# Checking Out Temptation:
# A Natural Experiment with Purchases at the Grocery Register

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**Abstract:** A long literature in psychology, as well as a more recent theory literature in economics, suggests that prolonged exposure to a tempting stimulus can eventually lead people to "succumb" to that temptation. Here we develop a simple model of decision under temptation, and test its predictions using data from a natural experiment. We take advantage of naturally occurring, exogenous variation in the amount of time individual consumers spend waiting in grocery store checkout lines. We collect over 2,800 observations from three grocery stores. We obtain robust evidence that time spent in line economically and statistically significantly increases the probability that one purchases a tempting item. For example, people who wait in line 25 percent longer than average are between 12 and 25 percent more likely to purchase a tempting item. Moreover, for any fixed time in line, we find that the presence of a child significantly increases the likelihood of a purchase. These results are consistent with models that connect purchasing decisions to temptation, and also suggest that children yield to temptation more rapidly than adults. Our results offer novel quantitative and empirical content to the rapidly expanding economics literature on decisions under temptation.

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## I. Introduction

The iconic study of temptation is the famous "marshmallow test" of Mischel and Ebbeson (1970), which investigated the propensity of four-year-old children to delay gratification. In the experiment, the researchers offered each child the choice between taking one marshmallow immediately, or waiting fifteen minutes for a reward of two marshmallows.[1] A few children actually did wait the entire fifteen or twenty minutes until the researcher returned without the child's signal, while others opted for the early reward almost immediately. Most interestingly, a third group of children waited significant periods of time before deciding to give up on the reward and taking the one marshmallow already offered.

This third subset of subjects displayed a systematic deviation from economic theory. Their time-inconsistent behavior conflicts with standard economic models of maximizing present discounted values of consumption, where a rational agent should either eat the marshmallow right away (given a high discount rate), or else wait the entire period for the promised reward (given a low discount rate). While they demonstrated an initial preference for delaying gratification to receive the larger consumption bundle, they later switched their decision and earned nothing for the time they had spent waiting. On its face this does not appear to be utility-maximizing behavior.

What can we learn about adult decisions in naturally occurring environments from the behavior of young children in a lab? Anecdotally, it seems everyone can recall individuals who initially chose to delay gratification but thereafter failed to carry out their plan, especially when faced with a tempting stimulus. Are there naturally occurring situations where consumers change

[1] Rewards other than marshmallows were also used; it was usually an item that the child was found in pre-testing to prefer (say, a preference for marshmallows over pretzels). Also, the quantity of the delayed reward varied in relation to the first reward.

their behavior in response to exposure to a tempting stimulus in systematically measurable ways, akin to the marshmallow tests with four-year-olds?

Supermarkets may present a good source of field data on this question. Due to random variation in the number of customers, the number of open aisles, and the number of items in other customers' carts, shoppers exogenously face different amounts of time in line at the checkout aisle, giving us a natural experiment. Intuitively, if temptation theory has economic relevance in this setting, we should expect that those customers forced to wait in line longer will be more likely to pick up and purchase tempting items.[2]

The next section develops a model of decision under temptation that makes precise the hypotheses tested by our natural experiment. Section three details our experiment, and section four describes our results. Our main findings are that the amount of time a person spends in line is a significant predictor of his or her decision to purchase a tempting item, and that this effect is larger in magnitude when children are present. These results provide novel empirical evidence on the rapidly expanding theoretical literature on temptation and decision.

## II. A Simple Model of Decision Under Temptation

There has been substantial recent theoretical progress in the theory of temptation and self-control. Our focus is temptation within the context of an individual decision problem (e.g., Gul and Pesendorfer, 1997), as compared to temptation that might arise in strategic interaction (e.g., the temptation to defect in a public good game: Ledyard, 1995). Of particular relevance to our paper is a recent contribution by Ozdenoren et al., 2006, who develop a model of will-power depletion that

[2] There have been a number of attempts to model temptation: Dholakia (2000) gives such a model in the marketing literature, and Gul and Pesendorfer (2001) is an example from the economic literature.

can account for decision-switching behaviors such as those observed in the marshmallow task.[3] A simple model in the spirit of Ozdenoren et al., 2006, and which helps to provide structure to our data, can be developed as follows.

An agent either consumes ($d = 1$) or does not consume ($d = 0$) a "tempting" item. For simplicity, we assume that all utility associated with consuming or not consuming the item occurs at the point when the item is not longer a target for consumption, either because the agent consumed it or because it is no longer immediately available to the agent. An item is "tempting" to a consumer if her preferences for the item satisfy the following. First, the "no-consumption" ($d = 0$) utility depends on the exposure duration according to $U(0) - W(t)$, where $U(0)$ is a real scalar and $W(t)$ (cost of depleted willpower) is real valued and monotonically increasing in $t$. Second, utility derived from consumption is a scalar $U(1)$ that does not vary with exposure duration and that satisfies $U(1) < U(0)$. This model captures the simple intuition that the longer an agent is exposed to a tempting item the less satisfaction they feel in the ultimate decision not to consume it, while consuming it gives them the same pleasure regardless.

Thus, when exposed to a tempting item for duration $t$, consumer $j$'s preferences are:

$$V(d = 0, t) = U(0) - W(t)$$

$$V(d = 1, t) = U(1)$$

The consumption decision $d^*$ is $d^* = 0$ if $V(0, t) > V(1, t)$, and $d^* = 1$ otherwise.

Now, suppose there are two possible exposure durations, $S$(hort) and $L$(ong), so that $W(S)$ is less than $W(L)$. Suppose also that a consumer knows whether she will be exposed to the tempting good for duration $S$ or $L$. Three cases can arise:

[3] The Ozdenoren et al. model draws on arguments and experiment results detailed in a lengthy literature in psychology and economics, including Abelson (1963), Hoch and Lowenstein (1991), Baumeister et al. (1998) and Vohs and Faber (2007).

**Case 1.** $U(1) > [U(0) - W(S)] > [U(0) - W(L)]$.

In this case the agent consumes the tempting good immediately and obtains utility $U(1)$.

**Case 2.** $[U(0) - W(S)] > [U(0) - W(L)] > U(1)$.

In this case the consumer does not consume the tempting good and obtains utility $U(0) - W(S)$ if the duration is short, and $U(0) - W(L)$ if the duration is long.

**Case 3.** $[U(0) - W(S)] > U(1) > [U(0) - W(L)]$.

This agent consumes the tempting good immediately and obtains utility $U(1)$ if the known duration is $L$, but does not consume the good and earns utility $U(0) - W(S)$ if the duration is short.

Assuming different individuals are characterized by different cases, this simple model is sufficient to predict (i) the frequency of tempting purchases increases as exposure duration increases, and (ii) some people will not purchase tempting goods even with long exposure; (iii) some people will purchase tempting goods even with short exposure. Moreover, if there is uncertainty regarding exposure duration then the model can also account for delay, in the sense of the apparent "switching" observed in the marshmallow task. In particular, because the value of consumption is time-invariant, a person with Case 3 preferences will always wait to resolve whether the duration will be short prior to making their consumption (or no-consumption) decision. Consequently, an additional prediction of this model is that consumption decisions will not necessarily cluster near the end of total wait period, but may occur at any point after the "short" length of time has passed.

## III. A Natural Experiment

To test the predictions of our simple model of decision under temptation, we turned to the checkout aisles of local supermarkets. At the checkout aisle, "tempting items" such as magazines, batteries, candy bars, and gum have become an everyday part of our grocery experience, thanks in part to the historical influence of the noted behavioral psychologist John Broadus Watson.

### III. 1. Background

One hundred years ago customers placed their grocery orders at the counter in full service stores. At the counter, grocery staff members retrieved the requested items for the customer, who did not have direct access to the goods. This institution required advanced planning on the part of the buyer, and it maintained visual and physical distance between products and their potential customers. The first experiments with self-service grocery stores occurred in 1916.[4] Observations indicated that when customers were able to amble through the aisles and handle products for themselves, they tended to purchase more. This technological change also increased the importance of consumer packaging, since labels now had to do more than simply identify their contents to store clerks.

The psychologist John Watson has been credited with revolutionizing marketing in the 1920s and 1930s, through the application of his behaviorist theories to the advertising industry.[5] Watson advocated techniques that targeted consumers emotionally, such as the use of testimonials, vague appeals to scientific authority, and the selling of ideals rather than the

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[4] Clarence Saunders introduced self-service grocery stores with the opening of the first Piggly Wiggly on September 9, 1916. The initial self-service stores were cramped mazes in which customers snaked up and down the aisles in a fixed pattern and then paid for their purchases upon exiting the last aisle.

[5] Buckley (1989), Ewen (1976), Gold (1987), Pease (1958), and Rorty (1934) have argued the importance of Watson's direct contributions to marketing via innovations based on his academic insight. Others, such as Coon (1994), have deemphasized his role, making the case that Watson's contributions to marketing served merely to reinforce and legitimize preexisting trends in the industry. That is, some view Watson as the motive force behind the marketing revolution, and others as just its figurehead.

products themselves. Through observation of consumer behavior in a retail environment, he noticed that the placement of products affected their sales. He therefore recommended that "tempting" products be displayed in locations physically convenient to customers—such as at the store entrance, on shelves at eye level, or near the registers.[6]

The last major element of the modern supermarket came with the introduction of the shopping cart in 1936, which allowed customers to comfortably linger in the store and browse much longer than before.[7] The confluence of the convenience of shopping carts and the availability of purposefully placed tempting items at checkout aisles sets the stage for our study. Due to random variation in the number of customers, the number of open aisles, and the number of items in other shoppers' carts, different shoppers exogenously face different amounts of time in line, giving us a natural experiment. If temptation theory has economic relevance in this setting, we should see that those customers forced to wait in line longer are more likely to purchase tempting items placed in the checkout aisle.

### III.2. Procedures

The data for this project were collected by undergraduate research assistants, who directly observed checkout aisles at three grocery stores in Tucson, Arizona. First, 886 observations were made at an Albertsons, which is part of a national chain. This particular store is in a middle-income area. Later, we collected data from a Wild Oats, a more upscale chain store in a

[6] Cohen (1979).

[7] Sylvan Goldman bought the failing Humpty Dumpty chain of grocery stores at the height of the Depression. He observed that his customers would promptly head to the register once their market baskets filled or grew too heavy and that they hardly ever started a second basket. Thinking that they would buy more if they could simply be helped with carrying their purchases, he had his employees put together makeshift carts consisting of two baskets and wheels attached to a folding chair. Customers avoided the new contraptions until Goldman hired undercover shoppers to demonstrate their intended purpose, at which point his shopping carts became enormously popular.

wealthier part of town, and from Grant-Stone Market, a local, independent grocery in a lower-income neighborhood.

Initially, a set of 1671 data points included: (1) the time that a customer entered a checkout line, (2) the time at which the customer reached the cashier, (3) whether the customer purchased a tempting item from the checkout aisle, (4) the customer's gender, and (5) whether the consumer had children with him or her. Later, 1156 additional observations were made, adding three more variables: (6) the approximate age of the customer, and (7) the elapsed time (if any) until the customer actually picked up a tempting item that he or she eventually purchased.[8] This yielded a total of 2827 independent observations concentrated mainly at the Albertson's store (72.2 percent), and more modest proportions from Wild Oats (15.0 percent) and Grant-Stone (12.8 percent).[9] Observations were made on different days of the week and various times of the day.

## IV. Results

### IV.1. Descriptive Statistics

Overall, slightly more than half of the observed customers (56.0 percent) were female (see Table 1).[10] We observed a higher proportion of females at Wild Oats (63.4 percent) and a lower proportion of females at Grant-Stone (40.1 percent), with Albertson's close to the group average (57.3 percent). We also observed that at each store the proportion of females purchasing tempting items was greater (9.5 percent) than the proportion of males who did so (6.4 percent).

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[8] We also made an effort to collect information on race. Our sample is overwhelmingly white (about 86%), with Hispanics, Asians and Blacks representing 7%, 4% and 3% of our sample, respectively. Thus, we have too few observations for reasonable inference regarding race effects on temptation, and we will not pursue a race analysis.

[9] Different shoppers decided independently whether to purchase a tempting item. There could have been correlation in the amount of time adjacent shoppers spent in line. However, this correlation raises problems for our analysis only in the event that shoppers select wait times for reasons that are correlated with their individual propensities to purchase a tempting item. For example, if people who are more likely to purchase tempting items also systematically select lines with longer expected waits, then our inferences regarding duration effects will be biased upwards.

[10] When a mixed-gender group checked out together in a single transaction, we recorded an appropriate fraction for the gender variable (e.g. 0.5 for one man and one woman). This occurred in 263 of the 2827 observations.

We observed children with 8.8 percent of the customers, and this ratio was fairly consistent across the three stores (see Table 2). Children led to a much higher probability of a tempting purchase (46 out of 250, 18.4 percent) than the aggregate average (229 out of 2827, 8.1 percent). Nearly three quarters (74.8 percent) of the observations with children present occurred with a female customer, so we see already that the male/female difference in purchases of tempting items is likely attributable at least in part to the increased presence of children.

For our purposes, the most interesting descriptive statistics concern time in line, which are detailed in Table 3. Aggregating our data from all stores, time spent in line before reaching the cashier ranged from a mere 3 seconds to a whopping 18.5 minutes, with a mean of 3 minutes 56 seconds. Interestingly, no customer who spent less than 20 seconds in line purchased a tempting item. The average time in line among those who did purchase a tempting item is 4 minutes 57 seconds, a full minute longer than the group who did not purchase, and this difference is statistically significant ($p < 0.01$). Table 3 also shows that this pattern holds true separately for each store, although statistical significance is lost at Wild Oats where we have relatively few purchase observations. Overall, Table 3 provides first evidence that customers who wait longer in line are more likely to purchase a tempting item, providing empirical support that temptation affects consumer decisions.

A subset of the Albertson's data ($N = 1156$) included observations on age and elapsed time until tempting item pickup. We assigned customers to one of three approximate age categories: younger than 25 (14.53 percent), between 25 and 60 (69.20 percent), and older than 60 (16.26 percent). The younger and older groups exhibited somewhat higher proportions of purchases (6.0 percent and 4.3 percent respectively) than the middle group (3.8 percent). However, these differences are economically small, and statistically insignificant in pair-wise comparisons ($p >$ 0.3 in all cases).

Lastly, for this latter subset of Albertsons data we measured the time elapsed from arrival in the checkout line until the pickup of a tempting item. This set contains only 48 purchases. The elapsed times ranged from a minimum of 2 seconds to a maximum of 5 minutes 21 seconds, with a mean of 1 minute 34 seconds. An interesting feature of this chart is that it seems to suggest decision switching. It is consistent with the view that, like the children in the lab, people do not initially choose to purchase a tempting item, but eventually succumb to temptation and do so.

### IV. 2. Analysis

When applied to our grocery store data, the main prediction of our simple model are that (i) frequencies of purchases of tempting items will increase with time in line and (ii) assuming there is uncertainty regarding time to be spent in line, the decision to purchase a tempting item will not be made upon entering the line, but with some delay.

The goal of our analysis is to investigate the validity of these predictions. To do this we conducted logit regressions that shed light on the impact of exposure duration on purchase decisions.[11]

**Result 1:** *Total time spent in the checkout line is a significant predictor of a shopper's decision to purchase a tempting item.*

Support for this derives from an analysis of our 2827 observations. The dependent variable is whether a tempting item was purchased, and the independent variables available to us are the duration of time in line, the sex of the consumer and whether children were present. Our

[11] Using probit or OLS regressions yields qualitatively similar results.

findings are reported in Table 4, and strongly suggest that, after controlling for these factors, time spent in the checkout line is significantly positively related to purchases (in each case with a *z*-statistic greater than 3). The logit coefficient on time is 0.17, which implies one additional minute in line increases the probability of a purchase from 8.1 to 9.5 percent (a 17.2 percent increase).

We explored the robustness of Result 1 in a variety of ways. First, Table 4 reports two logit analyses of a smaller 2039-observation data set. The first includes store dummies for Wild Oats and Grant-Stone Market and corresponding interaction terms with time, while the second does not. Neither the store dummies nor their interaction terms are significant. However, time in line remains a significant predictor.

We also analyzed the subset of data that contained observations on age. The first of these regressions includes dummies for age, as well as interactions terms for each with time. The second does not include these dummies. In all cases total time in line is highly significant. Finally, we also investigated but found no evidence for correlations between purchases of tempting goods and time of day or day of week.

Thus, this result provides empirical support for models of willpower depletion such as those mentioned in Section II, and particularly Ozdenoren et al. 2006.

**Result 2:** *The presence of children significantly increases the likelihood of purchasing a tempting item.*

Table 4 shows that the presence of children is also a significant predictor of purchase decisions. This is consistent with the view that children are more impatient than adults. Moreover, the different rates of purchases between men and women detailed in the descriptive statistics seem entirely attributable to the fact that women were more likely than men to shop with children. In particular, after controlling for the presence of children the gender dummy becomes statistically insignificant. Finally, note that this result is robust to the various alternative specifications described in the discussion of Result 1.

**Result 3:** *The decision to purchase a tempting item is generally made with delay.*

We support this result using observations in our Albertsons data that include elapsed time until item pick up. In particular, we ran a survival model to estimate the effect of time on a person's "failure to resist" purchases at the register. The estimated hazard rate is 1.2 percent per minute, and this is statistically significant ($p < 0.05$). Thus, purchases are frequently not made immediately, but the probability of a purchase increases with the amount of time spent in line. This is consistent with our simple model in section II of willpower depletion (and also Ozdenoren et al, 2006), as long as there is uncertainty regarding the amount of time one needs to stand in line, and when there are individual differences in the duration one considers "short."

## V. Conclusion

Drawing from a long literature in psychology and economics, and a more recent economic theory literature, we developed a simple model of decision under temptation. The key implication of our model, like other more sophisticated models in this area, is that one is more likely to purchase a tempting item if one is exposed to it for a longer period of time. We took advantage of a natural experiment to test this prediction. We collected over 2,800 observations on purchase decisions at grocery store checkout aisles, and found that time in line significantly increases the probability of purchasing a tempting item. This effect is both statistically and economically significant. For example, we found that waiting in line 25 percent longer, five instead of four minutes, increases the probability of purchasing a tempting item by up to 25 percent (from 0.08 to 0.10). Moreover, we found that, for any fixed duration of time in line, the presence of children increases the chance of purchasing a tempting item. This is consistent with the view that children "succumb" to temptation more quickly than adults (and are experts at persuading adults to buy the tempting product they want!).

Our results provide empirical content to the notion that "willpower" is depleted when a person is in the presence of a tempting item. It is this intuition that underlies a psychology literature dating to Abelson (1963), as well as more recent sophisticated theory on this topic (e.g., Ozdenoren et al., 2006). Future research might profitably address commitment strategies people use to avoid willpower depletion in tempting situations, especially those that, like standing in checkout lines, are largely unavoidable.

## Table 1. Distribution of Sex and Purchases by Store (N = 2827)

| | Albertson's | | Wild Oats | | Grant-Stone | | Aggregate | |
|---|---|---|---|---|---|---|---|---|
| | Total | Purchases | Total | Purchases | Total | Purchases | Total | Purchases |
| **Males** | 872.67 | 53 | 155 | 6.5 | 216.833 | 20 | 1244.5 | 79.5 |
| **Females** | 1169.33 | 114 | 268 | 14.5 | 145.167 | 21 | 1582.5 | 149.5 |
| **Total** | 2042 | 167 | 423 | 21 | 362 | 41 | 2827 | 229 |

Note: Groups of customers of mixed gender were treated as an appropriately proportioned fractional sex observation.

## Table 2. Distribution of Kid Observations and Purchases by Store (N = 2827)

| | Albertson's | | Wild Oats | | Grant-Stone | | Aggregate | |
|---|---|---|---|---|---|---|---|---|
| | Total | Purchases | Total | Purchases | Total | Purchases | Total | Purchases |
| **With Males** | 52 | 6 | 4 | 0 | 7 | 2.5 | 63 | 8.5 |
| **With Females** | 141 | 27 | 24 | 4 | 22 | 6.5 | 187 | 37.5 |
| **Overall** | 193 | 33 | 28 | 4 | 29 | 9 | 250 | 46 |

Note: Groups of customers of mixed gender were treated as an appropriately proportioned fractional sex observation.

## Table 3. Descriptive Statistics of Time in Line (mm:ss) (N = 2827)

| | Albertson's | | Wild Oats | | Grant-Stone | | Aggregate | |
|---|---|---|---|---|---|---|---|---|
| | Given Purchase | Given No Purchase | Given Purchase | Given No Purchase | Given Purchase | Given No Purchase | Given Purchase | Given No Purchase |
| **Min Time** | 0:29 | 0:03 | 0:26 | 0:26 | 0:21 | 0:09 | 0:21 | 0:03 |
| **Max Time** | 14:03 | 18:35 | 7:20 | 16:24 | 6:45 | 12:42 | 14:03 | 18:35 |
| **Mean Time** | 5:40 | 4:47 | 2:44 | 2:28 | 3:10 | 2:33 | 4:57 | 3:51 |
| **Std Dev** | 2:42 | 2:28 | 1:40 | 1:27 | 1:31 | 1:48 | 2:36 | 2:19 |
| **Difference**‡ | 0:53 | (3.84***) | 0:16 | (0.73) | 0:37 | (2.39**) | 1:06 | (6.19***) |

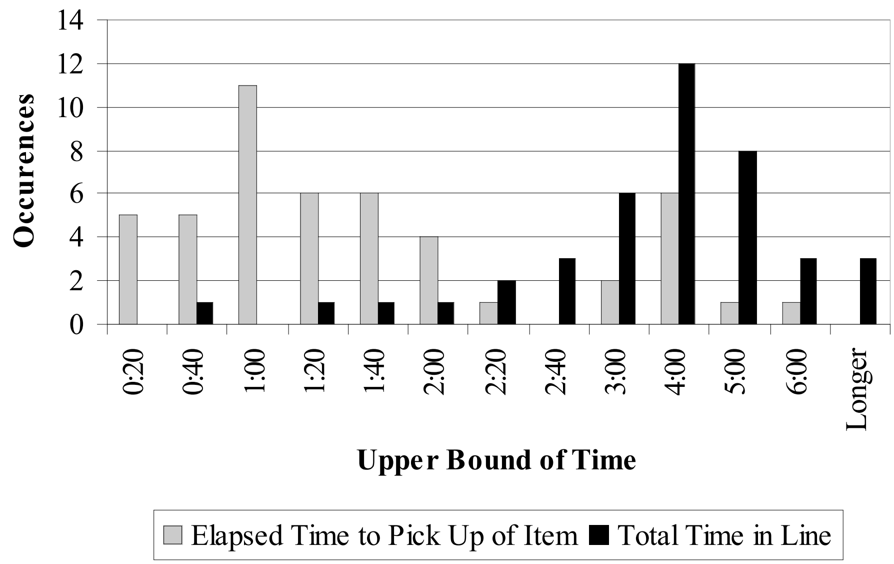
‡ Difference in mean of time in line given purchase and mean of time in line given no purchase (t-statistics for the test of equality of means appear in parentheses).
** significant at the 5% level
*** significant at the 1% level

**Table 4. Determinants of a Tempting Item Purchase: Logit Regressions**

| Variable | N=2827 | N=2039 | N=2039 | N=1156 | N=1156 |
|---|---|---|---|---|---|
| Constant | -3.473*** | -2.977*** | -2.978*** | -4.661*** | -4.273*** |
| | *0.246* | *0.291* | *0.239* | *0.600* | *0.539* |
| FEMALE | 0.332 | 0.279 | 0.138 | 0.782 | 0.909 |
| | *0.316* | *0.330* | *0.321* | *0.681* | *0.661* |
| KIDS | 1.134*** | 1.017** | 1.112*** | 1.614*** | 1.330* |
| | *0.369* | *0.401* | *0.390* | *0.735* | *0.703* |
| BELOW25 | | | | 0.979 | |
| | | | | *0.824* | |
| ABOVE60 | | | | 1.015 | |
| | | | | *0.839* | |
| WILDOATS | | -0.471 | | | |
| | | *0.449* | | | |
| GRANTSTONE | | 0.277 | | | |
| | | *0.373* | | | |
| TIME | 0.174*** | 0.133** | 0.137*** | 0.273*** | 0.220* |
| | *0.048* | *0.053* | *0.048* | *0.124* | *0.114* |
| FEMALE*TIME | -0.015 | -0.002 | 0.013 | -0.163 | -0.185 |
| | *0.060* | *0.062* | *0.061* | *0.148* | *0.142* |
| KIDS*TIME | -0.035 | -0.038 | -0.052 | -0.062 | -0.025 |
| | *0.065* | *0.070* | *0.068* | *0.161* | *0.154* |
| BELOW25*TIME | | | | -0.061 | |
| | | | | *0.192* | |
| ABOVE60*TIME | | | | -0.185 | |
| | | | | *0.194* | |
| WILDOATS*TIME | | -0.044 | | | |
| | | *0.127* | | | |
| GRANTSTONE*TIME | | 0.014 | | | |
| | | *0.291* | | | |

Notes: standard errors are given in italics.
* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

**Figure 1. Elapsed Time to Pick Up of a Tempting Item and Total Time in Line**



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