Institute for Empirical Research in Economics
University of Zurich

Working Paper Series
ISSN 1424-0459

Working Paper No. 330

Why does context matter? Attraction effects and binary comparisons

Wolfgang R. Köhler

July 2007

Why does context matter? Attraction effects and binary comparisons

Wolfgang R. Köhler

University of Zürich

Institut für empirische Wirtschaftsforschung

Winterthurerstrasse 30

8006 Zürich, Switzerland

wolfgang.koehler@iew.unizh.ch

July 18, 2007

Abstract

A large experimental and empirical literature on asymmetric dominance and attraction effects shows that the probability that an alternative is chosen can increase if additional alternatives become available. Hence context matters and choices and, therefore, market shares can not be accurately described by standard choice models where individuals choose the alternative that yields the highest utility. This paper analyzes a simple procedural choice model. Individuals determine their choice by a sequence of binary comparisons. The model offers an intuitive explanation for violations of regularity such as the attraction and the asymmetric dominance effect and shows their relation to the similarity effect. The model analyzes a new rationale why context matters. The model is applied to explain primacy and recency effects and to derive implications with respect to product design.

Keywords: asymmetric dominance, attraction effect, similarity effect, binary choice, primacy effect, recency effect, regularity

1. Introduction

A central question for sales managers and marketing experts is how customers choose among several alternatives. This is crucial in order to predict market shares and especially to predict how market shares change if new products are introduced or old ones are withdrawn from the market. The most fundamental assumption with respect to choice among several alternatives is *regularity*. Regularity requires that the probability that an alternative is chosen does not increase if the choice set is expanded. Formally: Let t be some alternative that is an element of choice sets A and B. If B is a subset of A, then the probability that t is chosen from B must not be less than the probability that t is chosen from A: $\Pr\{t|B\} \geq \Pr\{t|A\}$. Regularity is arguably the weakest and intuitively most plausible rationality condition suggested in the literature. Furthermore, regularity is a minimal requirement of nearly all theories of choice.

A growing body of literature documents that context effects exist and specifically that choice patterns systematically violate regularity. Violations of regularity were first documented by Huber et al. (1982). They investigate how the introduction of a new product affects the choice probabilities (i.e., the market shares) of existing products. The original choice set contains two alternatives. The expanded choice set contains additionally an alternative that is dominated by one of the alternatives in the original choice set. Huber et al. find that the probability that the dominating alternative is chosen is larger for the expanded choice set than for the original set. The literature refers to this violation of regularity as asymmetric dominance effect.

Following Huber et al. (1982), numerous studies of consumer choice have documented how asymmetric dominance effects lead to violations of regularity (e.g., Ranteshwar, Shocker and Stewart (1987), Kardes et al. (1989), Simonson and Tversky (1992), Lehman and Pan (1994), Doyle et al. (1999), and Dhar and Simonson (2003)). Violations of regularity are not limited to consumer products but appear to be a general pattern of choice situations. For example, asymmetric dominance effects have been documented in choice among political candidates in U.S. elections (Pan et al. 1995), job candidates (Highhouse 1996), policy issues (Herne 1997), lotteries (Herne 1999), and strategies in static games with complete information (Amaldoss et al. 2005). Shafir, Waite and Smith (2002) and Hurly (2003) examine the behavior of two kinds of birds and find that these birds violate regularity when choosing among feeding places.

Violations of regularity also occur if an alternative is added that is not dominated by one of alternatives in the original choice set (e.g., Simonson and Tversky 1992, Huber and Puto 1983). In these papers, the alternative that is added to the choice set is similar in terms of attributes to one of the original alternatives (the 'target'). While the new alternative is not dominated, it is clearly inferior to the target. These studies find that the probability that the target is chosen is larger for the expanded choice set than for the original choice set. To distinguish the effects of dominated and non-dominated alternatives, we use the term 'attraction effect' only for the observation that the probability that the target is chosen increases if a non-dominated alternative is added to the choice set.

In the literature, alternatives are described as vector of attributes. Explanations of asymmetric dominance and attraction effects can be broadly grouped into two classes. The first proposes that context matters because an expansion of the choice set changes how individuals perceive and weight the attributes of the alternatives. Depending on its design, the addition of an asymmetrically dominated alternative can stretch the range of the attribute where the dominant alternative is weaker than the competitor. According to the range effect, this reduces the experienced difference between the dominant alternative and the competitor and thereby makes the dominant alternative more attractive (e.g., Huber et al. 1982; Huber and Puto, 1983). According to the frequency effect, an increase of the number of alternatives which are inferior to the dominant alternative along some attribute, increases the weight that is placed on this attribute. These explanations describe individuals as comparing alternatives attribute by attribute. Differences in the strength of attributes are aggregated and then determine which alternative is chosen. The second class of explanations considers heuristic strategies in decision making. For example, Simonson (1989) argues that individuals, who perceive that they have to justify their decision, are more likely to choose the dominant alternative since this is easy to justify. The 'Majority of Confirming Dimensions' hypothesis proposes that individuals compare the strength of alternatives along each attribute and choose the alternative that compares most favorable for the largest number of attributes. These theories can explain the asymmetric dominance and attraction effect but they do not provide formal models which generate quantitative predictions about choice probabilities (one exception is Tversky and Simonson 1993).

We develop a simple procedural model of choice to generate quantitative predictions about choice probabilities (e.g., market shares). We consider individuals who determine their choice by a sequence of comparisons between the available alternatives. Consider an individual who has to choose one out of three available alternatives. The individual starts by comparing two alternatives. Then she discards the alternative that is not preferred and compares the preferred alternative to the third alternative and chooses whichever she prefers.

This approach has several advantages:

1) The model predicts choice patterns and especially how choices change if alternatives are added or removed from the choice set. Additionally, the model offers a simple and straightforward explanation for asymmetric dominance, attraction, and similarity effects.

2) Choices are determined by binary choice probabilities which can be easily observed. Since alternatives do not need to be describable as vector of attributes, the model can applied if the strenght of an attribute can not be measured (e.g., design).

3) The model does not get more complex if the number of attributes increases which is

important for applications where the number of product attributes is usually large.

Our model is a procedural choice model where individuals split the decision problem into a sequence of binary comparisons. This approach is similar to Blavatskyy and Köhler (2007) who model the pricing of a lottery as a sequence of binary comparisons between the lottery and monetary amounts. The model shows that violations of regularity such as the asymmetric dominance and the attraction effect can be explained by a simple and intuitive model where individuals compare alternatives to determine their choice. Additionally, we highlight a new rationale why the context of a choice situation matters. New alternatives affect choices simply because they are compared to the other alternatives.

The paper is organized as follows. Section 2 presents the model and relates the predictions of the model to the findings in the literature on asymmetric dominance, symmetric dominance, and attraction effects and shows the relation between attraction effect and the countervailing similarity effect. Section 3 discusses a more elaborate choice rule that improves the quality of the decision. Section 4 discusses implications for marketing and product design. Section 5 concludes.

2. Binary comparisons and choice

2.1. The Model

Let S be a choice set that contains $2 \leq n < \infty$ alternatives. Let S_r be the set of all alternatives that are in S and that have not been compared to another alternative. If a subject has to choose one alternative from S, she uses the following procedure P:

Procedure *P*:

Step 1: Draw two alternatives $i, j \in S$ at random and compare i and j.

Step 2: Draw a new alternative at random from S_r and compare it to the alternative that was preferred in the last comparison.

Step 3: Repeat step 2. The sequence of binary comparisons stops when $S_r = \varnothing$.

Step 4: Choose the alternative that is preferred in the last comparison.

There is plenty of evidence that choices are probabilistic. For example, Hey and Orme (1994) and Ballinger and Wilcox (1997) report that 25% and 20.8% of decisions in binary choice tasks are reversed if subjects face the same decision problem for a second time. To take the probabilistic nature of choice into account, we assume that subjects are characterized by binary choice probabilities. For any $i, j \in S$ exists $p_{i,j}$ with $0 \leq p_{i,j} \leq 1$ and $p_{j,i} = 1 - p_{i,j}$ where $p_{i,j}$ is the probability that i is preferred over j in a binary comparison.

Procedure P determines for each $i \in S$ the probability $\Pr\{i|S\}$ that the alternative is chosen with $\sum_{i \in S} \Pr\{i|S\} = 1$. The probability that an alternative is chosen is a function of the binary choice probabilities and is increasing in the probability that the alternative is preferred in a binary comparison. If $S = \{i, j\}$, the subject chooses i with probability $p_{i,j}$ and j with probability $1 - p_{i,j}$. Since $\Pr\{i|S\}$ gets increasingly complex as n gets large, it is convenient to define choice probabilities recursively. Given choice set S with $j \in S$, let $S_{-j} = \{x \in S | x \neq j\}$.

Proposition 1: $\Pr\{i|S\} = \frac{1}{n} \sum_{j \neq i} p_{ij} \left(\Pr\{i|S_{-j}\} + \Pr\{j|S_{-i}\}\right)$.

Most of the literature on asymmetrice dominance and attraction effects investigates choice sets with three alternatives since this is the simplest case where violations of regularity can occur. For the remainder of the paper, we restrict attention to choice sets with three or less alternatives. Consider a subject that chooses one alternative from the set $\{i, j, k\}$ and let $\Pr\{i|i, j, k\}$ denote the probability that i is chosen.

Corollary 1: $\Pr\{i|i, j, k\} = \frac{2}{3} p_{i,j} p_{i,k} + \frac{1}{3} \left[p_{i,j} p_{j,k} + p_{i,k}(1 - p_{j,k})\right]$.

The model differs in two respects from standard choice theory: it takes into account that choices are probabilistic and it models choice as result of a sequence of binary comparisons. One advantage of the model is that predictions in the limit coincide with the predictions from standard choice theory. Specifically, if all binary choice probabilities converge to either zero or one and if the limit can be represented by a transitive preference relation $\succ_P$, then in the limit the choice pattern under procedure P is deterministic and the same as predicted by $\succ_P$.

2.2. Asymmetric Dominance

The literature on asymmetric dominance and attraction effects defines alternatives by the strength of their attributes. An alternative dominates another alternative if it is superior or equal along all attributes and strictly superior along at least one attribute. Experimental studies have used different kinds of attributes, including price, physical product characteristics, and quality ratings. Most studies limit themselves to alternatives that are defined by two attributes. Figure 1 shows a typical setup in an experiment. The original choice set contains alternatives t and c. Alternative t is the target, i.e., the alternative whose probability to be chosen is of interest, and alternative c is the competitor. The expanded choice set contains an additional alternative which is usually called the 'decoy'. Studies of the asymmetric dominance effect consider an asymmetrically dominated decoy d such that d is dominated by the target t but not by the competitor c. Alternatives that lie in the dark shaded area are dominated by t. Alternatives that lie in the light shaded area are dominated by t and by c. Alternative z is not dominated by any of the other alternatives. The literature refers to z as 'relatively inferior' with respect to the target t since z is clearly worse than the target along attribute 1 and only slightly better along attribute 2.

(insert figure 1 here)

In our model, choices are determined by binary choice probabilities and not by the strength of attributes. To relate the predictions of our model to the observations in the literature we need one assumption on how the strength of attributes affects binary choice probabilities. We assume that in a binary comparison, an alternative is preferred with probability one if and only if it dominates the other alternative. The intuition behind the assumption is the following: Alternatives are usually presented as vector of two attributes. Hence dominance is obvious and, therefore, it is unlikely that an individual chooses the dominated alternative. If no alternative dominates the other, then there exists a trade-off in the sense that there exists at least one attribute where one alternative is superior and one attribute where the other alternative is superior. Hence, the preferred alternative depends on how important one attribute is compared to other attributes. In terms of the model, this implies that $p_{d,t} = 0$ and that $0 < p_{c,d} < 1$ and $0 < p_{t,c} < 1$.

The literature on asymmetric dominance analyzes choice patterns if a decoy d is added to the choice set that is dominated by the target alternative t but not by the other alternative c (i.e., $p_{d,t} = 0$ and $0 < p_{c,d} < 1$). The literature offers strong and compelling evidence that the addition of the asymmetrically dominated decoy d leads to an increase in the probability that the dominant alternative t is chosen.

Corollary 2: Let $p_{t,c}, p_{c,d} < 1$. If $p_{d,t} = 0$, then $\Pr\{t|c,t,d\} > \Pr\{t|c,t\}$.

Corollary 2 shows that whenever an asymmetrically dominated alternative is added to the choice set, the probability increases that the dominant alternative is chosen.

The reason for the asymmetric dominance effect is that with positive probability t is compared to d instead of c. If t is part of the first comparison, adding d to the choice set has no effect on the probability that t is chosen. The target t is chosen if it is preferred over c (which happens with probability $p_{t,c}$) and preferred over d (which happens with probability one). The difference occurs when the first comparison is between c and d. If c is chosen over d, the situation is the same as if there are only c and t in the choice set. But with probability $1-p_{c,d}$, alternative d is chosen over c. In this case, t is chosen with probability one instead of being chosen with probability $p_{t,d}$. The difference between the probabilities that t is chosen is equal to $\frac{1}{3}(1-p_{c,d})(1-p_{t,c})$. The first term $\frac{1}{3}(1-p_{c,d})$ is the probability that the first comparison is between c and d and that d is chosen over c. The second term is the difference between the probabilities that t is chosen if compared to d and c, respectively. While obviously dominated alternatives are not chosen in binary choice problems (i.e., $p_{d,t}=0$), from Corollary 1 follows that the asymmetrically dominated decoy d is chosen with small positive probability if there are three alternatives. In fact, in experiments between 1% and 4% of the subjects choose the asymmetrically dominated alternative.

Note that Corollary 2 does not hold if the expanded choice sets contains more than three alternatives. If there are more than three alternatives, the probability that the asymmetrically dominant alternative is chosen can increase or decrease.

2.3. Symmetric Dominance

While there exists a large literature on the effect of asymmetrically dominated alternatives, little research has been done on the effects of symmetrically dominated alternatives. An alternative is symmetrically dominated if it is dominated by all other alternatives (e.g., alternative s in fig.1). Recall that we assume that subjects never choose a dominated alternative in a binary choice problem. Our model predicts that an additional alternative does not affect choice probabilities if it is dominated by both alternatives in the original choice set.

Corollary 3: Let $0 < p_{t,c} < 1$. $\Pr\{t|c,t,s\} = \Pr\{t|c,t\}$ and $\Pr\{c|c,t,s\} = \Pr\{c|c,t\}$ if and only if $p_{s,t} = p_{s,c} = 0$.

Corollary 3 shows that a new alternative affects the choice probabilities unless the new alternative is dominated by both alternatives in the original choice set. From Corollary 1 and Corollary 3 follows that a new alternative only affects choice probabilities if it chosen with positive probability. In terms of attributes, Corollary 3 implies that the strength of attributes of the dominated alternative does not matter as long as the alternative is dominated by both alternatives in the original choice set. Unlike our model, other theories that propose that decoy effects arise from attributewise comparisons predict that the strength of the attributes of the dominated alternative matters even if the alternative is dominated by both alternatives in the original choice set. To test different choice models, Wedell (1991, Experiment 2 and 3) uses two types of decoys which are dominated by both alternatives in the original choice set. Decoys are either dominated by t for both attributes and by c for one attribute (i.e., one attribute is as strong as in c) or dominated by c for both attributes and by t for one attribute (i.e., one attribute is as strong as in t). Wedell finds that the type of the decoy has no effect on the probabilities that t or c are chosen. Hence asymmetrically dominated decoys are sufficient to increase the probability that the dominant alternative is chosen (as predicted by Corollary 2) but decoys that are dominated by both alternatives have no effect on choice probabilities (as predicted by Corollary 3). Wedell concludes that models where decoy effects arise from attributewise comparisons can not explain the results if a symmetrically dominated alternative is added to the choice set.

As benchmark, we assumed above that the probability that an alternative is part of the first comparison is the same for each alternative. We discuss in section 4 why firms have an incentive to manipulate the order of comparisons and which strategies can be used to achieve this goal. The predictions about the asymmetric and symmetric dominance effects continue to hold if the probability to be part of the first comparison differs across alternatives. Formally: Corollary 2 and 3 continue to hold if each binary combination of alternatives has positive probability to be compared in the first comparison.

2.4. Non-dominated decoys and the Attraction Effect

In the real world, non-dominated alternatives are more important than dominated ones because in reality, products have many attributes, and it is rare that one product dominates another in the sense that it is superior along all attributes. A number of papers (e.g., Simonson and Tversky 1992, Huber and Puto 1983) investigate what happens if an alternative is added to the choice set that is not dominated by one of the original alternatives. These studies design an alternative z such that z is more similar in terms of attributes to t than to c and such that the trade-off between t and z is in same direction as the trade-off between c and t (see fig. 1). While z is not dominated, it is unattractive compared to t since z is clearly worse than t along attribute 1 and only slightly better along attribute 2.

Huber and Puto (1983) were the first who demonstrated the attraction effect. They showed that the probability that an alternative is chosen can increase if a non-dominated alternative is added to the choice set. Subsequently, a large number of studies have documented huge effects of non-dominated alternatives (e.g., Ratneshwar et al. 1987, Simonson 1989, Simonson and Tversky 1992, etc.). However, the increase in the probability that the target t is chosen is smaller than if an asymmetrically dominated alternative is added.

Our model explains these results and provides necessary and sufficient conditions under which the attraction effect occurs. Additionally, it shows that the asymmetric dominance effect is just a special case of the attraction effect.

Corollary 4: Let $p_{t,c}, p_{z,c}, p_{t,z} \in (0,1)$. Then $\Pr\{t|c,t,z\} > \Pr\{t|c,t\}$ if and only if $\frac{p_{t,z}p_{z,c}}{2(1-p_{t,z})+p_{z,c}} > p_{t,c}$.

Corollary 4 shows that the probabilty that the target is chosen can increase even if a non-dominated alternative is added to the choice set. Recall that we assume that a dominated alternative is never preferred in a binary comparison (i.e., iff t dominates z, then $p_{t,z} = 1$). The term $\frac{p_{t,z} p_{z,c}}{2(1-p_{t,z})+p_{z,c}}$ is increasing in $p_{t,z}$. In the limit as $p_{t,z} \to 1$, the condition in Corollary 4 is satisfied for all $p_{t,c} < 1$. Hence the asymmetric dominance effect is just a special case of the attraction effect. Proposition 1 immediately implies that the probability that the target is chosen is strictly increasing in the probability that the target is preferred over z or c. Since the tradeoff between attributes is much worse between t and z than the tradeoff between t and c, one would expect that the probability that t is preferred over z is large relative to the probability that t is preferred over c. Corollary 4 shows that a violation of regularity (i.e., the attraction effect) is observed if it is relatively likely that the target is preferred over z compared to the likelihood that the target is preferred over c.

2.5. Attraction Effect versus Similarity Effect

In studies on the attraction effect, the new alternative z is similar to t in terms of attributes. The fact that the probability that t is chosen increases if a non-dominated alternative z is added to the choice set is even more surprising than the asymmetric dominance effect because the similarity effect predicts the opposite. The similarity effect refers to the observation that a new alternative takes disproportionately more share from similar alternatives than from dissimilar ones. One explanation for the similarity effect is that similar alternatives are closer substitutes. Hence the similarity effect predicts that the probability that t is chosen decreases more than the probability that c is chosen.

If a new alternative is added to the choice set, then the probability that t is chosen increases if the similarity effect is weaker than the attraction effect. Our model allows to separate the contributions of the similarity and attraction effect on choice probabilities. Note that

$$\Pr\{t|c,t,z\} - \Pr\{t|c,t\} = \frac{2}{3} p_{t,c}\left(p_{t,z} - 1\right) + \frac{1}{3} p_{z,c}\left(p_{t,z} - p_{t,c}\right) \tag{1}$$

The first term on the RHS of eqn.1 measures the size of the similarity effect. If $p_{t,z} < 1$, some consumers choose z instead of t. Hence the similarity effect decreases the probability that t is chosen. If t dominates z (i.e., if $p_{t,z} = 1$), the similarity effect vanishes. The second term on the RHS of eqn.1 measures the size of the attraction effect. The new alternative z increases the probability that t is chosen if the subject first compares z with c and prefers z (which happens with probability $\frac{1}{3}p_{z,c}$) and if t is more likely to be preferred in a binary comparison with z than in a binary comparison with c (i.e., if $p_{t,z} > p_{t,c}$). Hence, a necessary condition for the attraction effect is that z is a weaker competitor than c and, therefore, that t is more likely to be preferred in a binary comparison with z than in a binary comparison with c. If $p_{t,z}$ increases, the similarity effect gets weaker and the attraction effect gets stronger.

3. Other choice procedures

Under procedure P, an asymmetrically dominated alternative is chosen with positive probability. In experiments, between 1% and 4% of the subjects choose the asymmetrically dominated alternative. Since the choice of a dominated alternative is clearly suboptimal, the question arises which choice procedures ensure that dominated alternatives are never chosen. In experiments, alternatives are usually described as vector of attributes. In this case, it is straightforward to identify the dominated alternative by comparing the strength of attributes and it is not necessary to refer to preferences or choice probabilities. In this section, we consider situations where subjects know that it is posssible that one alternative is asymmetrically dominated in the sense that some other alternative is always 'better' (i.e., for all preference relations) but where there is no method to identify a dominated alternative without referring to preferences or choice probabilities. Therefore, we use the term 'asymmetrically dominated' for an alternative that is chosen with probability zero in a binary comparison with some other alternative in S.

We consider choice procedures that only rely on the results of binary comparisons to determine the alternative that is chosen.

Definition: A choice procedure is finite if there exists $h < \infty$ such that some alternative from S is chosen after at most h binary comparisons.

Theorem 1: For $n \geq 3$, there exists no finite choice procedure such that an asymmetrically dominated alternative is chosen with probability zero.

To see the intuition behind Theorem 1, note that is not possible to prove that the choice probability in a binary comparison is zero with a finite number of comparisons. Hence, it is not possible to identify asymmetrically dominated alternatives with a finite number of comparisons. But it is possible to identify alternatives that are not dominated. Hence the only way to ensure that asymmetrically dominated alternatives are not chosen is via a choice procedure that puts positive probability only on alternatives that have been preferred over all other alternatives in some binary comparison. While it is possible to identify non-dominated alternatives with a few comparisons, Theorem 1 shows that there exists no finite procedure that identifies at least one non-dominated alternative with probability one. Of course, if the choice set S contains only two alternatives, then any procedure that selects the alternative that is preferred in the binary comparison ensures that a non-dominated alternative is chosen.

Let $n = 3$ and consider the following choice procedure P':

Procedure *P'*:

Step 1: Draw two alternatives from S at random and compare them.

Step 2: Compare the preferred alternative to the alternative that was not part of the last comparison.

Step 3: Repeat step 2. The first alternative that has been preferred over the other two alternatives is chosen.

If $n = 2$, then P' coincides with a binary comparison and the subject simply chooses the preferred alternative. Procedure P' ensures that dominated alternatives are never chosen since subjects choose the first alternative of which they know that it is not dominated. The alternative that is chosen is also the alternative that won the most comparisons. Note that P' is not a finite choice procedure for $n = 3$. Hence for every $h < \infty$, with positive probability no alternative is chosen after h comparisons. For practical purposes, this is less problematic since P' determines with high probability an alternative after a few comparisons. For example, if the probability that an alternative is preferred in a binary comparison is 0.5, then on average, it takes three comparisons to determine the alternative that is chosen.

Let $\Pr_{P'}\{i|i,j,k\}$ be the probability that i is chosen from $\{i,j,k\}$ under procedure P'.

Proposition 2: $\Pr_{P'}\{i|i,j,k\} = \frac{1}{3}p_{i,j}p_{i,k}\left[\frac{1+p_{j,k}(1+p_{k,i})}{1-p_{k,i}p_{j,k}p_{i,j}} + \frac{p_{j,i}+2p_{k,j}+p_{i,j}p_{j,k}}{1-p_{j,i}p_{k,j}p_{i,k}}\right]$.

To relate the results for procedure P' to the findings in section 2, we use the notation from section 2. Hence t and c are the alternatives in the original choice set and t is the alternative whose probability to be chosen is of interest. An asymmetrically dominated alternative is denoted by d, a symmetrically dominated alternative by s, and z refers to an alternative that is inferior to t but not dominated by t or c.

Corollary 5: (Asymmetric Dominance) Let $0 < p_{t,c} < 1$ and $p_{c,d} < 1$. If $p_{d,t} = 0$, then $\Pr_{P'}\{t|t,c,d\} > \Pr_{P'}\{t|t,c\}$ and $\Pr_{P'}\{d|t,c,d\} = 0$.

Corollary 6: (Symmetric Dominance) Let $0 < p_{t,c} < 1$. $\Pr_{P'}\{t|t,c,s\} = \Pr_{P'}\{t|t,c\}$ and $\Pr_{P'}\{c|t,c,s\} = \Pr_{P'}\{c|t,c\}$ if and only if $p_{s,t} = p_{s,c} = 0$.

Corollary 7: (Attraction Effect) For every $0 < p_{t,c} < 1$ and $0 < p_{c,z} < 1$, there exist an interval I such that $\Pr_{P'}\{t|t,c,z\} > \Pr_{P'}\{t|t,c\}$ if and only if $p_{t,z} \in I$.

While P' is a different choice procedure, its qualitative results are the same as for procedure P. Specifically, if an asymmetrically dominated alternative is added to the choice set, the probability that the dominant alternative is chosen increases (Corollary 5) although the asymmetrically dominated alternative is never chosen. Corollary 6 shows that the addition of an alternative has no effect on choice probabilities if and only if the additional alternative is dominated by both alternatives in the original choice set. Corollary 7 shows that the probability that an alternative is chosen can increase even if an alternative is added that is not dominated but that is inferior to one of the alternatives in the original choice set. The fact that the qualitative results under procedure P and P' are the same shows that the explanation of asymmetric dominance and attraction effects does not rely on specific details of the choice procedure but that these effects are a more general property of choice by binary comparisons.

There are two differences between choice procedures P and P': Since P' involves a larger number of comparisons, it is a more complicated choice procedure but choices under P' are more informed since dominated alternatives are never chosen. This suggests that procedure P is more appropriate to describe choices among relatively unimportant alternatives (e.g., different brands of canned beans) whereas procedure P' is more appropriate to describe choices among important alternatives.

Procedure P' offers a formal model of why individuals sometimes compare the same alternatives more than once. Alternatives are compared for a second (third, etc.) time if the results from earlier comparisons are inconclusive because each alternative 'won' a comparison against one of the other alternatives and 'lost' a comparison against another alternative. In such a situation, there is no obvious choice and the only thing that the individual can do to make an informed decision is to proceed with another round of comparisons. Hence procedure P' implies that individuals sometimes revise their opinion and choose an alternative that was not preferred in some earlier comparison.

4. Marketing Implications

There exists plenty of empirical and experimental evidence that choices among three or more alternatives can not be accurately described by standard choice models where individuals choose the alternative that yields the highest utility. However, predicting choices and market shares is crucial for firms. Our model allows to predict market shares and explains the observations of the literature such as the asymmetric dominance, attraction, and similarity effects. The model shows why firms can increase their sales if they introduce a new product even if this product is rarely or never chosen. The model predicts the probability that an alternative is chosen as function of the binary choice probabilities. For firms, it is not only important to predict market shares for a given price of their product but also to determine the optimal price where the price obviously affects market shares. If firms can assess how prices affect binary choice probabilities, then the model can be used to compute market shares as function of the price and, therefore, can be used to determine the profit maximizing price.

We discuss two additional implications for marketing and product design.

4.1. Ordering Effects and the Presentation of Alternatives

It is common that firms try to influence how and where their products are displayed. In the context of this paper, how and where products are displayed is important because it is likely to affect the order in which products are recognized and compared. As benchmark, we assume in sections 2 and 3 that each alternative is with equal likelihood part of the first comparison. In real choice situations, there exist various possibilities to influence the order in which products are compared. For example, in a supermarket, two products can be placed on the same shelf and one product on the shelf above or below. Similarly, since all customers approach the check-out from the same direction, the order in which products are arranged on the same shelf can be chosen to affect the order in which they are compared.

Recall that P' is a more complicated choice procedure than P but that it leads to decisions that are better informed. This suggests that P is the more appropriate description if subjects choose among relatively unimportant items whereas P' is the more appropriate description for important items. Consider procedure P. If there are three products and product i is part of the first binary comparison, then it is chosen if it is preferred over each of the other two products. However, if product i is not in first but only in the second comparison, then it is chosen if it is preferred over one product (the one that 'wins' the first comparison). Hence, the probability that a product is chosen decreases in the probability that the product is part of the first comparison. Choices under procedure P exhibit a recency effect in the sense that an alternative is more likely to be chosen if it is presented later rather than earlier. The recency effect occurs because subjects only consider the alternative that was preferred in the last comparison when they make the next comparison. On the other hand, choices under procedure P' exhibit a primacy effect as the probability that a product is chosen increases in the probability that the product is part of the first comparison. The primacy effect occurs because subjects try to avoid the mistake of choosing a dominated alternative. Therefore, they choose the first alternative that is known to be not dominated which is equivalent to choosing the first alternative that is preferred over both other alternatives.

To summarize the results, the model shows that ordering effects matter and that we should expect to observe a recency effect if individuals choose among relatively unimportant items and a primacy effect if individuals choose among important items. Of course, firms should take these ordering effects into account and adjust the presentation of their products accordingly.

4.2. Product Design

Firms regularly redesign products to react to the products that are offered by competitors. Consider a firm that faces two competitors j and k. For simplicity, suppose that there exist only two options to redesign product i. The first increases the probability that i is preferred over j but has no effect on the probability that i is preferred over k. The second increases the probability that i is preferred over k but has no effect on the probability that i is preferred over j. Suppose that j is a stronger competitor than k in the sense that $p_{jk} > 0.5$ and that the probability that j is preferred over i is larger than the probability that k is preferred over i. Note that procedure P and P' predict that the market share of j is larger than the market share of k. The model shows that the firm should choose the first option to redesign product i. Both under procedure P and P' a marginal increase of $p_{i,j}$ has a larger effect on the probability that i is chosen than a marginal increase of $p_{i,k}$. The reason is twofold. Since $p_{j,k} > 0.5$, product i is more likely to be compared to j than to k. And since $p_{i,j} < p_{i,k}$, a marginal increase of $p_{i,j}$ raises the probability that i is preferred over j and k more that a marginal increase of $p_{i,k}$. Generally speaking, this implies that firms should orient the redesign of their products towards the strongest competitor. An increase of the probability that one's product is preferred over the strong competitor leads to a larger increase of the market share than an increase of the probability that one's product is preferred over the weak competitor.

5. Conclusion

By now, there exists plenty of experimental and empirical evidence that context effects matter and that choice patterns among more than two alternatives systematically violate the assumption of regularity. In particular, the asymmetric dominance and the attraction effect show that the probability that an alternative is chosen can increase if a new alternative is added to the choice set. These observations challenge standard economic theory because they contradict even the weakest rationality requirements in economic models. This poses difficulties for firms when they try to predict how market shares change if new products are introduced.

Most explanations of the asymmetric dominance and the attraction effect that have been suggested in the literature concentrate on qualitative results and do not generate quantitative predictions. These explanations relate the strength of attributes of different alternatives (essentially: the utility that is derived from an attribute) to the probability that an alternative is chosen. Context effects arise because new alternatives affect how individuals weight and perceive attributes or because new alternatives make it easier to justify a decision.

We analyze a simple and intuitive model of procedural choice among several alternatives. Individuals determine their choice by a sequence of binary comparisons between the alternatives. The model generates quantitative predictions about choice patterns and how choices change if alternatives are added or excluded. The model explains asymmetric dominance, attraction, and similarity effects in a simple unified framework. Our approach highlights a new and fundamental aspect why the context of the choice situation affects choices. New alternatives affect choices because they are compared to the other alternatives and because the result of the comparisons determines which alternative is choosen.

Since the model is easy to apply and uses a simple probabilistic choice framework, it is straightforward to use the model to analyze related questions such as marketing strategies or product design. For example, the model explains why we observe recency and primacy effects and shows how firms can benefit if they take these ordering effects into account. Another application is product design. The model shows that firms which redesign their product should orient the new design towards improving relative to the strongest competitor.

6. Appendix

Proof Proposition 1: If there exist n alternatives, then procedure P specifies $n-1$ binary comparisons. With probability $\frac{2}{n}$ is an alternative part of the first comparison. With probability $\frac{1}{n}$ it appears for the first time in comparison $2, 3, ..n-1$.

Therefore, with probability $\frac{n-1}{n}$ is i part of the first $n-2$ comparisons. Given that i is part of the first $n-2$ comparisons, with probability $\frac{1}{n-1}$ is j not part of the first $n-2$ comparisons and appears only in the last comparison. Given that i is part of the first $n-2$ comparisons while j is not, the probability that i is chosen is $\Pr\{i|S_{-j}\} \cdot p_{ij}$.

Alternative i appears with probability $\frac{1}{n}$ only in the last comparison. Given that i appears for the first time in the last comparison, the probability that j is the winning alternative after $n-2$ comparisons is $\Pr\{j|S_{-i}\}$. Hence $\frac{1}{n}\sum_{j\neq i}\Pr\{j|S_{-i}\} \cdot p_{ij}$ is the probability that i appears only in the last comparison and that i is chosen.

Hence $\Pr\{i|S\} = \frac{1}{n}\sum_{j\neq i}\Pr\{i|S_{-j}\}\cdot p_{ij} + \frac{1}{n}\sum_{j\neq i}\Pr\{j|S_{-i}\}\cdot p_{ij} \; = \frac{1}{n}\sum_{j\neq i} p_{ij}\left(\Pr\{i|S_{-j}\} + \Pr\{j|S_{-i}\}\right)$

Proof Corollary 1: With probability $\frac{2}{3}$, alternative t is part of the first comparison. In this case t is chosen if it is preferred against c and d, i.e., with probability $p_{t,c}p_{t,d}$. With probability $\frac{1}{3}$, the first comparison is between c and d. With probability $p_{c,d}$, c is preferred over d and t is chosen with probability $p_{t,c}p_{c,d}$. With probability $1-p_{c,d}$, d is preferred over c and t is chosen with probability $p_{t,d}(1-p_{c,d})$.

Proof Corollary 2: If $p_{t,d} = 1$, then $\Pr\{t|c,t,d\} = \frac{2}{3}p_{t,c} + \frac{1}{3}\left[p_{t,c}p_{c,d} + 1 - p_{c,d}\right]$. By assumption, $p_{c,t}, p_{c,d} \in (0,1)$. Hence $\frac{2}{3}p_{t,c} + \frac{1}{3}\left[p_{t,c}p_{c,d} + 1 - p_{c,d}\right] > p_{t,c}$. Hence $\Pr\{t|c,t,d\} > \Pr\{t|c,t\}$.

Proof Corollary 3: obvious

Proof Corollary 4: Recall that $\Pr\{t|c,t,z\} > \Pr\{t|c,t\}$ if $\frac{2}{3}p_{t,c}p_{t,z} + \frac{1}{3}\left[p_{t,c}p_{c,z} + p_{t,z}(1-p_{c,z})\right] > p_{t,c}$. Rearranging terms shows that $\Pr\{t|c,t,d\} > \Pr\{t|c,t\}$ if $\frac{p_{t,z}p_{z,c}}{2(1-p_{t,z})+p_{z,c}} > p_{t,c}$.

Proof Theorem 1:

We prove the Theorem for $n = 3$. The extension to $n > 3$ is straightforward (e.g., one can always add alternatives that are dominated by the first three alternatives).

If $n = 3$, then there are three binary comparisons possible. Let h_1, h_2, and h_3 denote how often i is compared to j, j is compared to k, and k is compared to i, with $h_1 + h_2 + h_3 = h$ with $h < \infty$. Wlog. suppose that $p_{i,j} > 0$, that $p_{j,k} > 0$, and that $p_{k,i} > 0$. Hence it is possible that j is dominated by i or that k is dominated by j or that i is dominated by k (i.e., it is possible that $p_{i,j} = 1$ or $p_{j,k} = 1$ or $p_{k,i} = 1$).

With probability ${p_{i,j}}^{h_1}{p_{j,k}}^{h_2}{p_{k,i}}^{h_3}$ each alternative 'wins' all comparisons against one of the remaining alternatives and 'looses' all comparisons against the other one. Since by assumption $p_{i,j} \cdot p_{j,k} \cdot p_{k,i} > 0$, with positive probability the choice procedure has to determine an alternative after h comparisons when each alternative has 'won' each comparisons against one of the remaining alternatives and 'lost' all comparisons against the other one. Hence, regardless whether the choice procedure chooses i, j, or k, it is possible that the chosen alternative is dominated by one of the other alternatives.

Note that the argument holds for all h_1, h_2, and h_3 with $h_1+h_2+h_3 = h$ and $h < \infty$. Hence, the argument does not depend on the details of the choice procedure (that might specify the order or frequency of comparisons as function of the outcomes of earlier comparisons). Hence the argument applies to all finite choice procedures.

Proof Proposition 2: With probability $\frac{1}{3}$ the first comparison is between i and j. The probability that i is chosen given that the first comparison is between i and j is:

$$\Pr_{P'}\{i|i,j,k\}_{\text{start } i,j} = \underbrace{p_{i,j}}_{\text{i-j}} \left[\underbrace{p_{i,k}}_{\text{i-k}} + \underbrace{(1-p_{ik})p_{j,k}p_{i,j}}_{\text{i-}\mathbf{k}\text{, k-}\mathbf{j}\text{, j-}\mathbf{i}} \left[\underbrace{p_{i,k}}_{\text{i-k}} + \underbrace{(1-p_{ik})p_{j,k}p_{i,j}}_{\text{i-}\mathbf{k}\text{, k-}\mathbf{j}\text{, j-}\mathbf{i}} [...] \right] \right]$$

$$+ \underbrace{(1-p_{i,j})(1-p_{j,k})p_{i,k}}_{\text{i-}\mathbf{j}\text{, j-}\mathbf{k}\text{, k-}\mathbf{i}} \left[\underbrace{p_{i,j}}_{\text{i-j}} + \underbrace{(1-p_{i,j})(1-p_{j,k})p_{i,k}}_{\text{i-}\mathbf{j}\text{, j-}\mathbf{k}\text{, k-}\mathbf{i}} \left[\underbrace{p_{i,j}}_{\text{i-j}} + \underbrace{(1-p_{i,j})(1-p_{j,k})p_{i,k}}_{\text{i-}\mathbf{j}\text{, j-}\mathbf{k}\text{, k-}\mathbf{i}} [...] \right] \right]$$

The first line of the equation is the probability that i is chosen if i is preferred over j in the first comparison, the second line is the probability that i is chosen if j is preferred over i in the first comparison. The letters under the horizontal curly brackets indicate which alternatives are compared. Alternatives that are preferred are denoted in bold letters.

Then $\Pr_{P'}\{i|i,j,k\}_{\text{start } i,j} = p_{i,j}p_{i,k}\left[1 + (1-p_{i,k})p_{j,k}p_{i,j} + ((1-p_{i,k})p_{j,k}p_{i,j})^2 + ...\right]$

$+p_{i,j}\left[(1-p_{i,j})(1-p_{j,k})p_{i,k} + ((1-p_{i,j})(1-p_{j,k})p_{i,k})^2 + ...\right]$

Hence $\Pr_{P'}\{i|i,j,k\}_{\text{start } i,j} = \frac{p_{i,j}p_{i,k}}{1-(1-p_{i,k})p_{j,k}p_{i,j}} + p_{i,j}\frac{(1-p_{i,j})(1-p_{j,k})p_{i,k}}{1-(1-p_{i,j})(1-p_{j,k})p_{i,k}}$.

With probability $\frac{1}{3}$ the first comparison is between i and k. The probability that i is chosen given that the first comparison is between i and k is:

$\Pr_{P'}\{i|i,j,k\}_{\text{start } i,k} = p_{i,k}\left[p_{i,j} + (1-p_{i,j})(1-p_{j,k})p_{i,k}\left[p_{i,j} + (1-p_{i,j})(1-p_{j,k})p_{i,k}\left[...\right]\right]\right]$

$+(1-p_{i,k})p_{j,k}p_{i,j}\left[p_{i,k} + (1-p_{i,k})p_{j,k}p_{i,j}\left[p_{i,k} + (1-p_{i,k})p_{j,k}p_{i,j}\left[...\right]\right]\right]$

Hence $\Pr_{P'}\{i|i,j,k\}_{\text{start } i,k} = \frac{p_{i,k}p_{i,j}}{1-(1-p_{i,j})(1-p_{j,k})p_{i,k}} + p_{i,k}\frac{(1-p_{i,k})p_{j,k}p_{i,j}}{1-(1-p_{i,k})p_{j,k}p_{i,j}}$.

With probability $\frac{1}{3}$ the first comparison is between j and k. The probability that i is chosen given that the first comparison is between j and k is:

$\Pr_{P'}\{i|i,j,k\}_{\text{start } j,k} = p_{j,k}p_{i,j}\left[p_{i,k} + (1-p_{i,k})p_{j,k}p_{i,j}\left[p_{i,k} + (1-p_{i,k})p_{j,k}p_{i,j}\left[...\right]\right]\right]$

$+(1-p_{j,k})p_{i,k}\left[p_{i,j} + (1-p_{i,j})(1-p_{j,k})p_{i,k}\left[p_{i,j} + (1-p_{i,j})(1-p_{j,k})p_{i,k}\left[...\right]\right]\right]$

Hence $\Pr_{P'}\{i|i,j,k\}_{\text{start } j,k} = \frac{p_{j,k}p_{i,j}p_{i,k}}{1-(1-p_{i,k})p_{j,k}p_{i,j}} + (1-p_{j,k})p_{i,k}\frac{p_{i,j}}{1-(1-p_{i,j})(1-p_{j,k})p_{i,k}}$.

Then $\Pr_{P'}\{i|i,j,k\} = \frac{1}{3}\Pr_{P'}\{i|i,j,k\}_{\text{start } i,j} + \frac{1}{3}\Pr_{P'}\{i|i,j,k\}_{\text{start } i,k} + \frac{1}{3}\Pr_{P'}\{i|i,j,k\}_{\text{start } j,k}$.

Since $p_{j,k} = 1 - p_{k,j}$ and similar for $p_{i,k}$ and $p_{i,j}$ we have

$\Pr_{P'}\{i|i,j,k\} = \frac{1}{3}p_{i,j}p_{i,k}\left[\frac{1+p_{j,k}(1+p_{k,i})}{1-p_{k,i}p_{j,k}p_{i,j}} + \frac{p_{j,i}+2p_{k,j}+p_{i,j}p_{j,k}}{1-p_{j,i}p_{k,j}p_{i,k}}\right]$.

Proof Corollary 5: If $p_{d,t} = 0$, then $\Pr_{P'}\{t|t,c,d\} = \frac{1}{3}p_{t,c}\left[1 + p_{c,d} + \frac{p_{c,t}+2p_{d,c}+p_{t,c}p_{c,d}}{1-p_{c,t}p_{d,c}}\right]$. If $p_{d,t} = 0$ and $p_{c,d} = 1$, then $\Pr_{P'}\{t|t,c,d\} = p_{t,c}$. Hence it is sufficient to show that $1 + p_{c,d} + \frac{p_{c,t}+2p_{d,c}+p_{t,c}p_{c,d}}{1-p_{c,t}p_{d,c}}$ is decreasing in $p_{c,d}$.

Recall that $p_{d,c} = 1 - p_{c,d}$ and $p_{c,t} = 1 - p_{t,c}$. Hence $1 + p_{c,d} + \frac{p_{c,t}+2p_{d,c}+p_{t,c}p_{c,d}}{1-p_{c,t}p_{d,c}} = 1 + p_{c,d} + \frac{3-p_{t,c}-2p_{c,d}+p_{t,c}p_{c,d}}{p_{t,c}+p_{c,d}-p_{t,c}p_{c,d}}$. Then $\frac{\partial}{\partial p_{c,d}}\left(1 + p_{c,d} + \frac{3-p_{t,c}-2p_{c,d}+p_{t,c}p_{c,d}}{p_{t,c}+p_{c,d}-p_{t,c}p_{c,d}}\right) = 1 + \frac{-3+2p_{t,c}}{(p_{t,c}+p_{c,d}-p_{t,c}p_{c,d})^2}$.

Note that $2p_{t,c} - 3 \leq -1$. Hence $1 + \frac{2p_{t,c}-3}{(p_{t,c}+p_{c,d}-p_{t,c}p_{c,d})^2} \leq 1 - \frac{1}{(p_{t,c}+p_{c,d}-p_{t,c}p_{c,d})^2}$. Note that $p_{t,c} + p_{c,d} - p_{t,c}p_{c,d} < 1$ except if $p_{t,c} = 1$ and/or $p_{c,d} = 1$. Since $0 < p_{t,c} < 1$ and $p_{c,d} < 1$ we have $1 + \frac{2p_{t,c}-3}{(p_{t,c}+p_{c,d}-p_{t,c}p_{c,d})^2} < 0$. Hence $1 + p_{c,d} + \frac{p_{c,t}+2p_{d,c}+p_{t,c}p_{c,d}}{1-p_{c,t}p_{d,c}}$ is decreasing in $p_{c,d}$ and, therefore, $p_{d,t} = 0$ implies that $\Pr_{P'}\{t|t,c,d\} > p_{t,c}$ for all $p_{t,c}, p_{c,d}$ with $0 < p_{t,c} < 1$ and $p_{c,d} < 1$.

Proof Corollary 6: The 'if' statement is obvious. With respect to the 'only if' statement, note that if $p_{s,t} > 0$ and $p_{s,c} > 0$, then s is chosen with positive probability and, therefore, it can not be true that $\Pr_{P'}\{t|t,c,s\} = \Pr_{P'}\{t|t,c\}$ and $\Pr_{P'}\{c|t,c,s\} = \Pr_{P'}\{c|t,c\}$. Consider $p_{s,t} = 0$ and $p_{s,c} > 0$. Then Corollary 5 shows that $\Pr_{P'}\{t|t,c,s\} > \Pr_{P'}\{t|t,c\}$. The same argument applies if $p_{s,t} > 0$ and $p_{s,c} = 0$.

Proof Corollary 7: From Corollary 5 follows that $\Pr_{P'}\{t|t,c,z\} > p_{t,c}$ if $p_{t,z} = 1$ and that $\Pr_{P'}\{t|t,c,z\} < p_{t,c}$ if $p_{t,z} = 0$. Note that $\Pr_{P'}\{t|t,c,z\}$ is continuous and increasing in $p_{t,z}$. Hence there exists $\epsilon > 0$ such that $\frac{1}{3}p_{t,c}(1-\epsilon)\left[\frac{1+\epsilon p_{c,z}+p_{c,z}}{1-\epsilon p_{c,z}p_{t,c}} + \frac{3-p_{t,c}-2p_{c,z}+p_{t,c}p_{c,z}}{1-(1-p_{t,c})(1-p_{c,z})(1-\epsilon)}\right] = p_{t,c}$. Hence for all $p_{t,z} \in (1-\epsilon, 1]$ we have $\Pr_{P'}\{t|t,c,z\} > p_{t,c}$.

7. References

Amaldoss, W., J. Bettman, J.W. Payne. 2005. Biased but Efficient: An Investigation of Coordination Facilitated by Asymmetric Dominance, mimeo Duke University.

Ballinger, P., N. Wilcox. 1997. Decisions, Error and Heterogeneity, *Economic Journal* **107**, 1090-1105.

Blavatskyy, P., W. Köhler. 2007. Lottery Pricing in the Becker-DeGroot-Marschak Procedure, IEW-Working Paper, University of Zürich http://papers.ssrn.com/sol3/papers.cfm?abstract_id=988695.

Dhar, R., I. Simonson. 2003. The Effect of Forced Choice on Choice, *Journal of Marketing Research* **40**, 146–160.

Doyle, J., D. O'Connor, G. Reynolds, G.,P. Bottomley. 1999. The Robustness of the Asymmetrically Dominated Effect: Buying Frames, Phantom Alternatives, and In-Store Purchases, *Psychology&Marketing* **16**(3), 225-243.

Herne, K. 1999. The Effects of Decoy Gambles on Individual Choice, *Experimental Economics* **2**, 31-40.

Herne, K.. 1997. Decoy Alternatives in Policy Choices: Asymmetric Domination and Compromise Effects, *European Journal of Political Economy* **13**, 575-589.

Hey, J., C. Orme. 1994. Investigating generalisations of expected utility theory using experimental data, *Econometrica* **62**, 1291-1326.

Highhouse, S. 1996. Context-Dependent Selection: The Effects of Decoy and Phantom Job Candidates, *Organizational Behavior and Human Decision Processes* **65**, 68-76.

Huber, J., C. Puto. 1983. Market Boundaries and Product Choice: Illustrating Attraction and Substitution Effects, *Journal of Consumer Research* **10**, 31-44.

Huber, J., J.W. Payne, C. Puto. 1982. Adding Asymmetrically Dominated Alternatives: Violations of Regularity and the Similarity Hypothesis, *Journal of Consumer Research* **9**, 90-98.

Hurly, T.A. 2003. The twin-threshold model: risk-intermediate foraging by rufous hummingbirds, *Animal Behaviour* **66**, 751-761.

Kardes, F., P. Herr, D. Marlino. 1996. Some New Light on Substitution and Attraction Effects, *Advances in Consumer Research* **16**, 203-208.

Lehman, D.R., Y. Pan. 1994. Context Effects, New Brand Entry, and Consideration Sets, *Journal of Marketing Research* **31**, 364-374.

Pan, Y., S. O'Curry, R. Pitts. 1995. The Attraction Effect and Political Choice in Two Elections, *Journal of Consumer Psychology*, 85-101.

Ratneshwar, S., A. Shocker, D. Stewart. 1987. Toward Understanding the Attraction Effect: The Implications of Product Stimulus Meaningfulness and Familarity, *Journal of Consumer Research* **13**, 520-533.

Roe, R.M., J.R. Busemeyer, J.T. Townsend. 2001. Multialternative Decision Field Theory:

A Dynamic Connectionist Model of Decision Making, *Psychological Review* **108**, 370-392.

Shafir, S., T. Waite, B. Smith. 2002: Context-dependent violations of rational choice in honeybees and gray jays, *Behavioral Ecology and Sociobiology* **51**, 180–187.

Sen, A. 1993. Internal Consistency of Choice, *Econometrica* **61**, 495-521.

Simonson, I., A. Tversky. 1992. Choice in Context: Tradeoff Contrast and Extremeness Aversion, *Journal of Marketing Research* **29**, 281-295.

Tversky, A., I. Simonson. 1993. Context-dependent Preferences, *Management Science* **39**, 1179-1189.

Wedell, D. 1991. Distinguishing Among Models of Contextually Induced Preference Reversals, *Journal of Experimental Psychology: Learning, Memory, and Cognition* **17**(4), 767-778.

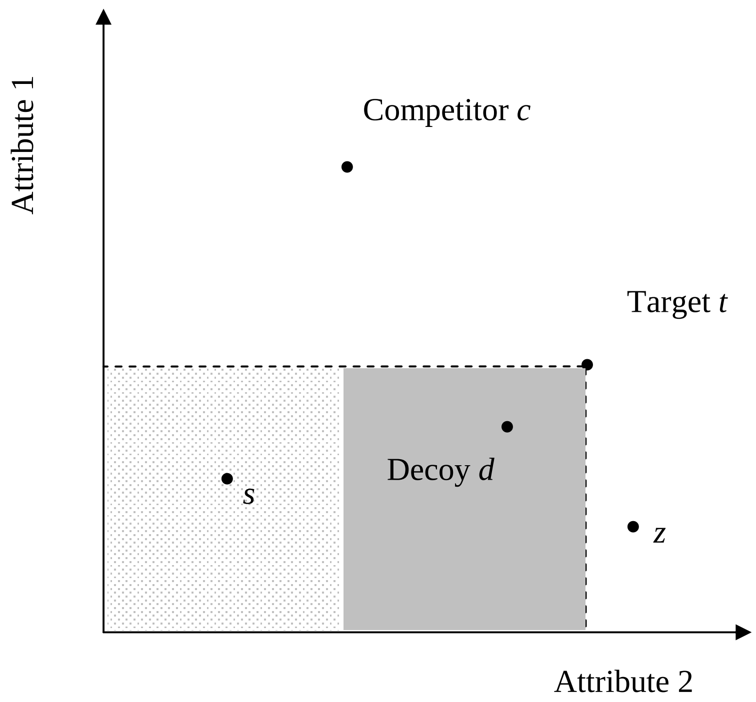

Figure 1