ the valuation of the reference point of attribute k in choice set S,

$\lambda_k > 1 =$ the loss aversion parameter for the attribute k, and

$1(\cdot) =$ the indicator function that takes the value of 1 when the relationship in the parentheses is true.

The reference point is given by the midpoint of the value of the different levels of attributes in the choice set:

$$v_{kR}(S) = \frac{\sum_{x \in S} v_k(k_x)}{|S|}, \quad (3)$$

where $|S|$ is the cardinality of choice set S. We formulate the reference point as average of the attribute levels simply for exposition purposes; our results do not change as long as the reference point is a linear combination of the attribute levels.[1]

Finally, we use $-R \cdot 1(\cdot)$ as a measure of consumers' screening ability to reject a dominated option, where R is the disutility associated with an option that is dominated and the indicator variable takes a value of 1 for a dominated alternative. This screening rule is theoretically consistent with Kahneman and Tversky's (1979) postulation that reference point formation happens in the coding stage of editing and "the location of the reference point . . . can be affected by the formulation of the offered prospects" (p. 274), but that in an independent editing stage, detection of dominance could occur, which involves "the scanning of offered prospects to detect dominated alternatives, which are rejected without further evaluation" (p. 275).As noted by Huber et al. (2014) and Simonson (2014), the magnitude of R captures the importance of consumers' ability to notice a dominance relationship and their willingness to reject the dominated option in successfully demonstrating the attraction effect. Higher values of R imply consumers are better at "screening out" dominated options in the choice set. Analogously, a smaller R implies that consumer inattention, in conjunction with other idiosyncratic factors such as inability to detect the dominance relationship or reluctance to reject the dominated option, could result in an outcome where some consumers select dominated options. As we detail in the appendix, even though our propositions on deferral hold for both small and large R's, focusing on situations with large R's (as we do in our empirical testing) allows us to focus on the effects of reference point shift (versus the effects resulting from the change in the number of options). As we will see later in our empirical applications, where the choice sets are small, information is transparent, and all the attribute levels can be unambiguously ranked, the vast majority of consumers (respondents) reject the dominated option (i.e., R is large).

Bringing it all together, the deterministic part of the utility that combines the screening rule, context-free utility, and context utility is written as follows:

$$M(x,S) = \begin{cases} v(x) + \theta g(x,S) - R, & \\ \quad \text{if } \exists y \in S \neq x \text{ s.t. } \forall k, v_k(k_y) \geq v_k(k_x) & \\ \quad \text{with strict inequality for at least one } k, & \\ v(x) + \theta g(x,S), \quad \text{otherwise.} & \end{cases} \quad (4)$$

The first and second parts of the above equation apply to the dominated options and to the nondominated options, respectively. The deterministic utility for "no choice" or deferral is normalized to zero.

Assuming additive independent and identically distributed extreme value error term on deterministic part of the utility (which captures the variation in the strength of individual preferences on vertical attributes), the market share of an alternative x is given by

$$\text{Share}(x) = \frac{M(x, S)}{1 + \sum_{x \in S} M(x, S)}. \quad (5)$$

Two-Attribute Model

To provide a sharper intuition of our findings, we present a simple two-attribute analytical framework based on the general framework that allows us to formalize the intuition and make precise predictions

[1] The loss aversion model formalized in Equations (3) and (4) is consistent with Tversky and Kahneman (1991), and empirically, this model had the best fit among the alternatives Kivetz et al. (2004) test for the compromise effect.

in a two-stage choice process. We consider a choice set in which products have two attributes and the products vary by the levels on these two attributes. The attributes are "vertical" in nature; that is, given different levels of an attribute, everyone agrees on the ranking of these levels. Examples of such attributes include price (everyone prefers a lower price to a higher price), processing speed of a laptop (everyone prefers a faster speed), megapixels in a camera (everyone prefers more megapixels), and so on. Although the attributes are vertical, consumers can vary in preference intensity for one attribute versus another. For example, although two consumers, A and B, always prefer a fast processing speed in a laptop, the willingness to pay for improvement in speed might be greater for A than B.

Because the attributes are vertical, the model assumes a screening rule that models consumers' ability to reject an option clearly dominated by another option leading to a very small market share for the dominated option (approaching zero in the limit based on (5) and (6)). However, the important insight from our model is that although dominated options might be chosen with very low probability, they do affect choice deferral and the preference for the options that dominate them through context effect.

Benchmark (No Decoy). We consider two attributes, which, to provide sharper intuition, we term "quality" and "price." In the benchmark case, we consider two options with equal context-free values and a choice to defer, and without loss of generality, we label the high-quality/high-price option (q_T, p_T) target (T) and the low-quality/low-price option (q_C, p_C) competitor (C) (with $q_T > q_C$ and $p_T > p_C$). Equality of context-free value implies that

$$v(T) = v_q(q_T) - v_p(p_T) = v_q(q_C) - v_p(p_C) = v(C) = v, \quad (6)$$

where $v_q'(q) > 0$ and $v_p'(p) > 0$ and $v_q''(q) < 0$ and $v_p''(p) < 0$.

We define

$$\Delta v = v_q(q_T) - v_q(q_C) = v_p(p_T) - v_p(p_C). \quad (7)$$

The value of option T for consumer i when faced with choice set $\{T, C\}$ is given by (using Equations (1)–(4))

$$V_i(T, \{T, C\}) = v + \theta\big[(v_q(q_T) - v_{qR}(\{T, C\})) - \lambda((v_p(p_T) - v_{pR}(\{T, C\}))\big] + \varepsilon_{iT}, \quad (8)$$

where $v_{qR}(\{T, C\}) = (v_q(q_T) + v_q(q_C))/2$ and $v_{pR}(\{T, C\}) = (v_p(p_T) + v_p(p_C))/2$. Substituting these in Equation (8) yields the following:

$$V_i(T, \{T, C\}) = v + \theta\left[\left(\frac{v_q(q_T) - v_q(q_C)}{2}\right) - \lambda\left(\frac{v_p(p_T) - v_p(p_C)}{2}\right)\right] + \varepsilon_{iT}.$$

We can write this succinctly as

$$V_i(T, \{T, C\}) = v - \theta\left(\frac{\lambda - 1}{2}\right)\Delta v + \varepsilon_{iT}. \quad (9a)$$

Similarly, we can derive the value of option C for consumer i as

$$V_i(C, \{T, C\}) = v - \theta\left(\frac{\lambda - 1}{2}\right)\Delta v + \varepsilon_{iC}. \quad (9b)$$

Using Equation (5), the market shares of T and C are given by

$$\Pr_i(T/\{T, C\}) = \frac{\exp(v - \theta((\lambda - 1)/2)\Delta v)}{1 + 2\exp(v - \theta((\lambda - 1)/2)\Delta v)}, \quad (10a)$$

$$\Pr_i(C/\{T, C\}) = \frac{\exp(v - \theta((\lambda - 1)/2)\Delta v)}{1 + 2\exp(v - \theta((\lambda - 1)/2)\Delta v)}. \quad (10b)$$

Finally, the share of consumers who defer is as follows:

$$\Pr_i(N/\{T, C\}) = \frac{1}{1 + 2\exp(v - \theta((\lambda - 1)/2)\Delta v)}. \quad (10c)$$

The values given in Equations (10a)–(10c) are the benchmark values against which we compare the effects of the appearance and disappearance of the decoys. Note that by construction, the shares of T and C are equal—that is, $T \sim C$. We summarize the results of these comparisons in Table 2.

Compromise Decoy (D_c). We consider a choice set that consists of $\{D_c, T, C\}$, such that $q_{D_c} > q_T > q_C$ and $p_{D_c} > p_T > p_C$, and we assume that both D_c and C are "equidistant" from T. In other words, in addition to the target and the competitor, we now have another option that makes the target a "compromise" choice. Two opposing forces come into play with the introduction of a compromise decoy. Without the decoy, the reference point is in the middle of T and C, whereas the introduction of the decoy shifts the reference point toward T. This causes the gain associated with the high quality of T to decrease but also makes the loss associated with its high price to go down. Loss aversion implies that the latter effect dominates the former, which leads to T being overall more attractive relative to the baseline. On the other hand, this movement of reference point makes C more attractive on the price dimension (leading to increase in the gain) while making it less attractive on the quality dimension (leading to increase in the loss). For C, because of loss aversion, the latter effect dominates the former and results in C becoming less attractive relative to the baseline. Since the T and C are equivalent in baseline (by construction), the overall effect is that T becomes more attractive relative to C, leading to the classic compromise effect. As can be seen in the appendix, T is also more attractive relative to the decoy that makes it a compromise option. Since T becomes more

Table 2 List of Hypotheses

Compared with baseline, the presence of:
- H1A: A compromise decoy decreases deferral (i.e., $d < b$).
- H1B: An asymmetrically dominated decoy decreases deferral (i.e., $f < b$).
- H1C: A superior decoy decreases deferral (i.e., $h < b$).

Compared with baseline, the presence of:
- H2A: A compromise decoy improves preference for target (i.e., $c > a$).
- H2B: An asymmetrically dominated decoy improves preference for target (i.e., $e > a$).
- H2C: A superior decoy worsens preference for competitor (i.e., $[1 - g - h] < [1 - a - b]$).

Compared with baseline, the disappearance of:
- H3A: A compromise decoy keeps the deferral below the baseline (i.e., $j < b$).
- H3B: An asymmetrically dominated decoy keeps the deferral below the baseline (i.e., $l < b$).
- H3C: A superior decoy raises the deferral above the baseline (i.e., $n > b$).

Compared with baseline, the disappearance of:
- H4A: A compromise decoy keeps the preference for target above the baseline (i.e., $i > a$).
- H4b: An asymmetrically dominated decoy keeps the preference for target above the baseline (i.e., $k > a$).
- H4C: A superior decoy lowers the preference for target below than the baseline (i.e., $m < a$).

Decoy condition	Choice of target	Deferral rate
Baseline (no decoy)	a	b
First choice (of two-stage with decoy)		
Compromise	c	d
Asymmetrically dominated	e	f
Superior	g	h
Second choice (of two-stage without decoy)		
Compromise	i	j
Asymmetrically dominated	k	l
Superior	m	n

Notes. Here, for example, $a \cong (1 - a - b)$. In other words, the choice share of the target and competitor is similar in the baseline condition. This is empirically established in pretests and confirmed in Studies 1, 2, and 3.

attractive relative to the baseline, it draws some of the consumers who might have otherwise deferred, reducing deferral, whereas the decreased appeal of C causes some of the consumers to defer resulting in increased deferral. The increase in attractiveness of the target dominates the decrease in attractiveness of the competitor, as the former is due to changes in the direction of the reference point (i.e., reduction in gain and reduction in loss) whereas the latter effect is due to changes away from the reference point (i.e., increase in gain and increase in loss). Because of diminishing return to scale of the value function in both gains and losses, changes in the direction of the reference point should have larger magnitudes than changes away from the reference point. The overall impact, therefore, is a reduction in deferral. We present this formally below.

Proposition 1 (P1). *The addition of a compromise decoy decreases deferral compared with the baseline condition.*

If one looks at P1 in isolation, one possible alternative explanation is that the deferral decrease could be simply driven by the fact that there is additional option in the choice set.[2] Although the deferral could indeed go down after the introduction of a third option in a choice set even without appealing to the context effect, our theory predicts that the key source of the deferral decrease is through enhanced appeal of the target. Indeed, as we explained, even if we do not take into account the decoy that makes T a compromise, our model still predicts a decrease in deferral (this is formally shown in Lemma 1 in the appendix)—a theory without incorporating context effect would not be able to explain this prediction. We detail in the empirical section later that, in all the studies, the deferral rate is below the baseline case even when we ignore the share of the decoy.

Asymmetrically Dominated Decoy (D_{ad}). We now consider a choice set that contains an asymmetrically dominated decoy in addition to the target and the competitor. Without loss of generality, we assume that the asymmetrically dominated decoy has the same quality level as the target but has a higher price ($p_T + d$), where $d > 0$. Introduction of D_{ad} changes the references points on both quality and price dimensions and subsequently affects the context effect, leading to changes in the market shares; D_{ad} increases the reference level on both the quality and price dimensions, leading to increase in individuals' preference for the target by strengthening their preference of an attribute on which the target clearly dominates the decoy (Dhar and Simonson 2003, Hedgcock et al. 2009, Pettibone and Wedell 2000). Instead of an ad hoc weight used in the past literature to capture this effect, our model allows us to parsimoniously capture this effect simply through the reference point formulation (see the appendix for details). The market shares of the three options (T, C, and D_{ad}) are calculated by plugging (5) into (6).

Again, two opposing effects come into play with the introduction of an asymmetrically dominated decoy. Specifically, the introduction of D_{ad} raises the reference level on quality dimension that decreases gain associated with higher quality for T while reducing the loss associated with the higher price because of increase in the reference level for price. Because of loss aversion, the latter effect dominates the former leading to an increase in the overall attractiveness of T. In a similar fashion, these two effects in conjunction decrease the attractiveness of the competitor relative to the baseline level. This results in the improvement of the share of the target relative to the competitor (replicating the attraction effect; see Huber et al. 1982). Furthermore, because of the diminishing return to scale of the value function, the increase in the share of T

[2] We are grateful to an anonymous reviewer for bringing this important point to our attention.

more than compensates the decrease in the share of C implying an overall decrease in the relative utility of the no-choice option, which results in less deferral.

Proposition 2 (P2). *The addition of an asymmetrically dominated decoy decreases deferral compared with the baseline condition.*

Note that the test of our theory for P2 relies on not just showing that there is a decrease in the deferral rate but also in simultaneously demonstrating that choice shares of T and C follow the patterns consistent with the model and that even after ignoring the (typically small) choice share taken by D_{ad} option, the deferral is still lower than the baseline. This is precisely what we do in our empirical analyses.

Superior Decoy (D_{sup}). Finally, we consider a decoy that has the same quality as the target but is priced lower—that is, a decoy that clearly dominates the target but not the competitor. The market shares of the three options are again obtained by (5) and (6). The analysis follows the same procedure as in the case of an asymmetrically dominated decoy except that the preference for the decoy is enhanced by the attribute on which it clearly dominates the target. The effect of the target comes into play via its effect on the reference point that consequently raises the context utility for the superior decoy. The introduction of a superior decoy adds an alternative that has higher utility than the target and, in addition, provides an increased context-based utility through a clearly dominating attribute. Thus, it takes shares away from both the no-choice option and the competitor. Similar to the analysis done for D_{ad}, the increase in the share of the D_{sup} more than compensates the decrease in the share of C, implying an overall decrease in the relative utility of the no-choice option, which results in less deferral.

Proposition 3 (P3). *The addition of a superior decoy decreases deferral compared with the baseline condition.*

Note that the result P3 holds even if the superior decoy has a vanishingly small advantage over T (that is, $d \to 0$) because of the context effect. In other words, the deferral decrease is not simply because choice set has a better alternative relative to T but is largely due to the reference effects through the addition of an option that clearly dominates another option.

Impact of the Disappearance of a Decoy on Deferral. Suppose that the decoys we consider become unavailable. Do the market shares return to the baseline level? What about the deferral? If not, what qualitative predictions can we make with regard to these in the second stage?

We hypothesize that when a decoy disappears, the reference point shifts back but only imperfectly toward the baseline level because of a "lingering effect." Kahneman and Tversky (1979) suggest that alternatives are evaluated relative to a reference point and that this reference point could correspond to the status quo, the alternatives in the choice set, or expectations. Consistent with this postulation, we suggest all of the alternatives in a choice set affect the reference point. When a second choice set is presented (in our case, when a decoy becomes unavailable), the alternatives in the second choice set affect the reference point, but the initial choice set is still salient and continues to exert influence on the reference point. This lingering effect is consistent with the argument in Strahilevitz and Loewenstein (1998) and Chen and Rao (2002) that the reference point shifts after an event occurs but the adaptation of the event into the new reference point is gradual and takes time. Arkes et al. (2008, 2010) rely on this notion of gradual reference point shift and directly estimate the degree of reference point shift in a stock market setting. The lingering effect is also consistent with the notion of hedonic adaptation whereby individuals gradually adapt to the occurrence of an event (Brickman et al. 1978, Frederick and Loewenstein 1999, Wilson and Gilbert 2005).

We define $0 < \psi < 1$ as a coefficient that indicates this lingering effect. The reference point after the disappearance of a decoy is given by

$$\begin{aligned} &v_{mR}(\{D_n, T, C\} - \{D_n\}) \\ &\quad = \psi v_{mR}(\{D_n, T, C\}) + (1-\psi) v_{mR}(\{T, C\}), \qquad (11) \end{aligned}$$

where $m \in \{q, p\}$ and $n \in \{c, ad, sup\}$, where the last three symbols represent compromise, asymmetrically dominated, and superior decoys, respectively.

When ψ is close to 1, complete lingering occurs; that is, the reference point does not reset at all. By contrast, when ψ is close to 0, the reference point adjusts completely back to the baseline condition. We hypothesize that in the decisions consumers make relatively quickly after the decoy's disappearance, ψ lies in the middle of this range as consumers gradually adapt to the disappearance of the decoy.

Disappearance of Compromise Decoy. The intuition for the effect of a compromise decoy becoming unavailable is relatively straightforward. The disappearance of the decoy makes the choice set the same as the original baseline condition with two options and thus results in an increase in the deferral rate *compared* with the condition with a decoy. Nevertheless, the decoy's lingering effect continues to shift the reference point toward T compared with the baseline condition, which still makes the target more attractive and the competitor less attractive than in the baseline condition. The combined effect, which reduces deferral when the decoy is available, lingers after the decoy disappears and continues to keep the deferral at a lower rate than in the baseline.

Proposition 4 (P4). *The disappearance of a compromise decoy increases deferral, but deferral remains lower than in the baseline condition.*

Disappearance of Asymmetrically Dominated Decoy. Previously, we showed how the presence of an asymmetrically dominated decoy enhances preference for the target. This improvement in preference lingers when the decoy becomes unavailable because of the imperfect adjustment of the reference point. Thus, although the disappearance of the decoy results in a decrease in the share of the target compared with the condition when it is available for selection, the share should still be above the baseline level; similarly, the deferral rate increases but should still be lower than in the baseline condition.

Proposition 5 (P5). *The disappearance of an asymmetrically dominated decoy increases deferral, but deferral remains lower than the baseline condition.*

Disappearance of Superior Decoy. Previously, we showed how a superior decoy shifts the reference point, causing the attractiveness of the competitor to diminish—an effect that continues to linger even after the decoy becomes unavailable. The effect on the target is more complex: On the one hand, the rise in the reference level on the quality and price dimensions as a result of the presence of D_{sup} lingers even after its disappearance, resulting in both the decreased gain on quality dimension and the decreased loss on price dimension that overall increases the utility of T relative to the baseline. On the other hand, the shifting-back of the reference point on the price dimension toward its original location mitigates the decrease in the loss identified in the first effect. This makes the overall utility of the target after the disappearance of D_{sup} ambiguous. But we hypothesize a "backlash effect" associated with the removal of D_{sup} that can easily be incorporated into the existing framework. This backlash effect arises as a result of the frustration engendered by the removal of the dominating decoy from the choice set.[3] A large enough backlash effect should result in an outcome wherein the preferences for T (relative to C) decreases after the removal of D_{sup}. With such a backlash effect, the deferral rate increases after the removal of D_{sup} relative to both the D_{sup} condition and the baseline (see the appendix for details). Intuitively, the frustration associated with the removal of the dominating option drives people toward the no-choice option. We can formally state our last testable proposition below.

Proposition 6 (P6). *The disappearance of a superior decoy increases deferral, and deferral becomes higher than in the baseline condition.*

[3] We are grateful to an anonymous reviewer for suggesting formalizing the backlash effect in our model.

Note that although our focus is on the impact of decoys and their removal on deferral rates, our model also allows us to generate predictions on the shares of target and competitor before and after the disappearance of the decoys. Many of these predictions are consistent with existing decision biases documented in the literature. For example, our model predicts an increase in the choice share of the target with the introduction of an asymmetrically dominated decoy or a compromise decoy, replicating the attraction effect (Huber et al. 1982) and the compromise effect (Simonson 1989), respectively. In addition, our model also makes novel predictions, e.g., concerning a repulsion effect of a superior decoy on the choice share of the target. For completeness, we summarize these predictions along with our focal predictions on choice deferral in the form of a series of testable hypotheses in Table 2. In the General Discussion, we discuss them in more detail, benchmarking our results against the existing literature.

Below we present four lab experiments designed to empirically test the model's predictions. We designed the conditions in the first two studies to determine whether observed preferences are in line with our model predictions, and the final two studies are intended to study the choice dynamics and provide process evidence in support of our model.

Study 1

Study 1 used a 4 (decoy: none, compromise, asymmetrically dominated, superior)×2 (order of options) full-factorial between-subjects design. The order of options was varied to avoid potential confounds. Order was not significant in any of our analyses, so we do not discuss it further.

Participants and Procedure

A total of 563 undergraduate students who were enrolled in introductory marketing classes participated in the study in exchange for course credit. This and all the following studies were part of hour-long lab sessions that also included other unrelated studies. Participants were asked to choose a six-pack of beer for a barbeque the following weekend. Beer is a frequently used stimulus in this literature. The six-packs were described with price and quality ratings.

Sample sizes were determined as follows: we designed our studies to be sensitive to 15-percentage-point shifts in preferences and deferral rates. We based these effect sizes on findings from the literature (e.g., Huber et al. 1982, Dhar and Simonson 2003). Given our study design, this meant we needed approximately 110 participants in our preference shift analyses. After accounting for predicted deferral rates (which reduced the number of participants in each preference analysis), our intended test cell sizes were between 130 and 160, depending on condition.

Table 3 **Study 1: Beer Options**

Alternative	Price/Six-pack ($)	Average quality rating (100 = best, 0 = worst)
Quality option (target)	6.50	74
Price option (competitor)	4.60	63
Compromise decoy	8.40	85
Asymmetrically dominated decoy	6.90	74
Superior decoy	6.20	82

In the baseline condition, participants made one decision between two alternatives and had an option to defer choice ("Don't buy from this store; visit another store"). One alternative had a better price ("price option"), and the other alternative had a better quality ranking ("quality option"). Participants in the decoy conditions made two decisions. The first decision was identical to the baseline condition except that an additional alternative, the decoy, was available for selection. After the first choice, participants were told that the decoy "was mistakenly not ordered and is unavailable to purchase at this time." They were then asked to choose again between the remaining two alternatives and deferral. Attribute values for all alternatives, listed in Table 3, were based on a pretest (also see Figure 1). Note that the second choice in all the decoy conditions had the same alternatives available for selection as in the baseline condition (quality option, price option, and purchase deferral). However, we predicted that the choice share of the focal options and deferral would differ per our model.

Results

We report four sets of results: initial deferral rates, initial choice, final deferral rates, and final choice. We summarize these results in Table 4.

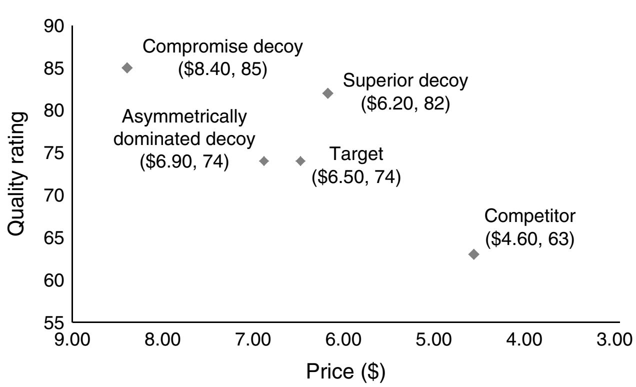
Initial Deferral (Decoy Available for Selection). Our model predicted that asymmetrically dominated, compromise, and superior decoys would decrease choice deferral compared with the baseline condition when no decoy was present. To test these predictions, we ran a multinomial logistic regression with choice deferral as the dependent variable and type of decoy and order of options as factors. The analysis revealed a significant main effect of decoy type ($\chi^2(3) = 20.17$, $p < 0.001$). Specifically, we found that participants were less likely to defer choice in the compromise (4.4%; $\chi^2(1) = 7.27$, $p < 0.01$), asymmetrically dominated (5.2%; $\chi^2(1) = 7.13$, $p < 0.01$), and superior (2.7%; $\chi^2(1) = 13.54$, $p < 0.001$) decoy conditions than in the baseline condition (15.7%). These results are consistent with H1A–H1C in Table 2.

Initial Choice (Decoy Available for Selection). According to the attraction effect and compromise effect, compromise and asymmetrically dominated decoys would increase choice share of the target compared with the baseline condition. Our results support these effects. Specifically, a multinomial logistic regression with the first choice as the dependent variable and type of decoy and order of options as factors revealed a significant main effect of decoy type ($\chi^2(2) = 39.64$, $p < 0.001$).[4] Specifically, we found that participants were more likely to choose the target in the compromise (91.4%; $\chi^2(1) = 25.39$, $p < 0.001$) and asymmetrically dominated (80.2%; $\chi^2(1) = 18.07$, $p < 0.001$) decoy conditions than in the baseline condition (54.0%). These results are consistent with H2A and H2B in Table 2.

We predicted that superior decoys would decrease the choice share of the competitor compared with the baseline. To test this prediction, we ran a logistic regression with the first choice as the dependent variable and type of decoy and order of options as factors. The analysis revealed that the competitor was less likely to be chosen in the superior decoy condition (11.3%; $\chi^2(1) = 39.22$, $p < 0.001$) than in the baseline condition (46.0%). These results are consistent with H2C in Table 2.

Final Deferral (Decoy Unavailable for Selection). Our model predicted that decoys would affect deferral even after they became unavailable for selection. Specifically, we predicted that asymmetrically dominated and compromise decoys would decrease choice deferral compared with the baseline condition even after the decoy became unavailable. By contrast, we predicted that the superior decoy would increase choice deferral compared with the baseline condition after the decoy became unavailable. To test these predictions, we ran a multinomial logistic regression with choice deferral as the dependent variable and type of decoy and order of options as factors. We found a

Figure 1 **Locations of Different Options (Study 1)**



[4] For this analysis, in all studies we removed the deferral and decoy choices because our predictions pertain to choice of the target relative to choices of the competitor. This is consistent with existing practice in the literature (e.g., Dhar and Simonson 2003, Study 2).

Table 4 **Results of Study 1**

	Choice						
	Competitor	Decoy	Target	Defer	Total	$T/T+C$ (%)	Deferral %
Baseline	52	N/A	61	21	134	54.0	15.7
First choice							
D_c	7	27	74	5	113	91.4	4.4
D_{ad}	25	1	101	7	134	80.2	5.2
D_{sup}	20	151	6	5	182	88.7[a]	2.7
Second choice							
D_c	14	N/A	82	17	113	85.4	15.0
D_{ad}	31	N/A	93	10	134	75.0	7.5
D_{sup}	64	N/A	44	74	182	40.7	40.7

Note. D_c = compromise decoy, D_{ad} = asymmetrically dominated decoy, D_{sup} = superior decoy, T = target, C = competitor, D = decoy.
[a]The decoy dominates the target. Therefore, this is calculated as $(T+D)/(T+C+D)$.

significant main effect for type of decoy ($\chi^2(3) = 59.55$, $p < 0.001$). Specifically, respondents were *less* likely to defer choice in the asymmetrically dominated decoy condition (7.5%; $\chi^2(1) = 4.28$, $p < 0.05$) and were *more* likely to defer choice in the superior decoy condition (40.7%; $\chi^2(1) = 21.47$, $p < 0.001$) than in the baseline condition (15.7%); these results are consistent with H3B and H3C in Table 2, respectively. However, there was no significant difference in deferral between the compromise decoy condition (15.0%; $\chi^2(1) = 0.19$, $p = 0.89$) and the baseline condition. This result failed to support H3A in Table 2.

Final Choice (Decoy Unavailable for Selection). Our model predicted that decoys would still affect choices after they became unavailable for selection. Specifically, we predicted that asymmetrically dominated and compromise decoys would increase choice share of the target compared with the baseline condition even after the decoy became unavailable. By contrast, we predicted that the superior decoy would decrease choice share of the target compared with the baseline condition after the decoy became unavailable. To test these predictions, we ran a multinomial regression with the final choice as the dependent variable and type of decoy and order of options as factors. The analysis revealed a significant main effect of decoy type ($\chi^2(3) = 57.67$, $p < 0.001$). Specifically, we found that participants were more likely to choose the target in the compromise (85.4%; $\chi^2(1) = 21.68$, $p < 0.001$) and asymmetrically dominated (75.0%; $\chi^2(1) = 11.20$, $p < 0.001$) decoy conditions than in the baseline condition (54.0%). By contrast, we found that participants were less likely to choose the target in the superior decoy condition (40.7%; $\chi^2(1) = 3.86$, $p < 0.05$) than in the baseline condition. These results are consistent with H4A–H4C in Table 2.

Discussion

The results from Study 1 are largely consistent with the predictions of our model. The three types of decoys affected deferral rates and choice shares in the predicted manner, and we observed the impact of the decoys even after the decoys became unavailable. Our results not only replicate the attraction effect and compromise effect but also provide empirical support for the novel predictions regarding deferral and choices after removal of the decoys.

Having obtained support for our predictions, we conducted another study to enhance the generalizability of our results. We used a choice scenario that involved a different product and provided more evidence for our model by adding a condition to our design that included a superior decoy that was immediately unavailable for selection (i.e., a "phantom"). As discussed earlier, prior research has established that phantoms produce an attraction effect, similar to the effect of asymmetrically dominated decoys (Doyle et al. 1999, Farquhar and Pratkanis 1993, Highhouse 1996, Pratkanis and Farquhar 1992); however, this research used a forced choice setting. According to our model, phantoms should have a different effect when participants have an option to defer. In particular, we suggest that phantoms have an effect on reference points similar to that of superior decoys that become unavailable but exert a lingering effect. Therefore, phantoms should also reduce the choice share of the target (i.e., yielding a repulsion effect instead of an attraction effect) and increase the deferral rate compared with a baseline condition. Demonstrating these effects of a phantom superior decoy provides additional evidence for our model.

Study 2

Study 2 used a 5 (decoy: none, compromise, asymmetrically dominated, superior, phantom superior) × 2 (order of options) full-factorial between-subjects design. Order of options was varied to avoid potential confounds. Order was not relevant to our hypotheses, so we do not discuss it further.

Table 5 Study 2: Camera Options

Alternative	Price ($)	Megapixels
Quality option (target)	162	12.0
Price option (competitor)	85	8.0
Compromise decoy	239	16.0
Asymmetrically dominated decoy	168	10.0
Superior decoy	160	14.0
Superior decoy immediately unavailable	160	14.0

Participants and Procedure

A total of 734 undergraduate students who were enrolled in introductory marketing classes participated in the study in exchange for course credit. Participants were asked to choose a point-and-shoot digital camera. Cameras were described with price and megapixels. Our method for determining sample sizes is detailed under the Participants and Procedure section in Study 1.

In the baseline condition, participants made one decision between two alternatives and had an option to defer choice ("Tell sales associate you want to see more options"). One alternative had a better price, and the other alternative had more megapixels. Participants in the compromise, asymmetrically dominated, and superior decoy conditions made two decisions. The first decision was identical to the baseline condition except that an additional alternative, the decoy, was available for selection. After the first choice, participants were told that the decoy "is unavailable to purchase at this time." They were then asked to choose again between the two remaining alternatives and deferral. In the phantom superior decoy condition, participants made only one decision between the two alternatives and the option to defer choice. These participants saw the attribute values for the superior decoy and were immediately told it was unavailable. Attribute values for all alternatives, listed in Table 5, were based on a pretest.

Results

Again, we report four sets of results: initial deferral rates, initial choice, final deferral rates, and final choice. We summarize these results in Table 6.

Initial Deferral (Decoy Available for Selection). Our model predicted that asymmetrically dominated, compromise, and superior decoys would decrease choice deferral compared with the baseline condition when no decoy was present. To test these predictions, we ran a multinomial logistic regression with choice deferral as the dependent variable and type of decoy and order of options as factors. The analysis revealed a significant main effect of decoy type ($\chi^2(3) = 10.99$, $p < 0.05$). Specifically, we found that participants were less likely to defer choice in the compromise (12.9%; $\chi^2(1) = 7.33$, $p < 0.01$), asymmetrically dominated (13.7%; $\chi^2(1) = 6.27$, $p < 0.05$), and superior (15.3%; $\chi^2(1) = 5.32$, $p < 0.05$) decoy conditions than in the baseline condition (25.8%). These findings are consistent with H1A–H1C in Table 2.

Initial Choice (Decoy Available for Selection). Supporting the attraction and compromise effects and replicating the results in Study 1, a multinomial logistic regression with the first choice as the dependent variable and type of decoy and order of options as factors revealed a significant main effect of decoy type ($\chi^2(2) = 40.06$, $p < 0.001$). Specifically, we found that participants were more likely to choose the target in the compromise (75.8%; $\chi^2(1) = 20.26$, $p < 0.001$) and asymmetrically dominated (81.5%; $\chi^2(1) = 30.28$, $p < 0.001$) decoy conditions than in the baseline condition (44.6%). These results are consistent with H2A and H2B in Table 2.

We predicted that superior decoys would decrease choice share of the competitor compared with the baseline condition when no decoy was present. To test this prediction, we ran a logistic regression with

Table 6 Results of Study 2

	Choice						
	Competitor	Decoy	Target	Defer	Total	$T/T+C$ (%)	Deferral %
Baseline	67	N/A	54	42	163	44.6	25.8
$D_{phantom\_sup}$	59	N/A	30	62	151	33.7	41.1
First choice							
D_c	23	20	72	17	132	75.8	12.9
D_{ad}	20	5	88	18	131	81.5	13.7
D_{sup}	34	88	11	24	157	74.4[a]	15.3
Second choice							
D_c	31	N/A	80	21	132	72.1	15.9
D_{ad}	21	N/A	87	23	131	80.6	17.6
D_{sup}	67	N/A	32	58	157	32.3	36.9

Note. $D_{phantom\_sup}$ = phantom superior decoy (one choice—decoy immediately unavailable), D_c = compromise decoy, D_{ad} = asymmetrically dominated decoy, D_{sup} = superior decoy, T = target, C = competitor, D = decoy.
[a]The decoy dominates the target. Therefore, this is calculated as $(T+D)/(T+C+D)$.

the first choice as the dependent variable and type of decoy and order of options as factors. We found that participants were less likely to choose the competitor in the superior decoy condition (25.6%; $\chi^2(1) = 23.44$, $p < 0.001$) than in the baseline condition (55.4%). These results are consistent with H2C in Table 2.

Final Deferral (Decoy Unavailable for Selection). We predicted that asymmetrically dominated and compromise decoys would decrease choice deferral compared with the baseline condition even after the decoy became unavailable. By contrast, we predicted that the superior decoy would increase choice deferral compared with the baseline condition after the decoy became unavailable or when the decoy was immediately unavailable. To test these predictions, we ran a multinomial logistic regression with choice deferral as the dependent variable and type of decoy and order of options as factors. The analysis revealed a significant main effect of decoy type ($\chi^2(4) = 36.49$, $p < 0.001$). Specifically, we found that participants were less likely to defer choice in the compromise (15.9%; $\chi^2(1) = 4.17$, $p < 0.05$) and asymmetrically dominated (17.6%; $\chi^2(1) = 2.80$, $p < 0.05$, one tailed) decoy conditions and more likely to defer choice in the superior (36.9%; $\chi^2(1) = 4.56$, $p < 0.05$) and phantom superior (41.1%; $\chi^2(1) = 8.12$, $p < 0.01$) decoy conditions than in the baseline condition (25.8%). These results are consistent with H3A–H3C in Table 2.

Final Choice (Decoy Unavailable for Selection). We predicted that asymmetrically dominated and compromise decoy conditions would increase choice share of the target compared with the baseline condition even after the decoy became unavailable for selection. By contrast, we predicted that the superior decoy condition would decrease choice share of the target compared with the baseline condition, regardless of whether the decoy became unavailable or was immediately unavailable. To test these predictions, we ran a multinomial regression with the final choice as the dependent variable and type of decoy and order of options as factors. The analysis revealed a significant main effect of decoy type ($\chi^2(4) = 86.49$, $p < 0.001$). Specifically, we found that participants were more likely to choose the target in the compromise (72.1%; $\chi^2(1) = 17.31$, $p < 0.001$) and asymmetrically dominated (80.6%; $\chi^2(1) = 28.94$, $p < 0.001$) decoy conditions than in the baseline condition (44.6%). By contrast, participants were less likely to choose the target in the superior (32.3%; $\chi^2(1) = 3.44$, $p < 0.05$, one tailed) and phantom superior (33.7%; $\chi^2(1) = 2.53$, $p = 0.055$, one tailed) decoy conditions than in the baseline condition. These results are consistent with H4A–H4C in Table 2.

Discussion
The results from Study 2 are consistent with our predictions and replicate the results from Study 1. Therefore, these results demonstrate that our model is robust across different product contexts. In addition, we show that our model can predict deferral and choices when a superior decoy is immediately unavailable (i.e., a phantom superior decoy). These results provide converging evidence for our model.

In the next study, we aim to replicate our earlier results and, more importantly, provide evidence for the proposed mechanism underlying the effects. Toward that goal, we measure each participant's reference point and loss aversion coefficient to demonstrate how choice and deferral are driven by shifts in reference points and the resultant changes in reference-dependent loss-averse utilities.

Study 3
Study 3 used three decoy conditions (decoy: none, asymmetrically dominated, superior) and two orders of process questions for the asymmetrically dominated and superior decoy conditions (order: after initial choice, after final choice). We focused on these two types of decoys because they are predicted to exert opposing effects on choice and deferral. For example, the superior decoy should increase initial deferral but decrease final deferral, whereas the asymmetrically dominated decoy should decrease both initial and final deferral. Therefore, focusing on these two types of decoys provides critical evidence for the proposed mechanism. Order of process questions did not significantly affect choice shares.

Participants and Procedure
A total of 799 participants from an online panel completed the study in exchange for $0.50. This sample size is similar to Study 2 (approximately 160 per condition). Participants were asked to choose a point-and-shoot digital camera. Attribute values for all alternatives, listed in Table 7, were adjusted from the values in Study 2 to account for changes in price and megapixels commonly found in retail outlets. In the no-decoy conditions, participants made one choice (i.e., target, competitor, or deferral). In the conditions with a decoy, participants made two choices, first with the decoy and then without it after being told that the decoy "was mistakenly not ordered and is unavailable to purchase at this time." We collected additional information from each participant to support our underlying process account that these choices are due to shifting reference points and loss aversion, as well as to check other possible accounts. These questions are described below.

Table 7 Study 3: Camera Options

Alternative	Price	Megapixels
Quality option (target)	$159	16.0
Price option (competitor)	$109	12.0
Asymmetrically dominated decoy	$165	14.0
Superior decoy	$155	18.0

Table 8 **Choice Results of Study 3**

	Choice						
	Competitor	Decoy	Target	Defer	Total	$T/T+C$ (%)	Deferral %
Baseline	55	N/A	66	29	150	54.5	19.3
First choice							
D_{ad} (1)	30	11	94	18	153	75.8	11.8
D_{ad} (2)	39	3	100	14	156	71.9	9.0
D_{ad}-total	69	14	194	32	309	73.8	10.4
D_{sup} (1)	37	93	12	16	158	73.9	10.1
D_{sup} (2)	33	98	5	17	153	75.7	11.1
D_{sup}-total	70	191	17	33	311	74.8[a]	10.6
Second choice							
D_{ad} (1)	53	N/A	82	18	153	60.7	11.8
D_{ad} (2)	43	N/A	97	17	156	69.1	10.9
D_{ad}-total	96	N/A	178	35	309	65.0	11.3
D_{sup} (1)	65	N/A	44	49	158	40.4	31.0
D_{sup} (2)	52	N/A	46	55	153	46.9	35.9
D_{sup}-total	117	N/A	90	104	311	43.5	33.4

Notes. D_{ad} = asymmetrically dominated decoy, D_{sup} = superior decoy, T = target, C = competitor, D = decoy. "(1)" denotes the condition where the process measures appeared after the initial decision; "(2)" denotes the condition where process measures appeared after the final decision.
[a]The decoy dominates the target. Therefore, this is calculated as $(T+D)/(T+C+D)$.

Choice and Deferral. The results are summarized in Table 8, and they replicate those of Studies 1 and 2.[5] Specifically, the type of decoy had a significant main effect on initial deferral ($\chi^2(2) = 7.99$, $p = 0.018$), such that participants are less likely to defer choice in the asymmetrically dominated (10.4%; $\chi^2(1) = 6.86$, $p = 0.009$) and superior (10.6%; $\chi^2(1) = 6.44$, $p = 0.011$) decoy conditions than in the baseline condition (19.3%). In addition, participants were more likely to choose the target when the asymmetrically dominated decoy was present (73.8% > 54.5%; $\chi^2(1) = 13.68$, $p < 0.001$), and they were less likely to choose the competitor when the superior decoy was present (25.2% < 45.5%; $\chi^2(1) = 15.68$, $p < 0.001$) than in the baseline condition. Furthermore, there was a significant main effect of decoy type on final deferral ($\chi^2(2) = 45.87$, $p < 0.001$), such that participants were less likely to defer choice after the asymmetrically dominated decoy disappeared (11.3%; $\chi^2(1) = 5.28$, $p = 0.022$) but more likely to defer choice after the superior decoy disappeared (33.4%; $\chi^2(1) = 9.58$, $p = 0.002$) than in the baseline condition (19.3%). Finally, there was a significant main effect of decoy type on final choice ($\chi^2(2) = 22.20$, $p < 0.001$), such that participants were more likely to choose the target after the asymmetrically dominated decoy disappeared (65.0% > 54.5%; $\chi^2(1) = 3.84$, $p = 0.050$) but less likely to choose the target after the superior decoy disappeared (43.5% < 54.5%; $\chi^2(1) = 3.73$, $p = 0.054$) than in the baseline condition. These results replicate those of Studies 1 and 2 and are consistent with our predictions.

[5] The analyses drops 29 participants (3.6%) because their response to our process questions (i.e., expected price and expected megapixels) was more than three standard deviations from the mean response. All p-values remain significant whether or not these participants are included.

Process Evidence. To test the proposed mechanism, we measured reference point and loss aversion to construct a utility function of each available option for each participant. To check other possible accounts, we drew upon previous research and also measured perceived importance of price and of quality, the ease to justify choices, and the amount of negative emotion and cognitive difficulty in making the choice (e.g., Luce 1998, Hedgcock et al. 2009).

To measure reference point, we followed Arkes et al. (2010, 2008) and Baucells et al. (2011) and asked participants to indicate the price and megapixels that would make them "neither happy nor unhappy" in purchasing a point-and-shoot digital camera. Specifically, we asked, "In purchasing a point and shoot digital camera, what price and megapixels would make you neither happy nor unhappy? In other words, what would be your expected price and your expected number of megapixels for a point-and-shoot digital camera?"

We borrowed the lottery task from Gächter et al. (2010) to measure each participant's loss aversion tendency. Participants were asked whether they would play each of six gambles such that they would lose between \$2 and \$7 if a coin flip shows head and win \$6 if it shows tails. Each participant's loss aversion tendency was then estimated (see Table 1, column 4 of Gächter et al.). The loss aversion coefficient ranged between 0.79 and 2.49, and it has a mean of 1.70 and a median of 1.72, suggesting an overall tendency of loss aversion.

Expected price was higher in the superior and asymmetrically dominated decoy conditions than in the control; it was significant in the two asymmetrically dominated conditions (\$140.15 > \$130.67, $p = 0.032$ and \$140.23 > \$130.67, $p = 0.029$) and marginally significant in the superior decoy condition where it was measured after the initial choice (\$138.59 > \$130.67, $p = 0.072$) but not significant when it was measured after the final choice (\$136.61 > \$130.67, $p = 0.175$). Expected megapixels were higher in the superior and asymmetrically dominated decoy conditions than in the control but only significantly so in the two superior decoy conditions ($15.48 > 14.29$, $p = 0.001$; $15.39 > 14.29$, $p = 0.002$) but not in the two asymmetrically dominated decoy conditions ($14.55 > 14.29$, $p = 0.478$ and $14.36 > 14.29$, $p = 0.850$). These results are consistent with our argument about the reference point shift, as the asymmetrically dominated decoy has the highest price among all options and should move the reference point on the price dimension the most, and the superior decoy has the highest quality among all options and should move the reference point on the quality dimension the most.

For each participant, we then constructed a reference-dependent, loss-averse utility function for each option:

$$u_{ij} = \lambda_j^{1(\text{quality}_i < \text{quality}_j)} (\text{quality}_i - \text{quality}_j)^{\alpha^{1-1(\cdot)}\beta^{1(\cdot)}} + \lambda_j^{1(\text{price}_j < \text{price}_i)} (\text{price}_j - \text{price}_i)^{\alpha^{1-1(\cdot)}\beta^{1(\cdot)}},$$

where

i = target, competitor, or decoy;
j = participant;
quality_j = each participant's reference point for quality, i.e., the expected quality;
price_j = each participant's reference point for price, i.e., the expected price;
$\alpha = 2/3$ and $\beta = 3/4$; these are the parameters that give the utility function its curvatures in the domains of gains and losses respectively (Tversky and Kahneman 1992);
λ_j = each participant's loss aversion parameter; and
$1(\cdot)$ = an indicator function that takes the value of 1 when relationship in the parentheses is true.

This captures the utility derived from each option, per prospect theory's value function (Kahneman and Tversky 1979).

For each participant, we then constructed two measures: (1) the difference in utility between the dominating option that is available and the competitor and (2) the total utility of these options. For example, in the superior decoy condition where the process measure appeared after the initial choice, the first measure was the difference in utility between the superior decoy and the competitor, and the second measure is the total utility of the decoy and the competitor. (The utility of the target is not included in the measures, because it is dominated by the decoy, consistent with our model.) For all the other conditions, the first measure was the difference in utility between the target and the competitor, and the second of measure was the total utility of the same two options. This is because either a dominating (i.e., superior) decoy was not available (for the final choice in the superior decoy condition) or the target was the dominating option (over decoy, as in the asymmetrically dominated decoy condition).

We expect that the choice of the target versus the competitor should be mediated by the difference in utility, and the deferral should be mediated by the total utility. We relied on the bootstrapping analysis (Hayes 2013, Zhao et al. 2010) to test these mediation effects.

Superior Decoy. Recall that we predict and find that the superior decoy decreases initial deferral but its disappearance increases final deferral. In other words, the effect of the superior decoy should be negative on initial deferral but positive on final deferral. To examine the underlying mechanism for these effects, we conduct mediation analysis for initial and final deferral separately in the superior decoy conditions, using the process measures that appeared immediately after each choice as the mediator.

As expected, the presence of the superior decoy increased total utility ($a = 1.1259$, $p = 0.0005$), which decreased initial deferral ($b = -0.1200$, $p = 0.0294$). The indirect effect had a 95% confidence interval that excluded zero (-0.3430, -0.0120), and the direct effect was insignificant ($c = -0.5494$, $p = 0.1004$). Therefore, initial deferral in the superior decoy condition was fully mediated by total utility.

The disappearance of the superior decoy decreased total utility ($a = -0.4961$, $p = 0.0590$), and total utility contributed negatively to final deferral ($b = -0.2866$, $p = 0.0000$); the 95% confidence interval for the indirect effect excluded zero (0.0019, 0.3380), and the direct effect was in the same direction and marginally significant ($c = 0.5329$, $p = 0.0578$). Therefore, final deferral in the superior decoy condition was partially mediated by total utility.

Similarly, the presence of the superior decoy increased difference in utility ($a = 1.6412$, $p = 0.0000$), which decreased choice of the competitor ($b = -0.4186$, $p = 0.0043$). The indirect effect had a 95% confidence interval that excluded zero (-1.4141, -0.2274), and the direct effect was insignificant ($c = -0.2553$, $p = 0.4706$). Therefore, initial choice of the competitor was fully mediated by difference in utility.

However, final choice was *not* mediated by difference in utility. The disappearance of the superior decoy decreased difference in utility as expected but the effect was not significant ($a = -0.0320$, $p = 0.7458$), and difference in utility contributed positively to final choice of target as expected ($b = 1.5770$, $p = 0.0000$); the 95% confidence interval for the indirect effect included zero (−0.3827, 0.2585), and the direct effect was significant ($c = -0.6581$, $p = 0.0287$). Therefore, final choice in the superior decoy condition was *not* mediated by difference in utility.

Asymmetrically Dominated Decoy. In the asymmetrically dominated decoy conditions, since our predictions on choice and deferral were in the same directions between initial and final decisions, the underlying mechanism should also work in the same directions. Therefore, for statistical power we analyzed initial and final deferral together. We included a dummy variable to control for potential effects of the location of the process measures. Separate analyses of the two periods yields similar results.

The asymmetrically dominated decoy increased total utility ($a = 0.5375$, $p = 0.0553$), which decreased deferral ($b = -0.1294$, $p = 0.0111$). The indirect effect had a 95% confidence interval that excluded zero (−0.2202, −0.0016), and the direct effect was marginally significant ($c = -0.6192$, $p = 0.0628$). Therefore, deferral in the asymmetrically dominated decoy condition was partially mediated by total utility. In addition, the asymmetrically dominated decoy increased difference in utility ($a = 0.2175$, $p = 0.0309$), which increased the choice of the target ($b = 1.4578$, $p = 0.0000$). The indirect effect had a 95% confidence interval that excluded zero (0.0496, 0.6344), and the direct effect was insignificant ($c = 0.4433$, $p = 0.1250$). Therefore, choice in the asymmetrically dominated decoy condition was fully mediated by difference in utility.

Of note, similar analyses using perceived importance of quality over price, ease of justification, negative emotion, and cognitive difficulty in making the choices showed that they did not mediate deferral or choice in all cases but one (with 90% confidence intervals all including 0; i.e., $p > 0.10$). The exception was the mediation effect of quality (versus price) importance on the final choice of the target in the superior decoy condition. Specifically, quality (versus price) was perceived to be less important than in the control condition ($a = -0.7648$, $p = 0.0404$), and the quality (versus price) importance contributed positively to the choice of target ($b = 0.7188$, $p = 0.0000$). The indirect path had a 95% confidence interval excluding zero (−1.2089, −0.0280), and the direct effect was insignificant ($c = -0.3934$, $p = 0.2269$). Therefore, final choice in the superior decoy condition was fully mediated by perceived importance of quality over price. In other words, the disappearance of the superior decoy may have led participants to downgrade the perceived importance of quality (versus price), on which the decoy exceled, thereby reducing the attractiveness of the target that offered better quality over the competitor.

To quickly summarize, the mediation results are largely supportive of our proposed mechanism based on reference point shift. The evidence is obtained by using utility constructed from individual reference price and quality and loss aversion from each participant. The results demonstrate that participants' reference points moved in the expected directions with the introduction and disappearance of a decoy, and that the decoy's effects on participants' choice and deferral are largely driven by difference in utility and total utility respectively. These results are consistent with the proposed mechanism based on the reference point shift and loss aversion. However, the mediation effect of perceived importance of quality and price in one case and the existence of multiple, (marginally) significant direct effects suggest the possible existence of omitted mediators (Zhao et al. 2010), hinting at other underlying mechanisms at play.

As further evidence for the proposed mechanism, we examined the dynamics of participants' choices across the two stages. Recall that the model predictions for the final deferral rates relied on the lingering effects of reference point shifts. Because the participants who exhibited the greatest shift in reference point were likely to experience a stronger lingering effect, they should be more likely to demonstrate the predicted changes in deferral rate than other participants. To test this, we used participants' initial choice as a proxy for their reference point shift. For example, in the condition with the asymmetrically dominated decoy, shifting the reference point in the direction of the decoy should lead to a choice of the target. Therefore, we assume that participants who picked the target in their initial choice should have shifted their reference point more and should subsequently exhibit a stronger lingering effect than other participants. Under this assumption, we predict that the participants who picked the target in their initial choice in the asymmetrically dominated decoy condition should show the predicted decrease in the deferral rate in their final choice to a greater extent than those who picked other options in their initial choice. Indeed, this is what we found in Studies 1–3.[6]

[6] Specifically, in the asymmetrically dominated decoy condition, only participants who picked the target in their initial choice were less likely to defer in their final choice than those in the baseline condition (3.0% versus 15.7%, $\chi^2(1) = 10.13$, $p < 0.01$ in Study 1; 4.5% versus 25.8%, $\chi^2(1) = 17.19$, $p < 0.001$ in Study 2; 4.6% versus 19.3%, $\chi^2(1) = 18.58$, $p < 0.001$ in Study 3); participants who picked other options in their initial choice were as likely to defer as, or more likely to defer than, those in the baseline condition in their final choice (21.2% versus 15.7%, $\chi^2(1) = 0.58$, $p = 0.45$ in Study 1; 44.2% versus 25.8%, $\chi^2(1) = 5.54$, $p < 0.05$ in Study 2; 12.2% versus 19.3%, $\chi^2(1) = 2.46$, $p = 0.12$ in Study 3). Similarly, in the compromise decoy condition, only participants who picked the target in their initial choice were less likely to defer in their final choice than those in the baseline condition (1.4% versus 15.7%, $\chi^2(1) = 10.34$, $p < 0.01$ in Study 1; 4.2% versus 25.8%, $\chi^2(1) = 15.05$, $p < 0.001$ in Study 2);

In the next study, we provide more direct evidence for the choice dynamics using a within-subjects design.

Study 4

Although most of the existing studies on decoy and choice deferral (including Studies 1-3 here) used a between-subjects design to better understand the choice dynamics and underlying process, we conducted our final study using a within-subjects design. A total of 216 undergraduate students who were enrolled in an introductory marketing class participated in the study in exchange for course credit. The stimuli are identical to those in Study 3. Participants first made a choice between the target and competitor, with the option to defer. A week later, the same group of participants made two choices, first with the additional option of a superior or asymmetrically dominated decoy and then without the decoy. On both occasions, the focal stimuli were interspersed among questions of unrelated studies. Therefore, the study was a 2 (decoy: superior, asymmetrically dominated) $\times$ 3 (timing: no decoy, with decoy, after decoy disappeared) mixed design, with the first factor as a between-subjects factor and the second as a within-subjects factor. To account for the within-subjects nature of this study, we used random effect models to analyze the choice and deferral patterns over time.

Results

Overall, 41% of the 216 participants chose the target, 36% chose the competitor and 23% chose to defer at time 1. Of the 104 participants in the superior decoy condition, 38% chose the target, 41% chose the competitor, and 21% deferred at time 1. At time 2 when the superior decoy was available, 6% picked the target, 56% chose the superior decoy, 28% chose the competitor, and 11% deferred. At time 3 when the superior decoy disappeared, 20% chose the target, 51% chose the competitor, and 29% deferred. Therefore, the data seem consistent with our predictions that with the presence and disappearance of a superior decoy the choice share of the competitor first decreases (from 41% to 28%) and then increases (to 51%), and the deferral rate first decreases and then increases (from 21% to 11% and then to 29%). The results are summarized in the top panel of Figure 2.[7]

Of the 112 participants in the asymmetrically dominated decoy condition, 45% chose the target, 30% chose the competitor, and 25% deferred at time 1.[8] At time 2 when the decoy was available, 76% picked the target, 17% chose the competitor, and 7% deferred. At time 3 when the decoy disappeared, 70% chose the target, 24% chose the competitor, and 9% deferred. Therefore, the data seem consistent with our predictions that with the presence and disappearance of an asymmetrically dominated decoy the choice share of the target increases (from 45% to 76%) and stayed high (at 75%), and the deferral rate decreases (from 25% to 7%) and stays low (at 9%). The results are summarized in the bottom panel of Figure 2.

To formally test our predictions, a random effect model was used, which revealed a significant effect of timing ($p < 0.05$), a significant effect of decoy type ($p < 0.001$), and a significant interaction effect between timing and decoy type ($p < 0.001$) on the choice of the target versus the competitor. Planned contrasts of the significant interaction effect revealed that in the superior decoy condition the choice share of the competitor was lower at time 2 than at time 1 (31.6% < 52.4%, $p < 0.001$) but higher at time 3 than at time 1 (71.6% > 52.4%, $p = 0.015$). In the asymmetrically dominated decoy condition, the choice share of the target was higher at times 2 and 3 than at time 1 (81.7% > 59.5%, $p = 0.001$ and 73.5% > 59.5%, $p = 0.049$, respectively).

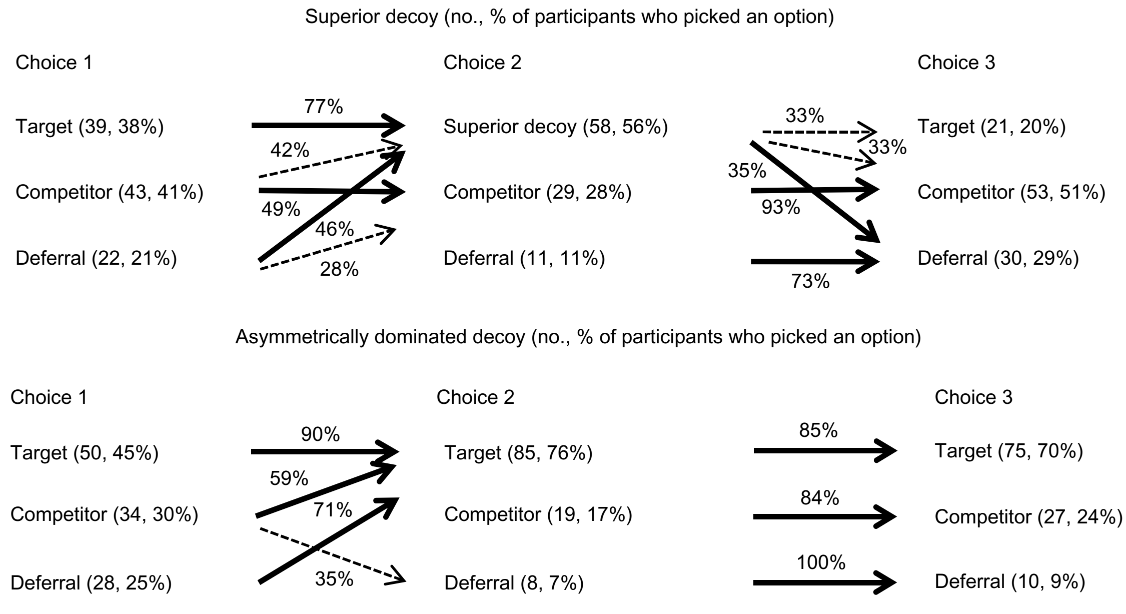
A similar analysis revealed a significant effect of timing ($p < 0.001$), a marginally significant effect of decoy type ($p = 0.065$), and a significant interaction effect between timing and decoy type ($p < 0.01$) on deferral. Planned contrasts revealed that in the superior decoy condition the deferral rate was lower at time 2 than at time 1 (10.6% < 21.1%, $p = 0.029$) but higher at time 3 than at time 1 (28.8% < 21.1%, $p = 0.084$, one tailed). In the asymmetrically dominated decoy condition, the deferral rate was lower at times 2 and 3 than at time 1 (7.1% < 25.0%, $p < 0.001$ and 8.9% < 25%, $p = 0.001$, respectively). These results are supportive of our predictions using a within-subjects design.

participants who picked other options in their initial choice were more likely to defer than, or as likely to defer as, those in the baseline condition in their final choice (41.0% versus 15.7%, $\chi^2(1) = 11.55$, $p < 0.01$ in Study 1; 30.0% versus 25.8%, $\chi^2(1) = 0.40$, $p = 0.53$ in Study 2). Finally, in the superior decoy condition, only participants who picked the decoy in their initial choice were more likely to defer in their final choice than those in the baseline condition (45.0% versus 15.7%, $\chi^2(1) = 28.50$, $p < 0.001$ in Study 1; 43.2% versus 25.8%, $\chi^2(1) = 7.98$, $p < 0.01$ in Study 2; 40.3% > 19.3%, $\chi^2(1) = 17.31$, $p < 0.001$ in Study 3); participants who picked other options in their initial choice were as likely to defer in their final choice as those in the baseline condition (19.4% versus 15.7%, $\chi^2(1) = 0.25$, $p = 0.62$ in Study 1; 29.0% versus 25.8%, $\chi^2(1) = 0.26$, $p = 0.61$ in Study 2; 22.5% versus 19.3%, $\chi^2(1) = 0.41$, $p = 0.52$ in Study 3).

[7] Out of the six participants who chose the dominated target in the superior decoy condition at time 2, two of them chose the target at time 1 as well. Their choice of the dominated option at time 2 may thus be justified for these participants as sticking to their initial choice (i.e., the target). For the other four participants, their choice of the dominated target is most likely the result of inattention.

[8] Since participants were assigned to the superior or asymmetrically dominated decoy conditions only at time 2, the choice patterns should not differ between the two conditions at time 1. It did not ($p > 0.10$). Combining the two conditions, the choice shares of the target and the competitor were similar (41% versus 36%, $p > 0.10$).

Figure 2 **Choice Dynamics in Study 4**



- *N* = 104 for superior decoy; *N* = 112 for asymmetrically dominated decoy.
- To reduce clutter, the target dominated by the superior decoy (in the top figure) and the asymmetrically dominated decoy dominated by the target (in the bottom figure) are not included at the time of choice 2. They were chosen by six and zero participants, respectively.
- Solid lines indicate the most popular paths; dotted lines indicate other popular paths.

Figure 2 visually demonstrates the choice dynamics. To reduce clutter, we highlight the most popular paths (solid lines). For example, among participants who picked the target in the superior decoy condition at time 1, the largest percentage (77%) shifted to the decoy at time 2. In cases where the most popular path is less than 50%, we also included other popular paths (dotted line). For example, among participants who picked the competitor in the superior decoy condition at time 2, most of them (49%) stayed with the competitor, but a large proportion (42%) shifted to the superior decoy.

As Figure 2 shows, in the superior decoy condition a large proportion of the participants migrated from the target, the competitor and deferral at time 1 toward the superior decoy at time 2, and from the superior decoy at time 2 to deferral at time 3. Therefore, the introduction of the superior decoy seems to have attracted participants toward the decoy, and the disappearance of the decoy drives them to deferral. Figure 2 also shows that the introduction of the asymmetrically dominated decoy seems to have attracted participants toward the target, and those participants tend to stay with the target even after the decoy is removed. These results provide evidence for the patterns in individual choice dynamics that are consistent with our theory.

General Discussion

Choice deferral is an important but understudied topic in marketing. This research helps fill this gap by demonstrating how decoys and prior choices affect choice deferral and preferences. We provide a model to describe choice and deferral behaviors when decoys are present in a dynamic choice setting. We use a two-stage process that models both choice deferral and the preferences of alternatives. Our parsimonious reference point model is able to predict novel behaviors that have not been discussed previously, in addition to replicating and extending prior findings, such as the attraction effect (Huber et al. 1982) and compromise effect (Simonson 1989), in choice settings that include the option to defer. Results from four studies are supportive of our model predictions and provide preliminary evidence for the proposed mechanism. Table 9 summarizes our predictions and results from our studies benchmarked against findings from extant literature. Below we highlight our novel findings and their implications.

Theoretical Contributions

Novel, experimentally confirmed behaviors for initial choice deferral include (1) compromise decoys reduce choice deferral; (2) superior, available decoys reduce deferral; and (3) superior, immediately unavailable decoys increase deferral. One novel behavior for the initial choice bias is that superior, immediately unavailable decoys decrease the choice of the target when choice deferral is an option. Though in agreement with prior research (e.g., Min et al. 2006), this result

Table 9 Benchmarking Current Findings Against the Literature

Model predictions	Study 1	Study 2	Study 3	Study 4	Examples of related findings
Initial deferral (decoy available except $D_{phantom\_sup}$)					
D_c decreases deferral	✓	✓	Not tested	Not tested	*New finding – 1*
D_{ad} decreases deferral	✓	✓	✓	✓	**2**, *3*, *4*
D_{sup} decreases deferral	✓	✓	✓	✓	*New finding*
$D_{phantom\_sup}$ increasing deferral	Not tested	✓	Not tested	Not tested	*New finding – 5*
Final deferral (decoy unavailable)					
D_c decreases deferral	n.s.	✓	Not tested	Not tested	*New finding – 6*
D_{ad} decreases deferral	✓	✓	✓	✓	*New finding*
D_{sup} increases deferral	✓	✓	✓	✓	*New finding*
Initial choice (decoy available except $D_{phantom\_sup}$)					
D_c increases choice of T	✓	✓	Not tested	Not tested	*7*, **8**
D_{ad} increases choice of T	✓	✓	✓	✓	**9**, *10*
D_{sup} decreases choice of C	✓	✓	✓	✓	**9**, *10*
$D_{phantom\_sup}$ decreases choice of T	Not tested	✓	Not tested	Not tested	*New finding – 11*, *12*
Final choice (decoy unavailable)					
D_c increases choice of T	✓	✓	Not tested	Not tested	*14*, *15*
D_{ad} increases choice of T	✓	✓	✓	✓	*16*, *17*
D_{sup} decreases choice of T	✓	✓	✓	✓	*New finding – 18*

Notes. D_{ad} = asymmetrically dominated decoy, D_c = compromise decoy, D_{sup} = superior decoy, $D_{phantom\_sup}$ = phantom superior decoy, T = target, C = competitor. Citations in bold have experimental designs that are conceptually similar to ours; citations in italics differ from ours.

[1]Dhar and Simonson (2003): compromise decoy decreases deferral, though results are not analyzed and appear statistically nonsignificant.

[2]Dhar and Simonson (2003): deferral decreases with the introduction of an asymmetrically dominated alternative.

[3]Dhar (1997a): deferral decreases with the introduction of a dominated alternative. However, the baseline choice set only had one alternative.

[4]Tversky and Shafir (1992): deferral decreases when one of the alternatives in a two-item choice set dominated the other versus when neither item dominated the other.

[5]Ge et al. (2009): deferral decreases when a sold-out alternative is presented in a choice set when compared with a baseline condition with only one alternative.

[6]Dhar and Simonson (2003): deferral increases after an initial stage that had a forced choice when compared with a single-stage decision that allowed deferral. Our task is different in that both choice stages allow deferral.

[7]Simonson (1989): choice of target increases with the introduction of a compromise decoy but no option to defer choice.

[8]Dhar and Simonson (2003): the compromise effect was weaker with the introduction of a no-choice option.

[9]Dhar and Simonson (2003): the attraction effect increased with the introduction of a no-choice option.

[10]Huber et al. (1982): choice of target increases with the introduction of an asymmetrically dominated decoy but no option to defer choice.

[11]Min et al. (2006): phantom superior decoys decrease choice of the target but no option to defer choice.

[12]Highhouse (1996): phantom superior decoys increase choice of the target but no option to defer choice.

[13]Pettibone and Wedell (2000): phantom superior decoys increase choice of the target but no option to defer choice.

[14]Hedgcock et al. (2009): exit of a compromise decoy increases the choice of the target but no option to defer choice.

[15]Dhar and Simonson (2003): choice share of the target decreases after an initial stage that had a forced choice. Our task is different in that both choice stages allow deferral.

[16]Hedgcock et al. (2009): exit of an asymmetrically dominated decoy increases the choice of the target but no option to defer choice.

[17]Doyle et al. (1999): asymmetrically dominated decoy that is immediately unavailable increases choice of the target. However, the studies had one decision, whereas our studies have an initial choice followed by another choice after the decoy became unavailable.

[18]Hedgcock et al. (2009): exit of a superior decoy increases the choice of the target but no option to defer choice.

is in contrast with the attraction effect that others document (Doyle et al. 1999, Farquhar and Pratkanis 1993, Highhouse 1996, Pratkanis and Farquhar 1992). This shows the importance of including choice deferral *and* choice bias in a unified model. Further research should examine how forced choice and deferral interact with a phantom decoy to affect consumer preferences.

Novel behaviors for choice bias when a decoy becomes unavailable include the following: (1) compromise decoys reduce choice deferral, (2) asymmetrically dominated decoys reduce deferral, and (3) superior decoys that become unavailable increase deferral. Furthermore, we find that the exit of a superior decoy causes a repulsion effect such that the exit decreases the choice share of the target. This seems to contradict the findings of Hedgcock et al. (2009), who show that the exit of a superior decoy increases the choice share of the target. Again, the contradictory results may be reconciled by noting that they did not include a deferral option in the choice set. Specifically, they found that most of the people who picked the superior decoy in the initial stage migrated to the target after the decoy disappeared, whereas we find that people who picked the superior decoy in the initial stage were more likely to defer after the decoy disappeared.

Although our results in support of H1A–H1C are consistent with the existence of an extra option available in the choice set, the proposed model provides a parsimonious explanation of the effects of the appearance and disappearance of a decoy on choice and deferral. For example, in the case of a compromise decoy and an asymmetrically dominated decoy, the appearance of the decoy is predicted to increase the choice share of the target. Without the predicted context effects, adding another option should not increase the choice share of the target. As another example, the effects on choice and deferral after the disappearance of a decoy cannot be explained by the number of options in the choice set, as there is the same number of options in these conditions as in the control condition (i.e., two).

To similar effects, if we ignore the (choice of) decoy, we still find the predicted effects in support of H1A–H1C in our studies. For example, if we ignore participants who picked decoy in Study 1, the initial deferral rate was 5.8%, 5.3%, and 2.8% for D_c, D_{ad}, and D_{sup}, respectively (see Table 4), which were all significantly smaller than the deferral rate in the control condition, 15.7% ($z = 2.11$, 2.78, and 4.03, respectively, $p < 0.05$). Similarly, in Study 2, when we ignore participants who picked decoy the initial deferral rate was 15.2%, 14.1%, and 16.4% for D_c, D_{ad}, and D_{sup}, respectively (see Table 6), which were all significantly smaller than the deferral rate in the control condition, 25.8% ($z = 2.10$, 2.45, 2.00, respectively, $p < 0.05$). In Study 3, when we ignore participants who picked decoy the initial deferral rate was 11% for both D_{ad} and D_{sup}, smaller than in the control condition, 19% ($z = 2.46$, 2.33, respectively, $p < 0.05$). Thus, the results in support of H1A–H1C do not seem to be driven entirely by having an extra option in the choice set. This is consistent with our argument that consumers' ability to detect and reject a dominated option (i.e., R) is likely high in our empirical setting, allowing us to focus on the effect of reference point shift (versus changes in the number of options) on deferral. Finally, the converging process evidence in favor of our theory in Studies 3 and 4 is largely supportive of the working of our model.

Managerial Implications

Many real-life purchase situations possess the three key characteristics we examine the presence of decoys, the option to defer a choice, and choice dynamics (i.e., prior decisions and the presence and disappearance of available alternatives). Therefore, our results could offer practical insights for managers who wish to understand individuals' choice biases and preferences for choice deferral. With the abundance of alternatives available online or in a typical grocery store, decoys pervade many decisions that people make. Consumers may also use products or brands they have previously purchased or are purchased by socially relevant others as phantom decoys. In addition, the entry and exit of these alternatives can be all too common. New options may appear during a decision process in real time, as is frequently the case for online purchases and large-item purchases that span a considerable period of time, such as cars and houses. During the decision process, options may also disappear from being out of stock (Fitzsimons 2000, Kramer and Carroll 2009), from being withdrawn, or for other reasons (Hedgcock et al. 2009). Our model and results can help inform managers of the impact of these contextual factors on choice deferral and decision biases.

Limitations and Future Research Directions

Our operationalization of the context effects is a terse one that has advantages and disadvantages. A richer cover story could have improved the external validity of our studies, but it could have also introduced confounds. For example, using "sold-out" as a cover story for the disappearance of a decoy could signal product popularity (Ge et al. 2009), which would introduce an extraneous factor outside of the scope of our study. Similarly, there is a recent debate surrounding whether the presence and magnitude of attraction effects depend on the market realism of the studies (Frederick et al. 2014, Huber et al. 2014, Simonson 2014). Although our terse operationalization provides a good setup to test context effects by, for example, making the dominance relationship easily observable (Huber et al. 2014), testing the generalizability of our results would be an important issue to investigate in future research. In our model, R captures the ease of detecting the dominance relationship: When R is large, the dominance is easily detected and the dominated option is rarely chosen. When R is small, the dominated option takes on a sizable choice share, which could mitigate the attraction effect. This is consistent with the argument of Huber et al. (2014) and Simonson (2014) that the attraction effect diminishes when dominance is not perceived or consumers choose the dominated options for other reasons (e.g., inattention, idiosyncratic preferences). In our studies the dominated option is rarely chosen, suggesting that R is likely large when choice sets are small, information is transparent, and rakings of attribute levels are unambiguous. Future research could fruitfully examine how R changes with stimuli features or consumer heterogeneity to account for variations in the attraction and other contextual effects.

Our model includes a lingering effect of the reference point on choice after a decoy is removed. However, we do not include several factors that have either previously been shown or seem likely to affect the temporal dynamics or magnitude of the lingering effect on choice. For example, prior work has shown that references points shift more over longer periods of time (Chen and Rao 2002, Strahilevitz and Loewenstein 1998). The magnitude of the reference point shift may also depend on outcome valence (Arkes et al. 2010, 2008).

Malkoc et al. (2013) have found that the attraction effect is attenuated or eliminated in undesirable domains when alternatives are unattractive. Other work has shown that the amount of time elapsed, elaboration, or distraction during a decision might affect choices via other routes (e.g., Hedgcock et al. 2009, Wolf et al. 2008, Dijksterhuis et al. 2006, Heyman et al. 2004). Future research should investigate whether and how these factors affect choice and develop models that can explicitly account for these effects.

Future research should also try to shed more light on the underlying mechanisms for the context effects. Multiple processes have been proposed in the literature, among which our model and data seem to favor the one based on a reference point shift. Our results, however, also hint at the possibility of other mechanisms at play. In fact, we agree with others who have suggested that multiple mechanisms likely contribute to these context effects (Huettel et al. 2009, Malkoc et al. 2013). Rather than identifying *which* one works, maybe it is more fruitful in future research to study *when* each mechanism works.

Supplemental Material

Supplemental material to this paper is available at http://dx.doi.org/10.1287/mnsc.2015.2289.

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Appendix

This appendix contains two parts. In the first part, we prove the propositions predicting the change in deferral rate as a consequence of the addition of a decoy to a product line consisting of target (T) and competitor (C). As detailed in the text, the decoys we consider are (1) compromise decoy (D_c), (2) asymmetrically dominated decoy (D_{ad}) and (3) superior decoy (D_{sup}). In the second part, we prove the predictions on the deferral rate when a decoy disappears from a three product choice set. To make this appendix somewhat self-contained, we reproduce the market shares of T, C, and N (no choice) in the baseline below:

$$\Pr_i(T/\{T,C\}) = \frac{\exp(v-\theta((\lambda-1)/2)\Delta v)}{1+2\exp(v-\theta((\lambda-1)/2)\Delta v)},$$

$$\Pr_i(C/\{T,C\}) = \frac{\exp(v-\theta((\lambda-1)/2)\Delta v)}{1+2\exp(v-\theta((\lambda-1)/2)\Delta v)}, \quad \text{and}$$

$$\Pr_i(N/\{T,C\}) = \frac{1}{1+2\exp(v-\theta((\lambda-1)/2)\Delta v)}.$$

Part 1. Impact of the Presence of a Decoy

Presence of a Compromise Decoy. We consider a choice set that consists of $\{D_c, T, C\}$, such that $q_{D_c} > q_T > q_C$ and $p_{D_c} > p_T > p_C$, and assume that both D_c and C are "equidistant" from T. In other words, in addition to the target and the competitor, we now have another option that makes the target a "compromise" choice. Formally,

$$v_q(q_{D_c}) - v_q(q_T) = v_p(p_{D_c}) - v_p(p_T) = \Delta v. \tag{A1}$$

Using Equation (3), we get $v_{qR}(\{D_c,T,C\}) = v_q(q_T)$, and $v_{pR}(\{D_c,T,C\}) = v_p(p_T)$. Using Equation (4), we have the following:

$$V_i(T,\{D_c,T,C\}) = v + \varepsilon_{iT}, \tag{A2a}$$

$$V_i(C,\{D_c,T,C\}) = v - \theta(\lambda-1)\Delta v + \varepsilon_{iC}, \tag{A2b}$$

$$V_i(D_c,\{D_c,T,C\}) = v - \theta(\lambda-1)\Delta v + \varepsilon_{iD_c}. \tag{A2c}$$

So, the market shares of target, competitor, compromise decoy, and the no-choice option, respectively, are given by (using Equation (6)) the following:

$$\Pr_i(T/\{D_c,T,C\}) = \frac{\exp(v)}{1+\exp(v)+2\exp(v-\theta(\lambda-1)\Delta v)}, \tag{A3a}$$

$$\Pr_i(C/\{D_c,T,C\}) = \frac{\exp(v-\theta(\lambda-1)\Delta v)}{1+\exp(v)+2\exp(v-\theta(\lambda-1)\Delta v)}, \tag{A3b}$$

$$\Pr_i(D_c/\{D_c,T,C\}) = \frac{\exp(v-\theta(\lambda-1)\Delta v)}{1+\exp(v)+2\exp(v-\theta(\lambda-1)\Delta v)}, \quad \text{and} \tag{A3c}$$

$$\Pr_i(N/\{D_c,T,C\}) = \frac{1}{1+\exp(v)+2\exp(v-\theta(\lambda-1)\Delta v)}. \tag{A3d}$$

As Equations (10a) and (10b) show, in the baseline condition $T = C$, whereas in the presence of a decoy that makes the target a compromise, it can be seen from (A3a)–(A3c) that $D_c \prec T \succ C$. Thus, our formulation replicates the compromise effect (Simonson 1989). In addition, our model analysis provides a specific prediction about the no-choice share in the presence of a decoy that makes the target a compromise. We present the proof of P1 as follows.

Proof of P1. We essentially need to show that

$$\frac{1}{1+\exp(v)+2\exp(v-\theta(\lambda-1)\Delta v)} < \frac{1}{1+2\exp\big(v-((\theta(\lambda-1))/2)\Delta v\big)},$$

$$\Rightarrow\ 1+\exp(v)+2\exp\big(v-\theta(\lambda-1)\Delta v\big) > 1+2\exp\left(v-\theta\frac{(\lambda-1)}{2}\Delta v\right).$$

If $\theta(\lambda-1)\Delta v = k$, then we need to show that $\exp(v) + 2\exp(v-k) > 2\exp(v-(k/2))$. Rearranging the terms, we have: $2\exp(v-(k/2)) - 2\exp(v-k) < \exp(v)$, and this implies that $2\exp(v)(\exp(-(k/2)) - \exp(-k)) < \exp(v)$. This simplifies to: $\exp(-(k/2)) - \exp(-k) < 1/2$. Now, we can rewrite this as $1/\sqrt{\exp(k)} - 1/\exp(k) < 1/2$. If $\exp(k) = y$, then we need to show that

$$\frac{1}{\sqrt{y}} - \frac{1}{y} < 1, \quad \Rightarrow \frac{1}{\sqrt{y}} < \frac{1}{y} + \frac{1}{2}.$$

Squaring both sides of the above equation, we get the following:

$$\frac{1}{y} < \frac{1}{y^2} + \frac{1}{4} + \frac{1}{y}.$$

This immediately implies that $1/y^2 > -1/4$. This is always true. Q.E.D.

To rule out an alternative explanation that the deferral decrease is simply due to the presence of an additional option, we present the following lemma.

Lemma A1. *Deferral rate goes down even when the compromise decoy share is not considered.*

Proof. We need to show that

$$\frac{1}{1+\exp(v)+\exp(v-\theta(\lambda-1)\Delta v)} < \frac{1}{1+2\exp(v-\frac{\theta(\lambda-1)}{2}\Delta v)}$$

$$\Rightarrow\ \exp(v)+\exp(v-\theta(\lambda-1)\Delta v) > 2\exp(v-\theta\frac{(\lambda-1)}{2})\Delta v)$$

Let $\theta((\lambda-1)/2)\Delta v = m$, so we need to show that $\exp(v)+\exp(v-2m) > 2\exp(v-m)$. This simplifies to $1+\exp(-2m) > 2\exp(-m)$. This implies $\exp(m)+\exp(-m) > 2$. This is always true.

Presence of an Asymmetrically Dominated Decoy. An asymmetrically dominated decoy has the same quality level as the target and a higher price (p_T+d), where $d>0$. Let $v_p(p_T+d)-v_p(p_T) \equiv \Delta D \ge 0$. Applying (4), we obtain the reference levels in the quality and price as

$$v_{qR}(\{D_{\text{ad}},T,C\}) = \frac{2v_q(q_T)+v_q(q_C)}{3} \quad\text{and}$$
$$v_{pR}(\{D_{\text{ad}},T,C\}) = \frac{2v_p(p_T)+v_p(p_C)+\Delta D}{3}. \tag{A4}$$

We obtain the following expression for the utilities of T and C in the presence of an D_{ad} (using 4):

$$V_i(T,\{D_{\text{ad}},T,C\}) = v+\theta\big[\big(v_q(q_T)-v_{qR}(\{D_{\text{ad}},T,C\})\big) - \lambda\big(\big(v_p(p_T)-v_{pR}(\{D_{\text{ad}},T,C\})\big)\big)\big]+\varepsilon_{iT},$$

$$V_i(C,\{D_{\text{ad}},T,C\}) = v+\theta\big[\big(v_{pR}(\{D_{\text{ad}},T,C\})-v_p(C)\big) - \lambda\big(v_{qR}(\{D_{\text{ad}},T,C\})-v_q(C)\big)\big]+\varepsilon_{iC},$$

$$V_i(D_{\text{ad}},\{D_{\text{ad}},T,C\}) = v+\theta\big[\big(v_q(q_T)-v_{qR}(\{D_{\text{ad}},T,C\})\big) - \lambda\big(v_p(p_T+d)-v_{pR}(\{D_{\text{ad}},T,C\})\big)\big]-R+\varepsilon_{iD}.$$

Substituting the reference values and simplifying, we get

$$V_i(T,\{D_{\text{ad}},T,C\}) = v-\theta\bigg[(\lambda-1)\frac{\Delta v}{3}-\lambda\frac{\Delta D}{3}\bigg]+\varepsilon_{iT}, \tag{A5a}$$

$$V_i(C,\{D_{\text{ad}},T,C\}) = v-\theta\bigg[(\lambda-1)\frac{2*\Delta v}{3}-\frac{\Delta D}{3}\bigg]+\varepsilon_{iC}, \tag{A5b}$$

$$V_i(D_{\text{ad}},\{D_{\text{ad}},T,C\}) = v-\theta\bigg[(\lambda-1)\frac{\Delta v}{3}+\lambda\frac{2\Delta D}{3}\bigg]-R+\varepsilon_{iD}. \tag{A5c}$$

Comparing the deterministic parts of (A5a) and (A5b), it can be readily seen that $E(V_i(T)) > E(V_i(C))$, implying $T>C$, relative to the baseline where the T and C were equivalent (by construction), T is now more attractive relative to C. The market share of no choice using Equations (A5a)–(A5c) is

$$\begin{aligned}\Pr_i(N/\{D_{\text{ad}},T,C\}) &= \bigg[1+\exp\bigg(v-\theta\bigg[(\lambda-1)\bigg(\frac{\Delta v}{3}\bigg)-\lambda\bigg(\frac{\Delta D}{3}\bigg)\bigg]\bigg)\\ &\quad+\exp\bigg(v-\theta\bigg[(\lambda-1)\bigg(\frac{2\Delta v}{3}\bigg)-\bigg(\frac{\Delta D}{3}\bigg)\bigg]\bigg)\\ &\quad+\exp\bigg(v-\theta\bigg[(\lambda-1)\bigg(\frac{\Delta v}{3}\bigg)+\lambda\bigg(\frac{2\Delta D}{3}\bigg)\bigg]-R\bigg)\bigg]^{-1}.\end{aligned} \tag{A6}$$

The proof of P2 is presented below.

Proof of P2. We need to show that the expression on the right-hand side (RHS) of (A6) is less than the RHS of (10c). Let $\theta((\lambda-1)/2)\Delta v = m$.

First, let us assume that $R \gg 0 (R\to\infty)$, so the share of a dominated option is vanishingly small (this reflects our context with small choice sets, transparent information and unambiguous rankings of attribute levels). As will become clear below, this assumption allows us to focus on the effect of reference point shift on deferral.

Then we need to show that

$$\begin{aligned}&[1+\exp(v-\theta(2/3)m+\lambda(\theta\Delta D/3))\\ &\quad+\exp(v-\theta(4/3)m+(\theta\Delta D/3))]^{-1} < \frac{1}{1+2\exp(v-\theta m)}\end{aligned}$$

$$\begin{aligned}\Rightarrow\ &\exp(v-\theta(2/3)m+\lambda(\theta\Delta D/3))\\ &\quad+\exp(v-\theta(4/3)m+(\theta\Delta D/3)) > 2\exp(v-\theta m).\end{aligned}$$

Rearranging the terms in this expression leads to

$$\exp(\theta(1/3)m+\lambda(\theta\Delta D/3))+\exp(-\theta(1/3)m+(\theta\Delta D/3)) > 2$$

Since $\theta\Delta D{>}0$, the above inequality holds as long as $\exp(\theta(1/3)m)+\exp(-\theta(1/3)m) > 2$. This always holds even when ΔD is close to zero.

Note that if this result holds for $R\to\infty$, it always holds for any $R\ge 0$. Actually when R is small, our proposition on deferral holds more strongly, because the dominated option now has a nonzero share which will further drive down deferral. In other words, when R is small the effect of reference point shift on reducing deferral is confounded by the mere fact that consumers have more options to choose from (three including the dominated decoy versus two in the baseline condition). Conversely, when R is large, the decrease in deferral is driven mostly by reference point shift.[9]

[9] In all our studies the choice share of the dominated option is very small, suggesting that R is likely large.

Presence of a Superior Decoy. Here we consider a decoy that has the same quality as the target but is priced lower at $p_T - d$ where $d > 0$. Let $v_p(p_T) - v_p(p_T - d) \equiv \Delta S \geq 0$. Applying (3), we obtain the reference levels:

$$v_{qR}(\{D_{\mathrm{sup}}, T, C\}) = \frac{2v_q(q_T) + v_q(q_C)}{3} \quad \text{and}$$

$$v_{pR}(\{D_{\mathrm{sup}}, T, C\}) = \frac{2v_p(p_T) + v_p(p_C) - \Delta S}{3}.$$

We obtain the following simplified expression for the utilities of D_{sup}, C, and T in the presence of D_{sup}:

$$V_i(D_{\mathrm{sup}}, \{D_{\mathrm{sup}}, T, C\}) = (v + \Delta S) - \theta\left[(\lambda - 1)\frac{\Delta v}{3} - \lambda\frac{2 * \Delta S}{3}\right] + \varepsilon_{iD}, \tag{A7a}$$

$$V_i(C, \{D_{\mathrm{sup}}, T, C\}) = v - \theta\left[(\lambda - 1)\frac{2 * \Delta v}{3} + \frac{\Delta S}{3}\right] + \varepsilon_{iC}, \tag{A7b}$$

$$V_i(T, \{D_{\mathrm{sup}}, T, C\}) = v - \theta\left[(\lambda - 1)\frac{\Delta v}{3} + \lambda\frac{\Delta S}{3}\right] - R + \varepsilon_{iT}. \tag{A7c}$$

Note in the baseline condition, $T = C$, whereas the utility for D_{sup} is higher relative to C, and hence the competitor becomes less attractive. So, the market share of no choice is

$$\begin{aligned}\Pr_i(N/\{D_{\mathrm{sup}}, T, C\}) &= \left[1 + \exp\left((v + \Delta S) - \theta\left[(\lambda - 1)\left(\frac{\Delta v}{3}\right) - \lambda\left(\frac{2 * \Delta S}{3}\right)\right]\right)\right. \\ &\quad + \exp\left(v - \theta\left[(\lambda - 1)\left(\frac{2 * \Delta v}{3}\right) + \left(\frac{\Delta S}{3}\right)\right]\right) \\ &\quad \left. + \exp\left(v - \theta\left[(\lambda - 1)\left(\frac{\Delta v}{3}\right) + \lambda\left(\frac{\Delta S}{3}\right)\right] - R\right)\right]^{-1}.\end{aligned}$$

Using this expression, the proof of P3 is almost identical to that of P2.

Proof of P3. Again, let us assume that $R \gg 0$ ($R \to \infty$), so the share of the dominated option is vanishingly small. In this case, the deferral is lower than baseline as long as $\Delta S + \theta\lambda(2 * \Delta S/3) \geq \theta(\Delta S/3)$. This always holds. Now again, as in P2, if the results hold for $R \gg 0$, then it always holds for any $R \geq 0$. When R is small, the decrease in deferral is due to both reference point shift and the mere fact that there are more options to choose from (three including the dominated option (T) versus two in the baseline). When R is large, in contrast, the decrease in reference point shift is mostly driven by reference point shift.

Part 2. Impact of the Disappearance of a Decoy

As detailed in the paper, the impact of disappearance of a lingering effect $0 < \psi < 1$. The reference point after the disappearance of a decoy is given by $v_{mR}(\{D_n, T, C\} - \{D_n\}) = \psi v_{mR}(\{D_n, T, C\}) + (1 - \psi) v_{mR}(\{T, C\})$, where, $m \in \{q, p\}$ and $n \in \{c, ad, \mathrm{sup}\}$ and the last three symbols represent compromise, asymmetrically dominated and superior decoys respectively.

Disappearance of a Compromise Decoy. We first consider the case in which a compromise decoy disappears. Using Equation (11), we have the following:

$$v_{qR}(\{D_c, T, C\} - \{D_c\}) = \frac{(1 + \psi)v_q(q_T) + (1 - \psi)v_q(q_C)}{2}, \tag{A8a}$$

$$v_{pR}(\{D_c, T, C\} - \{D_c\}) = \frac{(1 + \psi)v_p(p_T) + (1 - \psi)v_p(p_C)}{2}. \tag{A8b}$$

With this equation, we immediately get the following:

$$V_i(T, \{D_c, T, C\} - \{D_c\}) = v - \theta(1 - \psi)\frac{\lambda - 1}{2}\Delta v + \varepsilon_{iT}, \tag{A9a}$$

$$V_i(C, \{D_c, T, C\} - \{D_c\}) = v - \theta(1 + \psi)\frac{\lambda - 1}{2}\Delta v + \varepsilon_{iC}. \tag{A9b}$$

It can be readily seen that for $\Psi > 0$, $E(V_i(T)) > E(V_i(C))$ implying, $T > C$ – relative to the baseline where the T and C were equivalent (by construction), T is still more attractive relative to C. The market share of the no-choice option is given by

$$\begin{aligned}\Pr_i(N/\{D_c, T, C\} - \{D_c\}) &= \left[1 + \exp\left(v - \theta(1 - \psi)\left(\frac{\lambda - 1}{2}\right)\Delta v\right)\right. \\ &\quad \left. + \exp\left(v - \theta(1 + \psi)\left(\frac{\lambda - 1}{2}\Delta v\right)\right)\right]^{-1}.\end{aligned} \tag{A10}$$

Note that when $\Psi = 0$, the utilities converge to the baseline and when $\Psi = 1$, we get complete lingering as with the case of presence of the compromise decoy. Using this expression, we can prove P4.

Proof of P4. We need to show that

$$\Pr_i(N/\{D_c, T, C\} - \{D_c\}) > \Pr_i(N/\{D_c, T, C\}),$$

which implies that

$$\begin{aligned}1 + \exp(v) + 2\exp(v - \theta(\lambda - 1)\Delta v) &> 1 + \exp\left(v - \theta(1 - \psi)\frac{\lambda - 1}{2}\Delta v\right) \\ &\quad + \exp\left(v - \theta(1 + \psi)\frac{\lambda - 1}{2}\Delta v\right).\end{aligned}$$

This can be simplified to

$$\begin{aligned}1 + 2\exp(-\theta(\lambda - 1)\Delta v) &> \exp\left(-\theta(1 - \psi)\frac{\lambda - 1}{2}\Delta v\right) \\ &\quad + \exp\left(-\theta(1 + \psi)\frac{\lambda - 1}{2}\Delta v\right).\end{aligned}$$

This implies

$$\begin{aligned}1 > \Bigg[&\exp\left(-\theta(1 - \psi)\frac{\lambda - 1}{2}\Delta v\right) + \exp\left(-\theta(1 + \psi)\frac{\lambda - 1}{2}\Delta v\right) \\ &- 2\exp(-\theta(\lambda - 1)\Delta v)\Bigg].\end{aligned} \tag{A11}$$

Because $0 < \psi < 1$, the RHS is negative, and thus Equation (A11) holds.

Now, $\Pr_i(N/\{D_c, T, C\} - \{D_c\}) < \Pr_i(N/\{T, C\})$, if

$$1 + \exp\left(v - \theta(1-\psi)\frac{\lambda - 1}{2}\Delta v\right) + \exp\left(v - \theta(1+\psi)\frac{\lambda-1}{2}\Delta v\right) > 1 + 2\exp\left(v - \theta\frac{\lambda-1}{2}\Delta v\right).$$

Rearranging the terms yields the following:

$$\exp(v - (m/2) + \psi(m/2)) - \exp(v - (m/2)) > \exp(v - (m/2)) - \exp(v - (m/2) - \psi(m/2)), \tag{A12}$$

where $m = \theta((\lambda - 1)/2)\Delta v$. Because $\exp''(\cdot) > 0$, Equation (A12) must hold. Combining Equations (A11) and (A12), we get the following:

$$\Pr_i(N/\{D_c, T, C\}) < \Pr_i(N/\{D_c, T, C\} - \{D_c\}) < \Pr_i(N/\{T, C\}).$$

This completes the proof.

An examination of Equations (A9a) and (A9b) immediately also implies that $T \succ C$. Q.E.D.

Disappearance of an Asymmetrically Dominated Decoy. In this section, we consider the disappearance of an asymmetrically dominated decoy that brings the choice set to the same condition as the benchmark choice set. As previously, the reference point adjusts imperfectly and is given by

$$v_{mR}(\{D_{ad}, T, C\} - \{D_{ad}\}) = \psi v_{mR}(\{D_{ad}, T, C\}) + (1-\psi) v_{mR}(\{T, C\}),$$

where $m \in \{q, p\}$.

Substituting the values from (A4), we get:

$$v_{qR}(\{D_{ad}, T, C\} - \{D_{ad}\}) = \frac{v_q(q_T) + v_q(q_C)}{2} + \psi\frac{\Delta v}{6}, \tag{A13a}$$

$$v_{pR}(\{D_{ad}, T, C\} - \{D_{ad}\}) = \frac{v_p(p_T) + v_p(p_C)}{2} + \psi\frac{\Delta v + 2\Delta D}{6}. \tag{A13b}$$

Hence, this can then be used to translate into the valuation for T and C, respectively, as

$$V_i(T, \{D_{ad}, T, C\} - \{D_{ad}\}) = v + \theta\big[\big(v_q(q_T) - v_{qR}(\{D_{ad}, T, C\} - \{D_{ad}\})\big) - \lambda\big(v_p(p_T) - v_{pR}(\{D_{ad}, T, C\} - \{D_{ad}\})\big)\big] + \varepsilon_{iT}, \tag{A14a}$$

$$V_i(C, \{D_{ad}, T, C\} - \{D_{ad}\}) = v + \theta\big[v_{pR}(\{D_{ad}, T, C\} - \{D_{ad}\}) - v_p(p_C) - \lambda\big(v_{qR}(\{D_{ad}, T, C\} - \{D_{ad}\}) - v_q(q_C)\big)\big] + \varepsilon_{iC}. \tag{A14b}$$

These can be simplified as follows:

$$V_i(T, \{D_{ad}, T, C\} - \{D_{ad}\}) = v - \theta\left[(\lambda-1)\frac{\Delta v}{2} - (\lambda-1)\frac{\Delta v\psi}{6} - \frac{\lambda\psi\Delta D}{3}\right] + \varepsilon_{iT}$$

$$+ V_i(C, \{D_{ad}, T, C\} - \{D_{ad}\}) = v - \theta\left[(\lambda-1)\frac{\Delta v}{2} + (\lambda-1)\frac{\psi\Delta v}{6} - \frac{\psi\Delta D}{3}\right] + \varepsilon_{iC}.$$

Note that when $\Psi = 0$, the utilities converge to the baseline and when $\Psi = 1$, we get complete lingering as with the case of presence of D_{ad}.

It can be readily seen that for $\Psi > 0$, $E(V_i(T)) > E(V_i(C))$ implying, $T > C$-relative to the baseline where the T and C were equivalent (by construction), T is still more attractive relative to C.

These can be used to derive the choice of no share as follows assuming $m = \theta(\lambda - 1)(\Delta v/2)$:

$$\Pr_i(N/\{D_{ad}, T, C\} - \{D_{ad}\}) = \big[1 + \exp[v - m + (m\psi/3) + (\theta\lambda\psi\Delta D/3)] + \exp[v - m - (m\psi/3) + (\theta\psi\Delta D/3)]\big]^{-1}. \tag{A15}$$

We can prove P5 as below.

Proof of P5. The proof is straightforward and similar to that of P2. We need to show that

$$\exp[v - m + (m\psi/3) + (\theta\lambda\psi\Delta D/3)] + \exp[v - m - (m\psi/3) + (\theta\psi\Delta D/3)] > 2\cdot\exp[v - m],$$

$$\Rightarrow \exp[(m\psi/3) + (\theta\lambda\psi\Delta D/3)] + \exp[-(m\psi/3) + (\theta\psi\Delta D/3)] > 2.$$

Since $\exp[(m\psi/3) + \exp[-(m\psi/3)]] > 2$, the above must hold because the additive terms are positive.

Disappearance of a Superior Decoy. The reference levels after the disappearance of a D_{sup} as a result of the lingering effect (imperfect adjustment) are given as below:

$$v_{qR}(\{D_{sup}, T, C\} - \{D_{sup}\}) = \psi\left[\frac{2v_q(q_T) + v_q(q_C)}{3}\right] + (1-\psi)\left[\frac{v_q(q_T) + v_q(q_C)}{2}\right] = \frac{v_q(q_T) + v_q(q_C)}{2} + \psi\frac{\Delta v}{6} \tag{A16a}$$

$$v_{pR}(\{D_{sup}, T, C\} - \{D_{sup}\}) = \psi\left[\frac{2v_p(p_T) + v_p(p_C) - \Delta\tilde{S}}{3}\right] + (1-\psi)\left[\frac{v_p(p_T) + v_p(p_C)}{2}\right] = \left[\frac{v_p(p_T) + v_p(p_C)}{2}\right] + \psi\left(\frac{\Delta v - 2\Delta\tilde{S}}{6}\right) \tag{A16b}$$

We formulate $\Delta\tilde{S}$ as the combined effect of the advantage of D_{sup} over T (ΔS), and a "backlash effect" that arises from the removal of a clearly dominating option from the choice set. One way to think about this effect in this context is that the removal of an option that was clearly cheaper than T (with quality being the same) makes reference price go down more, so as to exacerbate the disadvantage of the target relative to the competitor on the price dimension (than without the backlash effect), leading to $\Delta\tilde{S} \geq \Delta S$. Using the reference formulation above, we get

$$V_i(T, \{D_{sup}, T, C\} - \{D_{sup}\}) = v - \theta\left[(\lambda-1)\frac{\Delta v}{2} - (\lambda-1)\frac{\Delta v\psi}{6} + \frac{\lambda\psi\Delta\tilde{S}}{3}\right] + \varepsilon_{iT}, \tag{A17a}$$

$$V_i(C, \{D_{sup}, T, C\} - \{D_{sup}\}) = v - \theta\left[(\lambda-1)\frac{\Delta v}{2} + (\lambda-1)\frac{\psi\Delta v}{6} + \frac{\psi\Delta\tilde{S}}{3}\right] + \varepsilon_{iC}. \tag{A17b}$$

Using these, we can calculate the share of the no-choice option as below:

$$\begin{aligned}
&\Pr_i(N/\{D_{\text{sup}}, T, C\} - \{D_{\text{sup}}\}) \\
&\quad = \left[1 + \exp\left(v - m + \frac{\psi m}{3} - \frac{\theta\lambda\psi\Delta\tilde{S}}{3}\right)\right. \\
&\qquad \left. + \exp\left(v - m - \frac{\psi m}{3} - \frac{\theta\psi\Delta\tilde{S}}{3}\right)\right]^{-1}, \qquad \text{(A18)}
\end{aligned}$$

where $m = \theta(\lambda - 1)(\Delta v/2)$. These leads to the proof of P6.

Proof of P6. Comparing the deterministic parts of (A17a) and (A17b), it can be seen that $E(V_i(T)) < E(V_i(C))$ iff

$$\Delta\tilde{S} > \Delta v. \qquad \text{(A19)}$$

To prove P6, we need to show that

$$\begin{aligned}
&\left[1 + \exp\left(v - m + \frac{\psi m}{3} - \frac{\theta\lambda\psi\Delta\tilde{S}}{3}\right)\right. \\
&\qquad \left. + \exp\left(v - m - \frac{\psi m}{3} - \frac{\theta\psi\Delta\tilde{S}}{3}\right)\right]^{-1} > \frac{1}{1 + 2\exp(v - m)}.
\end{aligned}$$

This holds if

$$\begin{aligned}
&\exp\left(v - m + \frac{\psi m}{3} - \frac{\theta\lambda\psi\Delta\tilde{S}}{3}\right) \\
&\qquad + \exp\left(v - m - \frac{\psi m}{3} - \frac{\theta\psi\Delta\tilde{S}}{3}\right) < 2\exp(v - m) \\
&\Rightarrow \exp\left(\frac{\psi m}{3} - \frac{\theta\lambda\psi\Delta\tilde{S}}{3}\right) + \exp\left(-\frac{\psi m}{3} - \frac{\theta\psi\Delta\tilde{S}}{3}\right) < 2.
\end{aligned}$$

Note that the second term in the above inequality is less than 1, and as long as the first term is less than 1, the above inequality is always satisfied. This requires that

$$\frac{\psi m}{3} - \frac{\theta\lambda\psi\Delta\tilde{S}}{3} < 0 \;\Rightarrow\; \Delta\tilde{S} > \frac{1}{2}\left(1 - \frac{1}{\lambda}\right)\Delta v. \qquad \text{(A20)}$$

Note that $\Delta v(1/2)((1 - 1/\lambda)\Delta v$. Combining this with (A19), we get $\Delta\tilde{S} > \Delta v > 1/2(1 - 1/\lambda)\Delta v$. Therefore, a backlash effect that makes the target less attractive increases deferral relative to the baseline.[10]

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[10] Indeed, in all our studies the choice share of the target decreases after the removal of D_{sup}, suggesting the presence of enough of a backlash from the subjects to satisfy (A19).

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