Marketing Science
Vol. 26, No. 6, November–December 2007, pp. 742–757
issn 0732-2399 | eissn 1526-548X | 07 | 2606 | 0742
doi 10.1287/mksc.1060.0254




# Zero as a Special Price: The True Value of Free Products

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When faced with a choice of selecting one of several available products (or possibly buying nothing), according to standard theoretical perspectives, people will choose the option with the highest cost–benefit difference. However, we propose that decisions about free (zero price) products differ, in that people do not simply subtract costs from benefits but instead they perceive the benefits associated with free products as higher.

We test this proposal by contrasting demand for two products across conditions that maintain the price difference between the goods, but vary the prices such that the cheaper good in the set is priced at either a low positive or zero price. In contrast with a standard cost–benefit perspective, in the zero-price condition, dramatically more participants choose the cheaper option, whereas dramatically fewer participants choose the more expensive option. Thus, people appear to act as if zero pricing of a good not only decreases its cost, but also adds to its benefits. After documenting this basic effect, we propose and test several psychological antecedents of the effect, including social norms, mapping difficulty, and affect. Affect emerges as the most likely account for the effect.

*Key words*: free; zero; affect; pricing
*History*: This paper was received December 14, 2005, and was with the authors 3 months for 1 revision; processed by David Bell.

## 1. Introduction

> The point about zero is that we do not need to use it in the operations of daily life. No one goes out to buy zero fish. It is in a way the most civilized of all the cardinals, and its use is only forced on us by the needs of cultivated modes of thought.
>
> —Alfred North Whitehead

Initially invented by Babylonians not as a number, but as a placeholder, the concept of zero and void was feared and denied by Pythagoras, Aristotle, and their followers for centuries. The most central objection of the early Greeks to zero was based on religious beliefs; they argued that god was infinite, and therefore void (zero) was not possible. In addition to religious arguments, the early Greeks did not recognize their need for zero because their mathematics was based on geometry, which made zero and negative numbers unnecessary. This failure to adopt the concept of zero likely impeded their discovery of calculus and slowed the development of mathematics for centuries.

The concept of zero as a number was first accepted in India where, unlike in Greece, algebra was separate from geometry, infinity and void appeared within the same system of beliefs (i.e., destruction, purity, and new beginnings), and the concept of zero flourished. The notion of zero later found its way into Arabia and later immigrated to Europe. Because Aristotle had not accepted zero, and because Christianity was partially based on Aristotelian philosophy and his "proof of God," zero was not widely embraced by the Christian world until the sixteenth century.[1]

In more recent history, the concept of zero enters into the understanding of multiple aspects of human psychology. In various domains, zero is used in a qualitatively different manner from other numbers, and the transition from small positive numbers to zero often is discontinuous.

Cognitive dissonance theory (Festinger and Carlsmith 1959) shows that getting a zero reward can increase liking for a task compared with receiving a small positive reward. Subsequent work reveals that changing a reward from something to nothing can influence motivation (Festinger and Carlsmith 1959)

[1] For a good source describing the history of zero, see Seife (2000).

and switch it from intrinsic to extrinsic (Lepper et al. 1973), alter self-perception (Bem 1965), and affect feelings of competence and control (Deci and Ryan 1985). For example, Gneezy and Rustichini (2000a) demonstrate that introducing a penalty for parents who are late picking up their children from kindergarten can actually increase tardiness. Similarly, Gneezy and Rustichini (2000b) find that although performance in tasks such as IQ tests or collecting money for charity increases, as expected, with the size of a positive piecewise reward, the zero reward represents an exception in which performance is greater when no reward is mentioned relative to when a small reward exists.

Related to these findings on motivation and incomplete contracts, it has also been shown that when prices are mentioned, people apply market norms, but when prices are not mentioned (i.e., the price effectively is zero), they apply social norms to determine their choices and effort (Heyman and Ariely 2004). As an illustration, Ariely et al. (2006) show that when offered a piece of Starburst candy at a cost of 1¢ per piece, students take approximately four pieces; when the price is zero, more students take the candy, but almost no one takes more than one piece (i.e., decreased demand when prices are reduced).

Finally, in a different domain and in the most influential research on the psychology of zero, Kahneman and Tversky's (1979) work on probabilities indicates that when it comes to gambles, people perceive zero probability (and certainty) substantially differently than they do small positive probabilities. That is, whereas the values of the latter are perceived as higher than they actually are, perceptions of zero probability are accurate.

In this work, we extend research on the psychology of zero to pricing and examine the psychology of "free." Intuition and anecdotal evidence suggest that in some sense, people value free things too much. When Ben and Jerry's offer free ice-cream cones, or Starbucks offers free coffee, many people spend hours in line waiting to get the free item, which they could buy on a different day for two to three dollars. At first glance, it might not be surprising that the demand for a good is very high when the price is very low (zero), but the extent of the effect is intuitively too large to be explained by this simple economic argument. The goal of this paper is to examine the validity of this intuition, and to establish the causes of the phenomenon.

In a series of experiments, we demonstrate that when people are faced with a choice between two products, one of which is free, they overreact to the free product as if zero price meant not only a low cost of buying the product, but also its increased valuation. In the next section, we describe a method to examine reaction and overreaction to free products. In §3, we detail two formal models: one that treats the price of zero as any other price, and one that includes a unique role for zero. The contrasts between these two models provide some predictions for the effects of price reductions on demand. Then, in §4, we report experimental evidence in support of the zero-price model. We take a first step in finding the psychological causes that bring about the effect of zero price and test them in §5, then end with general conclusions and some questions for further research.

## 2. Measuring Reaction/Overreaction to Zero Price

To determine if people overreact to free products, we might simply test whether consumers take much more of a product when it is free than they buy of the product when it has a very low price (e.g., 1¢). However, although such behavior would be consistent with an overreaction to free, it also could simply reflect an increase in demand when price decreases. Similarly, it is not sufficient to show that the increase in demand when price falls from 1¢ to zero is greater than the increase in demand when the price drops from 2¢ to 1¢ because such a pattern of behavior could reflect a demand structure that is nonlinear in price (e.g., created by a valuation distribution in which more people value the product between 0¢ and 1¢ than between 1¢ and 2¢).

To measure reaction to zero and overcome these possible alternative interpretations, we examine whether people select a free product even when they must forgo an option that they "should" find preferable. We employ a method that contrasts two choice situations that involve a constant difference between two products' net benefits and use aggregate preference inconsistency as a measure of overreaction to the free product. The basic structure of this approach (and our experiments) is as follows: All subjects may choose among three options: buy a low-value product (e.g., one Hershey's Kiss; hereafter "Hershey's"), buy a higher-value product (e.g., one Lindt truffle), or buy nothing. The variation across conditions that enables us to measure their reaction to the price of zero relies on two basic conditions: "cost" and "free." In the cost condition, the prices of both products are positive (e.g., Hershey's costs 1¢ and the Lindt truffle 14¢). In the free condition, both prices are reduced by the same amount, so that the cheaper good becomes free (e.g., Hershey's is free, and the Lindt truffle is 13¢).

We also consider how such constant price reductions might influence demand for these two products in a model in which zero is particularly attractive and one in which zero is just another price so that we may better understand how this scenario might test whether the price of zero has some added attraction. According to a model in which the price of zero is particularly attractive, a price reduction from the cost condition to the free condition should create a boost in the attractiveness of the product that has become free, and hence increase its relative demand. However, from the perspective of a model in which zero is just another price, because all changes in prices are the same, reducing one of the prices to zero should not create any unique advantage. In the next section, we examine these two models more formally and provide some testable predictions for distinguishing between them.

## 3. Formal Account of Standard Economic and Zero-Price Models

We describe a "standard" model of how consumers behave in a situation in which they must choose between two products at certain prices (or buy nothing), as well as how their choices might change if both prices are reduced by the same amount. We then consider a special case of this situation in which the price decrease is equal to the original smaller price; that is, the new smaller price is zero. Furthermore, we contrast this standard model with the *zero-price model*, which is identical in all respects except that it assumes that when a product becomes free, its intrinsic value for consumers (or "benefit," in cost–benefit terminology) increases. After clarifying the different predictions of the two models regarding the observable behavior of consumers, we empirically test them in §4.

Consider a model with linear utilities, in which a consumer must choose among three options X, Y, and N (we discuss the linearity assumption in detail later). Option X refers to buying one unit of product X priced at $P_X$; option Y means buying one unit of product Y priced at $P_Y$; and option N means the consumer buys nothing. Suppose that the consumer values the first product at $V_X$ and the second product at $V_Y$; he or she will then choose X if and only if

$$V_X > P_X \quad \text{and} \quad V_X - P_X > V_Y - P_Y.^2 \tag{1}$$

The consumer will choose Y if and only if

$$V_Y > P_Y \quad \text{and} \quad V_Y - P_Y > V_X - P_X. \tag{2}$$

Finally, the consumer will buy nothing (choose N) if and only if

$$V_X < P_X \quad \text{and} \quad V_Y < P_Y. \tag{3}$$

Assume there are multiple consumers with $[V_X, V_Y]$ distributed over $R^2$; the three sets of inequalities determine three groups of consumers who choose each of the three options (see Figure 1a).

Now consider a situation in which both prices are reduced by the same amount $\varepsilon$. The new prices are thus equal to $[P_X - \varepsilon, P_Y - \varepsilon]$. How do the demand segments change? With the new prices, consumers who choose X are those with

$$V_X > P_X - \varepsilon \quad \text{and} \quad V_X - P_X > V_Y - P_Y. \tag{1a}$$

Consumers choosing Y are those with

$$V_Y > P_Y - \varepsilon \quad \text{and} \quad V_Y - P_Y > V_X - P_X. \tag{2a}$$

Finally, consumers choosing N are those with

$$V_X < P_X - \varepsilon \quad \text{and} \quad V_Y < P_Y - \varepsilon. \tag{3a}$$

Comparing the two sets of formulas (or inspecting Figure 1b), we note that consumers who originally choose X keep choosing X, and consumers who originally choose Y keep choosing Y. Thus, according to this model, there should be no switching from one product to another. The only two possible changes in demand are that some consumers who originally buy nothing switch to either X (those with $V_X - P_X > V_Y - P_Y$ and $P_X - \varepsilon < V_X < P_X$) or Y (those with $V_Y - P_Y > V_X - P_X$ and $P_Y - \varepsilon < V_Y < P_Y$).

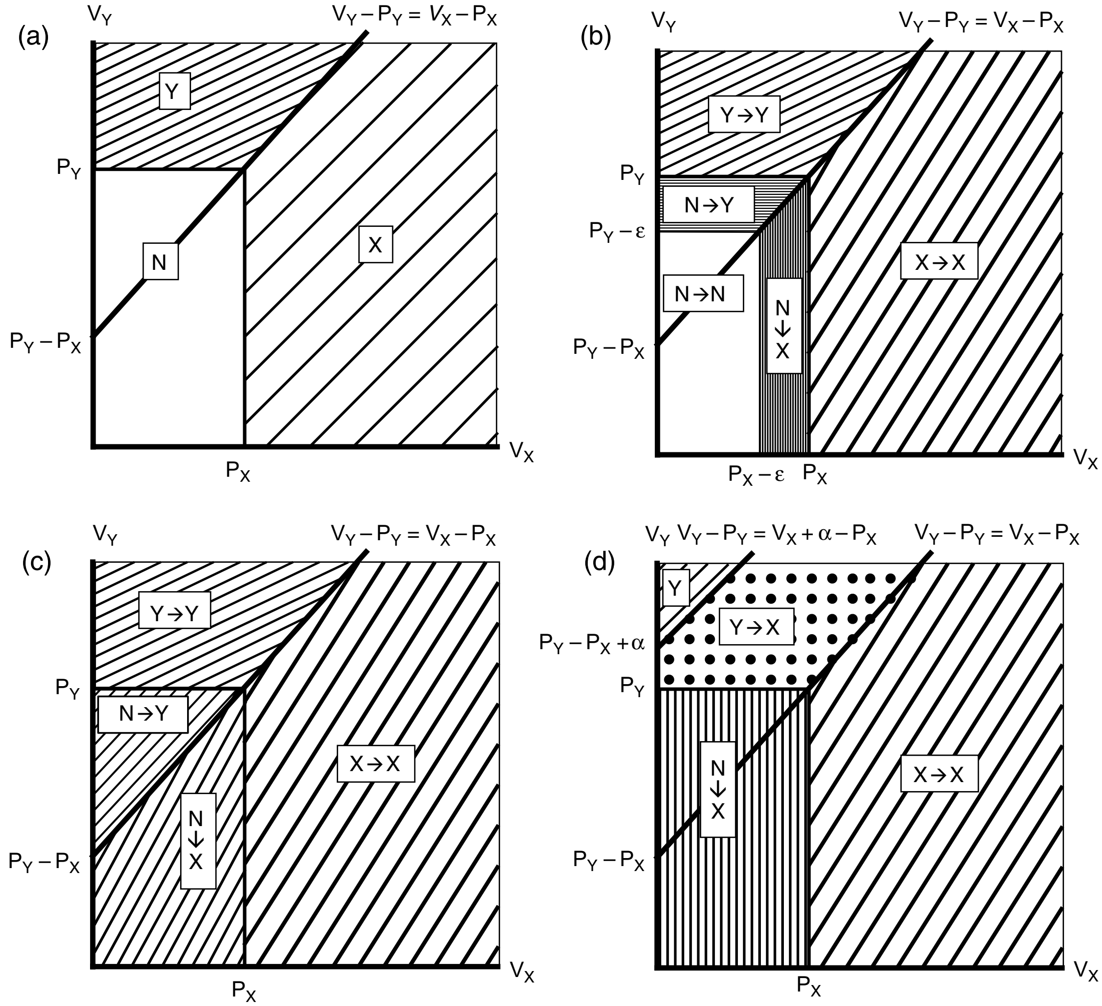
In short, according to this simple cost–benefit model, when prices decrease by the same amount, the costs decrease by the same magnitude for both products, whereas their benefits remain the same. Hence, the net benefits increase by the same amount. In turn, this model predicts that when the prices of both products drop by the same amount, both demands increase weakly (see Table 1).

Now consider a special case in which the price reduction, $\varepsilon$, equals the original smaller price, say $P_X$, so that the prices drop from $[P_X, P_Y]$ to $[0, P_Y - P_X]$. If zero is just another price, the preceding predictions remain valid. In our study setting, when prices decrease from the cost condition to the free condition, the proportion of consumers choosing each of the two products should increase weakly (see Figure 1c).

Next consider the zero-price model, which assumes that when a product becomes free, consumers attach a special value to it; that is, their intrinsic valuation of the good increases by, say, $\alpha$. Note that the decision to add $\alpha$ to the benefit (intrinsic valuation) of the free good is rather arbitrary. All the predictions would go through just the same, if we assume that $\alpha$ is added directly to the net benefit of the free good or subtracted from its cost, or even added to the costs

[2] Without loss of generality, we may assume that the probability that any of these or subsequent inequalities turns into an equality is zero.

**Figure 1** **Segments of Customers Who Choose Options X, Y, and N as Prices Go Down from $[P_X, P_Y]$ to $[P_X - \varepsilon, P_Y - \varepsilon]$, as Predicted by the Standard Economic Model with Linear Utilities and the Zero-Price Model**




*Notes.* Panel A presents the demand distribution when prices are $[P_X, P_Y]$.

Panel B presents the changes in segments of customers choosing options X, Y, and N when prices are reduced from $[P_X, P_Y]$ to $[P_X - \varepsilon, P_Y - \varepsilon]$.

Panel C presents the changes in segments of customers choosing options X, Y, and N when prices are reduced from $[P_X, P_Y]$ to $[0, P_Y - P_X]$ under the assumptions of the standard model.

Panel D presents the same changes under the assumptions of the zero price model.

of all nonfree goods (extra pain of paying). We will discuss the nature of $\alpha$ in more detail after the initial empirical findings are presented.

In this model, and in contrast with the standard model, some consumers switch from the more expensive good to the cheaper good if their valuations of the products satisfy the following set of inequalities. The first two inequalities imply the original choice of Y, and the second two inequalities lead to switching to X when its price is reduced to zero:

$$\begin{aligned} &V_Y > P_Y, \\ &V_Y - P_Y > V_X - P_X, \\ &V_X + \alpha > 0, \quad \text{and} \\ &V_X + \alpha - P_X > V_Y - P_Y. \end{aligned} \tag{4}$$

That is, as the prices fall from the cost condition to the free condition, the costs decrease by the same magnitude for both products, the benefit for the now-free product increases more than that for the more expensive product, and the net benefit of the cheaper product becomes higher. In terms of demand, the zero-price model predicts that as prices are reduced from the cost condition to the free condition, the demand for the cheaper good increases, and more importantly, the demand for the more expensive good may decrease as consumers switch from the more expensive product to the cheaper one (see Table 1, Figure 1d). We refer to the combination of the increase in the proportion of consumers choosing X and the decrease of those choosing Y when prices fall from $[P_X, P_Y]$ to $[0, P_Y - P_X]$ as *the zero-price effect*. The

**Table 1 Predictions of the Standard Cost–Benefit Model and Zero-Price Model**

| | Standard cost–benefit model | Zero-price model |
|---|---|---|
| Changes in valuations | | |
| Costs | Both costs decrease by the same amount | |
| Benefits | Both benefits remain the same | Benefit of the low-value good increases |
| Net benefits | Net benefits increase by the same amount | Net benefit of the low-value good increases more |
| Changes in demands | Some switching from nothing to something | |
| | No switching between goods | Some switching from high-value to low-value good |
| | Demand for the low-value good increases | Demand for the low-value good increases |
| | Demand for the high-value good increases | Demand for the high-value good decreases |

*Notes.* The table illustrates predictions as the prices for two products move from $[P_X, P_Y]$ (where $P_X < P_Y$) to $[0, P_Y - P_X]$.

prediction regarding the decrease in demand for the more expensive good represents the one observable difference between the two models, and thus, in our empirical section, we focus on it.

# 4. Testing the Phenomenon

In this section, we describe a series of experiments designed to test the validity of the zero-price model and rule out some trivial economic explanations for the changes in demand that take place as the price of the cheaper good decreases to zero (i.e., from the cost condition to the free condition).

## 4.1. Experiment 1: Survey

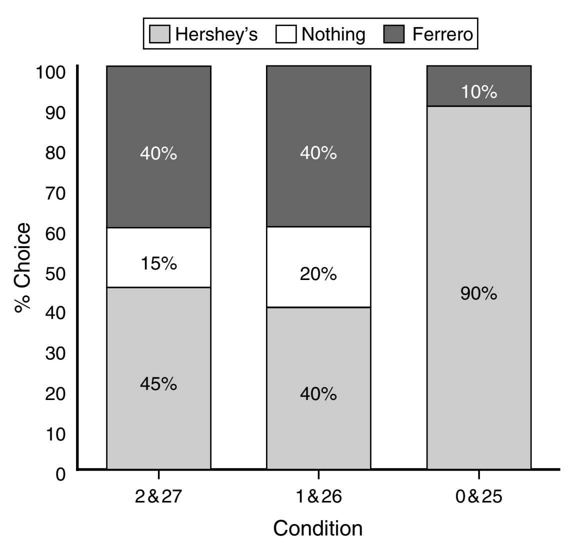
**Method.** We asked 60 participants to make a hypothetical choice among a Hershey's, a Ferrero Rocher chocolate, and buying nothing (we provided pictures of both chocolates). Across the three conditions, the prices of the two chocolates decreased by a constant amount (for a description of all conditions across all the experiments, see the appendix). In the cost condition, the prices of Hershey's and Ferrero were 1¢ and 26¢, respectively (1&26 condition). In the free condition, both prices were reduced by 1¢ and therefore were 0¢ and 25¢, respectively (0&25 condition). The third condition (2&27 condition) represents an additional cost condition in which the prices of goods increased by 1¢ above their prices in the first cost condition. The purpose of the 2&27 condition is to contrast the effect of a 1¢ price reduction that does not include a reduction to 0 (reduction from 2&27 to 1&26) with a 1¢ price reduction that does (reduction from 1&26 to 0&25).

**Results and Discussion.** We provide the results in Figure 2. As the prices decrease from the 1&26 condition to the 0&25 condition, the demand for Hershey's increases substantially $t(31) = 3.8$, $p < 0.001$) while, more importantly, the demand for Ferrero decreases substantially ($t(31) = -2.3$, $p = 0.03$) in support of the zero-price effect. The difference in demand between the 1&26 and 2&27 conditions is imperceptible (Hershey's $t(38) = -0.3$, $p = 0.76$; Ferrero $t(38) = 0$, $p = 1$), which demonstrates that when all prices are positive, a 1¢ change in prices does not have a significant effect on demand. Only when one of the prices becomes zero does the observed perturbation take place. Thus, we observe (hypothetical) behavior consistent with the zero-price model; participants reacted to the free Hershey's as if it had additional value.

## 4.2. Experiment 2: Real Purchases

Although the results of Experiment 1 suggest that consumers react to a price decrease to zero differently than they do to other price reductions, their reaction pertains to a hypothetical situation, which means that it remains an open question whether consumers will behave in the same way when faced with real transactions. As a secondary goal, Experiment 2 includes another condition to test the robustness of the zero-price effect. In this condition, the price reduction is much larger for the high-end candy, which gives participants a greater incentive to make choices opposite to the predictions of the zero-price effect.

**Figure 2 Proportions of Consumers Choosing Hershey's and Ferrero Rocher Chocolate Across the Three Experimental Conditions in Experiment 1**



Furthermore, this unequal price reduction provides a test of the notion that consumers divide, rather than subtract, costs and benefits (as we discuss subsequently).

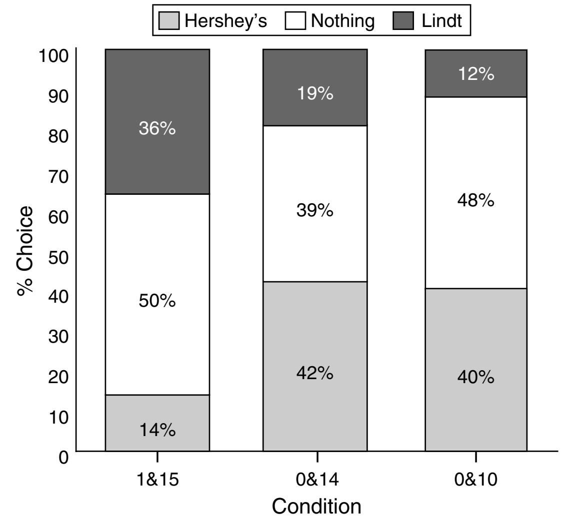
**Method.** Three hundred ninety-eight subjects took part in the experiment. We use a Hershey's as the low-value product and a Lindt truffle (hereafter, "Lindt") as the high-value product. The experiment includes a free condition (0&14), a cost condition (1&15), and a second free condition (0&10). In the 0&14 and 0&10 conditions, the price of Hershey's is 0¢, and the prices of Lindt are 14¢ and 10¢, respectively. In the 1&15 condition, the price of Hershey's is 1¢, and the price of Lindt is 15¢.

A booth in MIT's student center contained two cardboard boxes full of chocolates and a large upright sign that read "one chocolate per person." Next to each box of chocolates was a sign lying flat on the table that indicated the price of the chocolate in that condition. The flat signs could not be read from a distance, and the prices were visible only to those standing close to the booth. We used the flat signs because we wanted to measure the demand distributions, including the number of people who considered the offer and decided not to partake. By placing the price signs flat next to the chocolates, we could code each person who looked at the prices but did not stop or purchase, and classify them as "nothing."

Although field experiments have many advantages, this particular setup suffered a limitation in that the experimental conditions could not be randomized for each subject; instead, we alternated the price signs (conditions) approximately every 45 minutes. When replacing the signs, we wanted to reduce the chance that students would notice the change (which would mix within- and between-subjects designs) and therefore instituted 15-minute breaks between each of the 30-minute experimental sessions.

**Results and Discussion.** As we show in Figure 3, the results are similar to the hypothetical choices in Experiment 1. As the prices decrease from the 1&15 condition to the 0&14 condition, demand for Hershey's increases substantially ($t(263) = 5.6$, $p < 0.001$), while demand for Lindt decreases substantially ($t(238) = -3.2$, $p < 0.01$). In addition, we find no significant difference between the demand for Hershey's between the 0&14 and 0&10 conditions ($t(263) = 0.5$, $p = 0.64$) and a marginally significant difference in demand for the Lindt between the 0&14 and 0&10 conditions ($t(271) = 1.5$, $p = 0.13$). This marginal difference, however, is in the opposite direction of the expected effect of a price decrease on demand, which may be related to the higher number of participants who took nothing in the 0&10 condition. Together, these results show that the reduction

**Figure 3** Proportions of Consumers Choosing Hershey's and Lindt Across the Three Experimental Conditions in Experiment 2




of a price to zero is more powerful than a five-times-larger price reduction that remains within the range of positive prices.

A somewhat surprisingly large proportion of people selected "nothing." This observed lack of interest could be due to the way we coded the choice of nothing; some people who might not even have noticed the offers (and thus effectively were not part of the experiment) could have been misclassified as buying nothing (instead of being considered nonparticipants). Another possible contributor to the choice of nothing could be transaction costs; buying a chocolate or even taking a free chocolate requires attention and time. Finally, in the experimental setting, the value of chocolate may have been either not positive or not sufficiently large for our participants.

If we take those whom we coded as nothing out of the analysis, the share of Hershey's increases from 27% in the 1&15 condition to 69% in the 0&14 condition and to 64% in the 0&10 condition. The demand for Lindt shows a complementary pattern: decreasing from 73% in the 1&15 condition to 31% in the 0&14 condition and 36% in the 0&10 condition. The difference between the cost and the free conditions is statistically significant (both $ps < 0.001$), but the difference between the two free conditions is insignificant ($t(142) = -1.0$, $p = 0.31$).

In summary, the results of Experiment 2 demonstrate that valuations of free goods increase beyond their cost–benefit differences, as we show with real transactions in a field setting, and even when the price decrease for the high-value product is substantially larger than that of the low-value product. The observed drop in demand for the high-value good in such a case (from the 1&15 condition to the 0&10 condition) is theoretically even more impossible than in the case when prices decrease by the same amount.

Another advantage of the comparison of the 0&10, 0&14, and 1&15 conditions is that it sheds some light on the possibility that rather than evaluating options on the basis of their cost–benefit difference, consumers might consider goods on the basis of the ratio of benefits to costs (not a normative account). According to this interpretation, the net value of a free good is very high (strictly speaking, infinite) and therefore leads to the choice of the free good. However, the results of Experiment 2 weaken the possibility of this explanation in two ways. First, if our participants followed a strict ratio rule, and if we assume that everyone has at least an epsilon valuation for Hershey's, the choice share of the free chocolate should have been 100%, or at least 100% of those selecting any chocolate, which is not the case. Second, a less strict version of the ratio rule implies that the price reduction of the high-end chocolate from 15¢ to 10¢ (a 33% reduction) should have had a much larger effect on its share compared with the price reduction from 15¢ to 14¢ (a 7% reduction). This prediction does not bear out; there is no real difference in the changes in demand when the prices fall from 1&15 to 0&14 on the one hand and to 0&10 on the other hand.

### 4.3. Experiment 3: Cafeteria

We acknowledge a possible shortcoming of Experiment 2; namely, the difference between conditions may not be confined to prices, such that the size of the transaction costs associated with the three options differs among conditions. Taking a free Hershey's or buying nothing means not only a zero monetary price but also no associated hassle of looking for change in a pocket or backpack. If transaction cost is a consideration in our setting, it could lead to a choice pattern that favors Hershey's when its cost is zero (in the 0&14 and 0&10 conditions), but not when both options involve a positive cost and hence a larger transaction cost (the 1&15 condition). We derive an initial indication that transaction cost does not drive the effect from the results pertaining to the hypothetical choices in Experiment 1. Because Experiment 1 does not involve real transactions, it does not involve any transaction costs, which implies that the results will survive a situation without transaction costs. Although these results are indicative, when respondents made their hypothetical choices, they might have considered transaction costs that would have been present if the choice they were facing had been real. Because the results of Experiment 1 cannot be interpreted conclusively and because transaction costs could be an important alternative explanation, we conducted Experiment 3, designed explicitly to control for possible differences in transaction costs. In this experiment, we held the physical transaction costs constant for the three choices (high- and low-value chocolates and no purchase) and between the cost and free conditions.

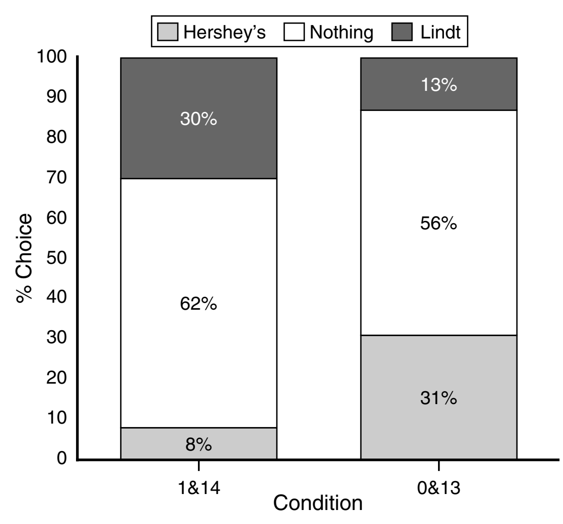
**Method.** We carried out this experiment as part of a regular promotion at one of MIT's cafeterias, using customers who were already buying products at the cafeteria and adding the cost of the chocolate to their bill as if it were any other purchase. By adding the cost to an existing purchase, we created a situation in which the chocolate purchase did not add anything to the transaction costs in terms of taking out one's wallet, looking for money, paying, and so forth.

The procedure of the experiment was similar to that used in Experiment 2: A box with two compartments, one containing Hershey's and the other containing Lindt, appeared next to the cashier. A large sign read "one chocolate per person," and we posted the price of each chocolate next to each compartment (varying across conditions). Customers who wanted one of the chocolates had its cost added to their bill. Thus, the transaction costs in terms of payment remained the same whether a customer purchased a chocolate, got a chocolate for free, or purchased nothing, because he or she still had to pay for the main purchase.

We manipulated the prices at two levels: 1¢ for Hershey's and 14¢ for Lindt in the cost condition, and 0¢ and 13¢, respectively, in the free condition. We switched the price signs (conditions) approximately every 40 minutes, with a 10-minute break between the experimental sessions. In this setting, it was difficult to separate customers who decided not to participate from those who did not notice the offer; therefore, all customers who passed by the cashier and did not select any of our chocolates were coded as "nothing." In total, 232 customers took part in this experiment.

**Results and Discussion.** As we show in Figure 4, in the condition in which Hershey's is free,

**Figure 4** Proportions of Consumers Choosing Hershey's and Lindt Across the Two Experimental Conditions in Experiment 3



the demand for Hershey's increases substantially ($t(189) = 4.7$, $p < 0.001$), while the demand for Lindt decreases substantially ($t(206) = -3.2$, $p = 0.001$). If we remove those whom we coded as nothing from the analysis, the share of Hershey's increases from 21% in the 1&14 condition to 71% in the 0&13 condition, whereas the share of Lindt decreases from 79% in the 1&14 condition to 29% in the 0&13 condition ($t(92) = 5.6$, $p < 0.0001$).

Thus, the zero-price effect is not eliminated when transaction costs are the same for all options and in both conditions, which provides strong evidence that the zero-price effect is not produced solely by a difference in transaction costs.

### 4.4. Summary of the Initial Experiments

These initial experiments contrast the choices respondents make when the prices for both options are positive relative to a case in which both options are discounted by the same amount, such that the cheaper option becomes free. This methodology enables us to examine the reaction to free offers and indicates both an increase in demand for the cheaper product and a decrease in demand for the more expensive product, an effect we term the zero-price effect.

Experiment 1 demonstrates that a 1¢ difference in price has an enormous influence on demands if it represents a difference between a positive and zero prices, but not when it is a difference between two positive prices. Participants reacted as if a free Hershey's had more intrinsic value than a positively priced Hershey's. Experiment 2 validates this finding with real choices and argues against the ratio explanation. Finally, Experiment 3 demonstrates that the zero-price effect is not driven by transaction costs. Thus, we show that for prices, as for many other domains, zero is treated qualitatively differently from other numbers.

When we consider how zero might differ from other numbers, we posit two general answers: The first relies on the proposed model and assumes a unique benefit of the price of zero, which leads to a demand discontinuity at zero. A second approach is to model this process with a concave utility of money. In such a model, instead of evaluating options by $V - P$ (i.e., value minus price), consumers evaluate them by $V - v(P)$, where $v$ is the prospect theory value function (Kahneman and Tversky 1979). To illustrate this point, consider the choices from Experiment 3: If the net benefit of a chocolate is defined by $V - v(P)$, participants could switch from Lindt to Hershey's because $v(14¢) - v(13¢) < v(1¢)$. The utility of money is likely to be generally concave (Kahenman and Tversky 1979), so the question for our purposes is not whether it is concave, but whether concavity may account for our findings. Moreover, the discontinuity in zero that we propose represents a special case of concavity; a function that is zero at zero and then "jumps" and is upward sloping and linear (or concave) is by definition concave. Our question, therefore, pertains to whether the effect of the price of zero is captured better by a continuous or discontinuous concave utility of money.

To examine the possibility that continuous concavity could be sufficient to account for the results, we consider the contrast between the two price reductions in Experiment 1: from 2&27 to 1&26 and from 1&26 to 0&25. A model claiming that a continuous concave utility function of money can account for the results would assume that consumers evaluate the options by $V - v(P)$, that $v(26¢) - v(25¢) < v(1¢)$, and that this difference is sufficient to explain the large zero-price effect documented in Experiment 1. However, this model would also have to assume that $v(27¢) - v(26¢) < v(2¢) - v(1¢)$, and thus we should expect an increase in demand for Hershey's and a decrease in demand for Ferrero in the 1&26 versus the 2&27 condition. Such demand changes should be smaller in magnitude than those between 1&26 and 0&25, but they would occur in the same direction. However, as we show in Figure 2, the results do not indicate anything of the kind. Although concavity is present in the utility of money, the type of concavity in our setting is more likely to exist because of a discontinuity at zero rather than continuous concavity alone (we provide further support for the discontinuous nature of the zero price in the Amazon gift certificates experiment and the flat-screen televisions experiment described later).

## 5. Why Is Zero Price Special?

In the first part of this article, we demonstrate that zero price has a special role in consumers' cost–benefit analysis. In this section, we take another step toward exploring the psychology behind the zero-price effect. In particular, we consider three possible explanations, which we label "social norms," "mapping difficulty," and "affect." On the basis of prior research and an additional study, we argue that the social norms explanation, although applicable in some cases, cannot account fully for the zero-price effect, so we focus on distinguishing between the mapping difficulty and affect accounts. Overall, the results support the role of affect as a main cause for the effect of zero.

### 5.1. Social Norms

A possible psychological mechanism that could underlie the zero-price effect deals with the norms that might accompany free products. Costly options invoke market exchange norms, whereas free products invoke norms of social exchange (Fiske 1992, McGraw et al. 2003, McGraw and Tetlock 2005), which can create higher value for the product in question. Heyman and Ariely (2004) offer one example in which they demonstrate that people are likely to exert more effort under a social contract (no monetary amounts) than when small or medium monetary amounts are mentioned. Another example of the relationship between social and exchange norms appears in Ariely et al. (2006) in which they examine the behavior of persons faced with a large box of candies and an offer to receive the candy either for free or for a nominal price (1¢ or 5¢). Not surprisingly, when the cost is zero, many more students take candy than when the price is positive. More interesting, when the price is zero, the majority of the students take one and only one candy, while those who pay to take candy take a much larger amount (effectively creating lower demand as prices decrease).

Together, these results suggest that social norms are more likely to emerge when price is not a part of the exchange, which could increase the valuation for a good and, in our experiments, increase the market share of the free chocolate. However, another condition in Heyman and Ariely's (2004) experiments suggests that the effect of social norms might not apply to our settings. When the elements of both social exchanges (e.g., a gift) and monetary exchanges are present (e.g., "Here is a 50¢ candy bar"), the results are very similar to those of a monetary exchange and different from those of a social exchange. Relating these findings to our setting suggests that it is highly unlikely that participants apply social exchange norms to one option in the choice set (free option) and monetary exchange norms to the other (cost option). Instead, participants probably apply the same set of norms to all choices in the set, and thereby eliminate the effect of social exchange norms.

To test the ability of social exchange norms to account for the zero-price effect further, we create an additional condition that enables us to disassociate the free cost from the social norms invoked by the lack of cost. That is, we offer the low-value chocolate for a small negative price (−1¢), which creates a transaction with no downside (no financial cost), but still mentions money, and thus presumably does not invoke social exchange norms. To the extent that the zero-price effect is due to the social nature of nonmonetary exchanges, a negative price, which has no social aspect, should not induce an increase in the intrinsic valuation of the products in the same way zero price does. However, if the zero-price effect is not due to social exchange norms, demand in this condition should be very similar to that in the free condition.

Three hundred forty-two subjects took part in this experiment, which replicates the 1&14 and 0&13 conditions of Experiment 2 with the addition of a −1&12 condition, in which the price of Hershey's is −1¢ (participants received Hershey's plus a penny) and the price of Lindt is 12¢. The demands in the 1&14 and 0&13 conditions replicate our previous findings: Compared with the 1&14 condition, the demand for Hershey's in the 0&13 condition increases substantially from 15% to 34% ($t(193) = 3.4$, $p < 0.001$), and the demand for Lindt decreases substantially from 38% to 16% ($t(212) = -3.8$, $p < 0.001$). Of greater significance, we find that when prices drop from 0&13 to −1&12, the demand for Lindt remains 16% ($t(220) = 0.04$, $p = 0.97$), but the demand for Hershey's increases from 34% to 50% ($t(212) = -3.8$, $p < 0.001$). Thus, in contrast with the social exchange norms explanation, the zero-price effect remains even when we mention money for both options in the choice set. These results also suggest that a change in the cost–benefit analysis likely causes the shift in evaluations for the free (or small negative cost) product.

### 5.2. Mapping Difficulty

A second possible psychological mechanism that might explain the overemphasis on free options comes from the findings of Ariely et al. (2003, 2006), Hsee et al. (2003), and Nunes and Park (2003), which demonstrate that people have difficulty mapping the utility they expect to receive from hedonic consumption into monetary terms. In one set of studies that illustrates this mapping difficulty, Ariely et al. (2003) demonstrate that maximum willingness to pay (elicited by an incentive-compatible procedure) is susceptible to anchoring with an obviously irrelevant number—the last two digits of a social security number (Tversky and Kahneman 1974, Chapman and Johnson 1999). For example, students whose last two digits of their social security numbers were in the bottom 20% of a distribution priced a bottle of 1998 Cotes du Rhone wine at $8.64 on average, whereas those whose last two digits were in the top 20% priced the same bottle at $27.91 (see also Simonsohn and Lowenstein 2006). These results suggest it is difficult for decision makers to use their internal evaluations for products, so they resort to the use of external cues to come up with their valuations.

Mapping difficulty could play a role in our setting as well. To the extent that evaluating the utility of a piece of chocolate in monetary terms is difficult, consumers might resort to a strategy that assures them of some positive surplus. Specifically, receiving a piece of the lower-value chocolate for free must involve positive net gain, but paying for a piece of the higher-value chocolate may or may not. To illustrate, imagine a situation in which a consumer's valuation for the lower-value chocolate is somewhere between 1¢ and 5¢ and his or her valuation for the higher-value chocolate is between 10¢ and 20¢. If this consumer were faced with the 1&14 condition, it would be unclear which of the options would give him or her a net benefit or the higher net benefit. However, the same consumer facing a 0&13 condition easily recognizes that the free option definitely provides a net benefit, so the consumer chooses that option. Thus, the zero-price effect might be attributed, according to this perspective, to the uncertainty surrounding the overall benefit associated with costly options and the contrasting certainty about overall benefits associated with free options.

### 5.3. Affect

A third possible psychological mechanism that might account for the zero-price effect pertains to affect, such that options with no downside (no cost) invoke a more positive affective response; to the extent that consumers use this affective reaction as a decision-making cue, they opt for the free option (Finucane et al. 2000, Slovic et al. 2002, Gourville and Soman 2005). We test this prediction directly with Experiment 5. The affective perspective also suggests the circumstances in which the zero-price effect should be eliminated: If the cause of the zero-price effect is a reliance on an initial (overly positive) affective evaluation, making a nonaffective, more cognitive evaluation accessible might diminish the zero-price effect.

To test which of these two psychological mechanisms (mapping difficulty, affect) is the more likely driver of the zero-price effect, we conduct three more experiments. In Experiment 4, we attempt to reduce or eliminate the mapping difficulty to observe whether that diminishes or eliminates the zero-price effect. In Experiment 5, we test the first proposition of the affective account, namely, that free offers elicit higher positive affect. In Experiment 6, we test whether forcing people to evaluate the options cognitively, and thereby making these evaluations available and accessible, eliminates the zero-price effect.

### 5.4. Experiment 4: Halloween

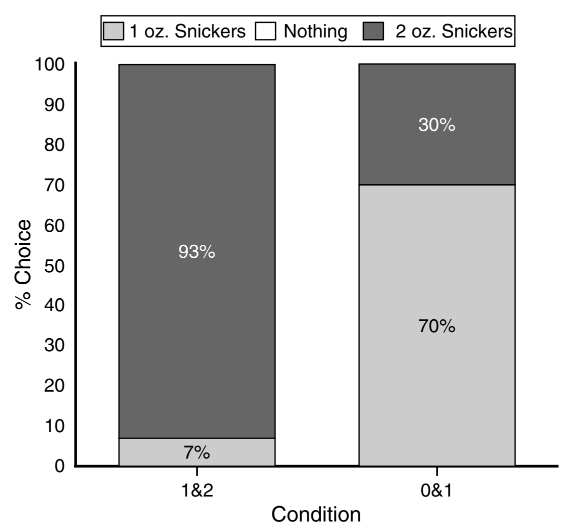
Experiment 4 aims to test whether mapping difficulty could be driving the zero-price effect. Therefore, we reduce mapping difficulty by making both sides of the transactions (i.e., that which participants stand to gain and that which they relinquish) commensurable. We predict that to the extent that mapping difficulty is the cause of the zero-price effect, it will diminish when the two sides of the transaction match. We also predict that this type of manipulation will have no bearing if affect is the cause of the zero-price effect.

**Method.** To reduce mapping difficulty, participants were able to exchange chocolate for chocolate rather than for money. On Halloween, 34 trick-or-treaters at an author's house were exposed to a new Halloween tradition. As soon as the children knocked on the door, they received three Hershey's (each weighing about 0.16 oz.) and were asked to hold the Hershey's they had just received in their open hand in front of them. Next, each child was offered a choice between a small (1 oz.) and a large (2 oz.) Snickers bar. In the free (0&1) condition, they could simply get the small Snickers bar or exchange one of their Hershey's for the large Snickers bar. In the cost (1&2) condition, the children could exchange one of their Hershey's for the small Snickers bar or exchange two for the large Snickers bar. They also could choose not to make any exchanges.

**Results and Discussion.** As we show in Figure 5, the zero-price effect remains strong even when the trade-offs involve commensurate products and exchange media ("money"). In the 0&1 condition, in which the small Snickers bar is free, demand for it increases substantially (relative to the cost condition), whereas demand for the large Snickers bar decreases substantially ($t(31) = 4.9$, $p < 0.001$). A follow-up experiment with adults, conducted at the MIT Student Center in a setting similar to Experiment 2, includes the 0&4 and 1&5 conditions for exchanges involving Hershey's for small and large Snickers, respectively. The results replicate the pattern of results of the Halloween experiment.

These results generalize our previous findings in five ways. First, they demonstrate that the attractiveness of zero cost is not limited to monetary transactions; there seems to be a general increase in attractiveness of those options that do not require giving up anything. Second, the results hold when the goods and exchange currency are commensurate—in this case, chocolate-based candy (for other results regarding commensurability, see Ariely et al. 2003,

**Figure 5** Proportions of Consumers Choosing Small and Large Snickers Bars Across the Two Experimental Conditions in Experiment 4

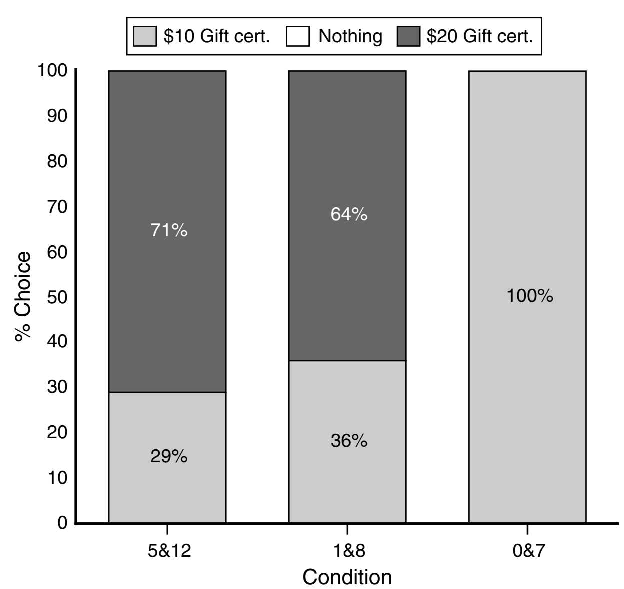


Hsee et al. 2003, Nunes and Park 2003). Third, although a 1¢ price is not very common in the marketplace, the choice and trading of candy is more common (particularly in the context of Halloween), which adds ecological validity to our finding. Fourth, the results provide further support that the physical hassle involved in transactions cannot account for the results. Fifth, this effect holds for adults as well as for children.

As a further test of the mapping account for the effect of zero prices, we conduct another experiment in which both the products and the method of payment were money. The two products participants could choose from were $10 and $20 Amazon gift certificates (or "neither"). The prices for the gift certificates were varied at three levels: $5 and $12, $1 and $8, and $0 and $7, respectively, with the $20 certificate always costing $7 more than the $10 certificate. As the reader may guess, we find no differences in demand patterns between the 5&12 and the 1&8 conditions ($t(65) = 0.53$, $p = 0.6$), but demand for the $10 certificate rockets in the 0&7 condition ($t(65) = 6.9$, $p < 0.001$), whereas demand for the $20 certificate falls to zero (see Figure 6). Thus, the experiment further invalidated mapping difficulty as a source of the zero-price effect; the effect survived a situation in which the product sold and the medium were both monetary.

This lack of difference in demand between the 5&12 and 1&8 conditions, together with the large shift in demand in the 0&7 condition, also argues against a ratio account. The ratios of the costs are much more favorable toward the $10 Amazon gift certificate in the 1&8 condition compared with the 5&12 condition (by approximately 3.3 times), so if participants actually used the ratio rule, we would have observed a large increase in demand for the $10 Amazon gift certificate in the 1&8 condition, which we did not.

**Figure 6** **Proportions of Consumers Choosing the $10 and $20 Amazon Gift Certificates Across the Three Experimental Conditions in the Follow-Up to Experiment 4**




The availability of multiple conditions with both positive prices in this experiment also helps us examine whether gradual price reduction to zero creates a continuous or discontinuous changes in demand, and hence whether $v(\mathrm{P})$ is continuous at zero. Continuous change would most likely result in at least a slight difference between the 5&12 and 1&8 conditions, and a (potentially larger) difference between the 1&8 and 0&7 conditions. The observed lack of the former difference suggests that discontinuity of $v(\mathrm{P})$ at zero might be a better account for our data.

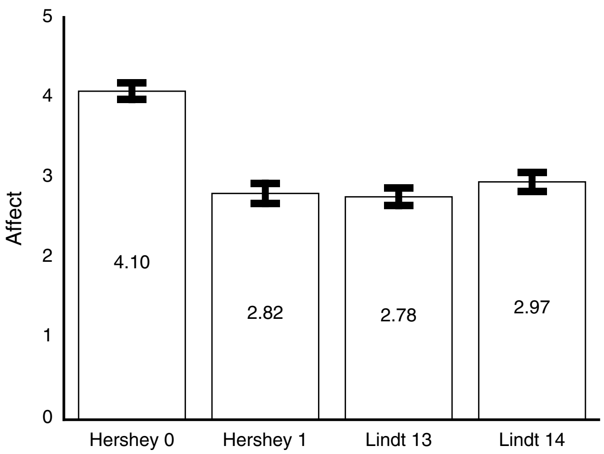
In summary, the main reason for our Halloween and Amazon gift certificate experiments was to test whether the difficulty of mapping money onto experiences could be the cause of the zero-price effect. We first replaced money as the exchange medium with chocolates, which presumably can be mapped more naturally onto other chocolates. We then replaced the product and the exchange medium with money. The results demonstrate that the zero-price effect is not limited to goods-for-money exchanges and that it is unlikely to be explained fully by mapping difficulties.

### 5.5. Experiment 5: Smilies

The affect account has two basic components. The first is that free offers evoke higher positive affect, and the second is that people use this affect as an input for their decision-making process. In Experiment 5, we examine the first component: People experience more positive affect when facing a free offer compared with other offers.

**Method.** We asked 243 participants to evaluate how attractive they found an offer of a chocolate at a certain price. We manipulated the offer on four levels among participants: Hershey's for free (H0), Hershey's for 1¢ (H1), Lindt for 13¢ (L13), and Lindt for 14¢ (L14). Participants received a questionnaire with the details of the offer and a picture of the chocolate. At the bottom of the page, schematic pictures of five faces ("smilies") with different expressions appeared, varying from unhappy to very happy. Participants were asked to indicate their feelings toward the offer by circling one of the faces. If participants' attitudes toward the offers reflected the offers' net benefits, the attitudes toward L14 and H1 should be slightly lower than those toward L13 and H0, respectively; and the difference between the attitudes toward L13 and L14 should be similar to the difference between H0 and H1. The affect argument, however, suggests that the attitude toward H0 should be much higher than that toward any other offer.

**Figure 7 Affective Ratings of the Four Offers in Experiment 5**




**Results and Discussion.** We depict the results in Figure 7. In line with the affect hypothesis, attitude toward the H0 offer is significantly higher than attitude toward any other offer ($t(113) = 7.0$, $p < 0.001$). Furthermore, we find no difference among the attitudes toward the other three offers ($F(2, 178) = 0.35$, $p = 0.7$). In support of the affect idea, the free good elicits more positive affect than standard cost–benefit analysis predicts.

Why does a free Hershey's elicit such a higher positive affect relative to a 13¢ Lindt? Ex ante, it is possible that a Lindt at 13¢ provides a much better deal than a Hershey's at any price. In fact, when people carefully consider the pros and cons of these offers, they much more often come to the conclusion that the value of 13¢ Lindt is higher than that of a free Hershey's (see Experiment 6). However, as the results of Experiment 5 demonstrate, it is also clear that free Hershey's creates a much higher affective reaction. One reason for this could be that the decision to take a chocolate for free is a much simpler decision, and that simplicity could be the driver of higher affect (Tversky and Shafir 1992, Luce 1998, Iyengar and Lepper 2000, Benartzi and Thaler 2002, Schwarz 2002, Diederich 2003, Gourville and Soman 2005). In particular, a free Hershey's involves benefits and no costs, while a Lindt for any positive price involves both benefits and costs—it is possible that options that have only benefits create more positive affect compared with options that involve both benefits and costs. Alternatively, much like the disutility of paying while consuming (paying for a vacation while experiencing it: Prelec and Loewenstein 1998), it is possible that options that involve both benefits and costs create a negative impact on affect due to the simultaneity of these two components, whereas options that have only benefits do not include this "penalty."

### 5.6. Experiment 6: Forced Analysis

In response to the high affective reaction to the free option in Experiment 5, we test whether consumers use this increased affect as a cue for their decisions, which in turn causes the zero-price effect. In Experiment 6, we force participants to engage in a cognitive and deliberate evaluation of the alternatives before they choose, and thereby make nonaffective, more cognitive evaluations available and accessible to participants. We assume that in these conditions, participants are more likely to base their evaluations on cognitively available inputs and therefore place a lower weight on the affective evaluations. To the extent that the cause of the zero-price effect is the affective component, such reliance on cognitive inputs should reduce the zero-price effect.

**Method.** Two hundred students filled out a survey in which they made a hypothetical choice among three options. We also asked half the subjects to answer two questions before making the choice. The design was a 2 (chocolates' prices: 1&14 versus 0&13) $\times$ 2 (survey type: neutral versus forced analysis) between-subjects design.

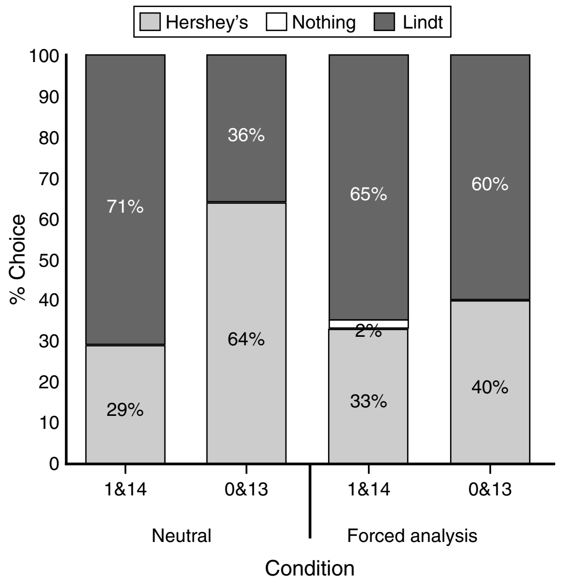
The survey in the [1&14, neutral] condition asked participants to imagine that there is a chocolate promotion at the checkout counter of their supermarket and that they could either buy one Hershey's kiss for 1¢ or one Lindt truffle for 14¢. Participants indicated their preferred option (a Hershey's for 1¢, a Lindt for 14¢, or neither). The [0&13, neutral] condition mirrored the 1&14 condition, except that Hershey's and Lindt were offered for free and 13¢, respectively.

In the forced-analysis conditions, after reading the introduction, but before being asked for their hypothetical choice, participants were asked the following two questions: "On a scale from 1 (not at all) to 7 (much more), how much more do you like the Lindt truffles in comparison with Hershey's kisses?" and "On a scale from 1 (not at all) to 7 (much more) how much more would you hate paying 14¢ (13¢) in comparison with paying 1¢ (nothing)?" Participants circled a number from one to seven, anchored at one (not at all), four (about the same), and seven (much more). After answering these questions, participants made their hypothetical choice among the three options.

**Results and Discussion.** We ran two logit regressions with the proportions of subjects buying Hershey's and Lindt as the dependent variables and the answers to the two questions as independent variables (forced-analysis conditions only). Unsurprisingly, preferring Lindt to Hershey's is related negatively to choosing Hershey's ($z = 3.1$, $p < 0.01$) and positively to choosing Lindt ($z = 3.0$, $p < 0.01$). Disliking paying more is related positively to choosing Hershey's ($z = 3.2$, $p = 0.001$) and negatively to choosing Lindt ($z = 3.1$, $p < 0.01$). Thus, participants' answers to the questions fall in line with their choices.

Next, we performed two ANOVAs with the proportions of subjects choosing Hershey's and Lindt as

**Figure 8** Proportions of Consumers Choosing Hershey's and Lindt Across the Experimental Conditions in Experiment 6




the dependent measures and the chocolates' prices, survey type, and the interaction term as independent variables. The ANOVAs reveal significant main effects of chocolates' prices (Hershey's $F(1,196) = 9.7$, $p < 0.01$; Lindt $F(1,196) = 8.7$, $p < 0.01$); no main effects of survey type (Hershey's $F(1,196) = 2.0$, $p = 0.2$; Lindt $F(1,196) = 1.6$, $p = 0.2$); and, most importantly, a significant interaction effect for the two factors (Hershey's $F(1,196) = 4.5$, $p = 0.03$; Lindt $F(1,196) = 5.1$, $p = 0.02$).

As we demonstrate in Figure 8, the zero-price effect is replicated in the neutral conditions (Hershey's $t(97) = 3.7$, $p < 0.001$; Lindt $t(97) = -3.7$, $p < 0.001$), but not in the conditions in which subjects compare their quality and price options before choosing. In the forced-analysis conditions, the direction of the effect remains the same, but the magnitude is much smaller and statistically insignificant (Hershey's $t(99) = 0.7$, $p = 0.5$; Lindt $t(99) = -0.6$, $p = 0.6$). These results support the basic affect mechanism we propose, according to which the affect invoked by the free option drives the zero-price effect, but when people have access to available cognitive inputs, they base their decisions on those, and the benefit of zero largely dissipates.

Another potential interpretation of these results is that in three of our four conditions, subjects act "rationally"—the two forced-analysis conditions and the [1&14, neutral] condition. In the [0&13, neutral] condition, however, they act on the basis of the affect evoked by the zero price. In support of this idea, we find no significant difference among subjects' choices in the three rational conditions (Hershey's $F(2,147) = 0.7$, $p = 0.5$; Lindt $F(2,147) = 0.7$, $p = 0.5$), whereas the [0&13, neutral] condition differs significantly from them (Hershey's $t(83) = 3.8$, $p < 0.001$; Lindt $t(83) = 0.3.7$, $p < 0.001$).

## 6. General Discussion

We start with two models, one that treats zero as just another price and one that assumes free options are evaluated more positively. We propose a method to distinguish these two approaches and demonstrate in three experiments that the latter model is better able to account for our findings. Experiment 1 provides the initial evidence of the zero-price model, and Experiment 2 supports the effect with a real buying scenario and clarifies that the effect could not be due to decision making based on cost–benefit ratios. Experiment 3 shows that the effect also could not be due to physical transaction costs.

After demonstrating the unique properties of zero price, we attempt to examine the psychological causes for this effect and propose three possible mechanisms: social norms, mapping difficulty, and affect. We discard the social norms explanation on the basis of findings (Heyman and Ariely 2004) that the mention of price invokes market-based transaction norms, which makes it unlikely that our scenario invokes social norms. We further discredit the ability of this account to explain our findings using negative prices that involve prices but no cost. We then carried out three experiments to explore which of the other two possible explanations is valid. Experiment 4 weighed in against the difficulty-of-mapping explanation, and Experiments 5 and 6 provide support for the affective evaluation hypothesis.

In general, this research joins a larger collection of evidence that shows that zero is a unique number, reward, price, and probability. Although our results suggest that the zero-price effect might be better accounted for by affective evaluations than by social norms or mapping difficulty, zero and the price of zero remain a complex and rich domain, and all of these forces may come into play in different situations. In addition, other effects of zero might include inferences about quality, changes in signaling to the self and others, an effect on barriers for trial, and its ability to create habits. Therefore, much additional work is needed to understand the complexities of zero prices in the marketplace.

### 6.1. Alternative Explanations and Boundary Conditions

One of the limitations of our experimental conditions is that they are restricted to relatively cheap products and relatively unimportant decisions. Given this limitation, it remains an open question whether the zero-price effect occurs when the decisions involve larger sums of money and more important decisions. To answer this question, at least partially, we distributed a survey in which participants responded to one of four hypothetical scenarios regarding purchasing an LCD flat-panel television. In these scenarios, participants were entitled to a large discount and had narrowed down their options to two: a cheaper 17" Philips and a more expensive 32" Sharp. The four conditions varied in terms of prices, such that the Sharp was always \$599 more expensive than the Philips, and the prices of both sets decreased by approximately \$100 across conditions. From most expensive to least expensive, the conditions were 299&898, 199&798, 99&698, and 0&598. Comparing demand across these conditions, we find that the results ($n = 120$) generally resemble our previous findings. Demand for the smaller, cheaper television is 40% in the 299&898 condition, 40% in the 199&798 condition, 43% in the 99&698 condition, and 83% in the 0&698 condition. Concurrently, demand for the larger, more expensive television is 40% in the 299&898 condition, 33% in the 199&798 condition, 43% in the 99&698 condition, and 17% in the 0&698 condition. Overall, these results show that a shift in demand is apparent only when the price is reduced to zero ($F(3, 98) = 3.24$, $p < 0.05$); otherwise, the effects of price reductions do not have a significant influence on the relative demand for the two televisions ($F(2, 69) = 0.06$, $p = 0.94$), providing additional evidence against the continuous concavity argument.

Although these results suggest that the effect of the price of zero is not limited to small prices and meaningless decisions, some thought experiments also imply it might not be as simple with large, consequential decisions. For example, if we replace Hershey's and Lindt with Honda and Audi and change the prices from \$28,000 and \$20,000 to either \$8,100 and \$100 or \$8,000 and \$0, respectively, we suspect that relatively small prices such as \$100 might be perceived within a just noticeable difference zone of zero, such that the effect of zero might be stretched to accommodate such prices as well. Thus, the question of which prices people perceive as zero might not be simple, because it likely relates to the context of the decision and the original prices.

Another possible limitation of our setup is that our positive prices could seem suspicious. People in general are not accustomed to prices of 1¢, 13¢, or 14¢, whereas free samples often are a part of a promotion, which would make people more accustomed to them. We selected such odd prices because we wanted to have a very small discount (1¢), but at the same time avoid alternative accounts related to accumulation and disposal of small change across the different conditions (assuming that people are averse to having many small coins fill their pockets). The potential problem is that these odd prices could have evoked suspicion, and our participants might have been making negative quality inferences about the cheap chocolates (the ones with odd prices), but not about the free chocolates. Three of the experiments cast doubt on this type of argument: In the Amazon gift certificates experiment the perceived quality of the gift certificates was unlikely to be influenced by price; in the Halloween experiment, all trade-offs were equally strange; and in the televisions experiment we gave an explicit explanation for the strange prices: "Luckily for you, you won a lottery that the store had conducted for its best customers. As a result, you are entitled to a huge discount on any product in the store."

To test this "negative inference from odd prices" alternative account more directly, we conducted two additional experiments. In one experiment we asked participants to make a hypothetical choice among Hershey's, Lindt, and nothing, but this time used prices that were less suspicious (0&15 and 10&25). The results replicated our previous findings, with demand for Hershey's increasing from 8% in the 10&25 condition to 65% in the 0&15 condition ($t(51) = 6.0$, $p < 0.0001$) and demand for Lindt decreasing from 45% in the 10&25 condition to 6% in the 0&15 condition ($t(54) = 3.8$, $p < 0.001$). In the second experiment we described in detail the setup of the cafeteria experiment (Experiment 3), and measured the inferences participants made about the products. Half of the participants read the description of the 0&13 condition, and the other half read the description of the 1&14 condition. After reading and viewing the verbal and graphical descriptions, the participants were asked to describe their reaction to the promotion in an open-ended manner, followed by seven questions in which they were asked to rate the promotion on oddity and the chocolates on perceived quality, taste, and expiration date (relative to the same brand chocolates from a supermarket). The written protocols reveal that although participants mentioned that the promotion is odd (in particular, because of the "One chocolate per person" sign), or that the prices are odd; none of the participants spontaneously mentioned the quality of the chocolates or made any price-quality inferences. In addition, the rating in the seven questions reveal no differences in promotion oddity or inferences about chocolate quality (or taste, or expiration date) between the conditions. In general, even though the promotion is seen as somewhat odd by the participants, they do not make any differential inferences for the condition with low positive prices versus the zero-price condition.

Even though the zero-price effect does not appear to be driven by the oddities of the prices we used, we do not assume that the price of zero effect will never interact with processes relating to consumers' inferences about quality. In many market situations, consumers might infer the expected quality of the product on the basis of such small prices, the price of zero itself, or the availability of free giveaway promotions (Simonson et al. 1994).

Finally, the asymmetric dominance effect could offer another possible explanation for our findings (Huber et al. 1982). In our free conditions, the cheaper product always weakly dominates the buying nothing alternative, because they share the same cost (zero) and clearly differ in their benefits. In the cost conditions, no such asymmetric dominance relationship exists. If the zero-price effect in our experiments is driven by the asymmetric dominance effect, the relationship between the option to buy nothing and the cheaper chocolate (whether dominant or not) serves as the basic cause for the effect. Note that if we exclude the option not to buy anything, the asymmetric dominance relationship no longer exists, and any effect due to it should be eliminated. To test this asymmetric dominance explanation, we conducted a survey ($n = 136$) in which we excluded the buy-nothing option (which we could only do in a hypothetical choice study) and contrasted the zero-price effect with the case in which participants had the buy-nothing option. The results replicate our standard findings: Free Hershey's experiences a demand boost (from 28% to 92%), whereas Lindt suffers a demand decrease (from 72% to 8%, $t(50) = 6.8$, $p < 0.0001$) even in the absence of a dominated alternative. Moreover, these changes in demand are basically identical to the case in which the option to select nothing appears. Although the asymmetric dominance therefore is an unlikely explanation for our findings, there are other context effects ranging from product assortments to reference points in online auctions (e.g., Dholakia and Simonson 2005, Leclerc et al. 2005) that could relate to these findings. Thus, we note that the more general questions of what context effects might be involved and influence prices of zero remain open and interesting.

### 6.2. Managerial Implications

The most straightforward managerial implication of our findings pertains to the increased valuations for options priced at zero. When considering promotions at a low price, companies should experiment with further discounts to zero, which likely will have a surprisingly larger effect on demand. At least one piece of anecdotal evidence supports this claim. When Amazon introduced free shipping in some European countries, the price in France mistakenly was reduced not to zero but to one French franc, a negligible positive price (about 10¢). However, whereas the number of orders increased dramatically in the countries with free shipping, not much change occurred in France. This example also suggests that when trying to use bundling with a cheap good in order to bring up the sales of another good, it might be wise to go all the way down with the cheap good and offer it for free.

Another possible implication of the effect of zero might be in the domain of food intake. When designing food and drink products, companies can decide whether to create low caloric (or fat or carbohydrate) content or reduce these numbers further to zero. Assuming that the effect of zero generalizes to other domains, investing further effort to create a product with zero grams of fat might have a very positive influence on demand.

Decisions about zero might be more complex, but also more relevant, in domains in which multiple dimensions can occur separately but be consumed together. In the domain of prices, some examples might include cars or computers, for which price is composed of a sum of multiple components, some of which might be set at a standard price and some at zero. In the food domain, these components might be calories, grams of fat, carbohydrates, amount of lead, and so forth, such that some offer a standard amount and some are set to zero. To the extent that the effect of zero holds for individual dimensions that are a part of a complete product, it might be beneficial to consider it at such levels as well.

**Appendix. The Different Types of Goods, Prices, and Dependent Measures Across Experiments and Conditions**

| Experiment | Dependent variable | Condition | Low-value good | High-value good |
|---|---|---|---|---|
| Experiment 1 | Hypothetical choice | 0&25 | Hershey's kiss for 0¢ | Ferrero Rocher for 25¢ |
| | | 1&26 | Hershey's kiss for 1¢ | Ferrero Rocher for 26¢ |
| | | 2&27 | Hershey's kiss for 2¢ | Ferrero Rocher for 27¢ |
| Experiment 2 | Real choice | 0&14 | Hershey's kiss for 0¢ | Lindt Truffle for 14¢ |
| | | 0&10 | Hershey's kiss for 0¢ | Lindt Truffle for 10¢ |
| | | 1&15 | Hershey's kiss for 1¢ | Lindt Truffle for 15¢ |
| Experiment 3 | Real choice | 0&13 | Hershey's kiss for 0¢ | Lindt Truffle for 13¢ |
| | | 1&14 | Hershey's kiss for 1¢ | Lindt Truffle for 14¢ |
| Negative price | Real choice | −1&12 | Hershey's kiss plus 1¢ | Lindt Truffle for 12¢ |
| | | 0&13 | Hershey's kiss for 0¢ | Lindt Truffle for 13¢ |
| | | 1&14 | Hershey's kiss for 1¢ | Lindt Truffle for 14¢ |
| Experiment 4 | Real choice | 0&1 | Small Snickers for 0 Hershey's | Large Snickers for 1 Hershey's |
| | | 1&2 | Small Snickers for 1 Hershey's | Large Snickers for 2 Hershey's |

## Appendix (Continued.)

| | | | | |
|---|---|---|---|---|
| Amazon gift certificates (GC) | Real choice | 0&7 | $10 Amazon GC for $0 | $20 Amazon GC for $7 |
| | | 1&8 | $10 Amazon GC for $1 | $20 Amazon GC for $8 |
| | | 5&12 | $10 Amazon GC for $5 | $20 Amazon GC for $12 |
| Experiment 5 | Attitude | H0 | Hershey's kiss for 0¢ | — |
| | | H1 | Hershey's kiss for 1¢ | — |
| | | L13 | — | Lindt Truffle for 13¢ |
| | | L14 | — | Lindt Truffle for 14¢ |
| Experiment 6 | Hypothetical choice | 0&13, neutral | Hershey's kiss for 0¢ | Lindt Truffle for 13¢ |
| | | 1&14, neutral | Hershey's kiss for 1¢ | Lindt Truffle for 14¢ |
| | Hypothetical choice and ratings | 0&13, forced analysis | Hershey's kiss for 0¢ | Lindt Truffle for 13¢ |
| | | 1&14, forced analysis | Hershey's kiss for 1¢ | Lindt Truffle for 14¢ |

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