

The domain effect in delay discounting: The roles of fungibility and perishability



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ABSTRACT

There is a growing body of literature demonstrating domain effects where the rate of temporal discounting depends, in part, on the commodity being evaluated. The commodity of money, for example, is typically discounted much less steeply than commodities of entertainment or food. There are several plausible explanations for domain effects: differences in conditioned reinforcer status, degree of fungibility, and differences in metabolic function. While money can be thought of as a conditioned reinforcer exchangeable for a number of different outcomes (highly fungible), comparing money to food (non-fungible) does not separate whether the difference in rates of discounting are due to food having metabolic importance, being perishable, being less fungible, or all of the above. We systematically manipulated the degree of fungibility and perishability of various outcomes and found that while food outcomes tend to be discounted most steeply, the rate of discounting for these outcomes can be moderated by reducing perishability and by increasing fungibility. Important here is that we have identified two independent means of moderating the effect of delay on the value of the outcome.

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Discounting, the devaluation of an outcome when it is delayed, is a robust finding in the literature and has been found to occur in both human and non-human animals (for reviews see Green and Myerson, 2004; Madden et al., 2010; Odum, 2011a). Furthermore, steep delay discounting has been implicated in numerous socially significant maladaptive patterns of behavior (e.g., for a meta-analysis see MacKillop et al., 2011; Johnson et al., 2015a,b; Ritschel et al., 2015; Moody et al., 2016). While temporal discounting of money is a robust finding, there is a growing body of literature demonstrating that rates of discounting vary across commodities (see Green and Myerson, 2013 for a discussion). This finding has been termed the *domain effect*, meaning that rates of temporal discounting depend, at least in part, on the commodity being evaluated (e.g., Baker et al., 2003; Odum, 2011b; Weatherly, 2014). For example, money has been found to be discounted much less steeply than other outcomes such as food, entertainment items, sex, or health outcomes (e.g., Baker et al., 2003; Chapman, 1996; Charlton and Fantino, 2008; Estle et al., 2007; Holt et al., 2014; Friedel et al., 2014; Lawyer, 2008; Odum and Rainaud, 2003; Tsukayama and Duckworth, 2010). This pattern of results even holds when individuals with addictive disorders are discounting their substance of

abuse (e.g., Bickel et al., 1999; Coffey et al., 2003; Madden et al., 1997; Petry, 2001; Mejía-Cruz et al., 2016; Johnson et al., 2010).

An early theory for the difference in discounting rates between commodities was offered by Raineri and Rachlin (1993) who provided evidence that the value of money and other commodities (i.e., vacation and car) depends in part on their rate (e.g., deprivation) and duration (i.e., perishability) of consumption. That is, the rate of discounting increases when the time to consume an outcome is limited. Odum and Rainaud (2003) posited that money is treated differently because it is a conditioned reinforcer instead of a primary (and consumable) reinforcer. Estle et al. (2007) offered a related version this line of reasoning in that money is not just a conditioned reinforcer, but it is a generalized conditioned reinforcer in that it can be exchanged for a wide variety of goods or services. This property of a commodity is called fungibility in economics and is important because the item may be exchanged for a wide variety of goods that can change over time depending on the individual's needs and desires. Other outcomes such as food, would not be considered fungible as food is only relevant when an individual is hungry. So according to Estle and colleagues the domain effect is due to money being a highly generalized (fungible) outcome. More recently, Stuppy-Sullivan et al. (2016) provide evidence that self-relevant commodities that are known to have future utility are not necessarily discounted any more steeply than highly fungible outcomes. This result poses a challenge to the other

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theories offered as explanations for the domain effect since neither the consumability nor fungibility of the commodity can be used to explain their observed pattern of results.

Charlton and Fantino (2008) offered that metabolic aspects of the outcomes might be responsible for domain effects. They examined discounting between money, food, books, DVDs, and music and found that the rate of discounting across the commodities to fall roughly along a continuum with money discounted the least and food discounted the most. Charlton and Fantino suggested that food was discounted more steeply due to metabolic effects (i.e., a biological relevance). The argument here is that the more biologically relevant the commodity, the more steeply the commodity will be discounted. Rasmussen et al. (2010) added some support to this position when they found money to be discounted less steeply than food, and a correlation between percent body fat and bites of food where the higher the persons' percent body fat, the steeper they discounted bites of food. Similar results were found by Manwaring et al. (2011) who found obese women to have steep discounting rates for food items. Because research suggests that people with a higher percent body fat have higher rates of metabolism than people with lower percent body fat (Welle and Nair, 1990), one could argue people with higher percentage of body fat discount food more steeply because food has greater biological relevance. That is to say, those with stronger food drives (due to metabolism or other factors) may make the immediacy of receiving food more important and as a result would lead to steeper rates of discounting for food.

A lingering question here is what specific dimension of the outcome accounts for the observed differences in rates of discounting (domain effect). While there are several plausible explanations for domain effects (i.e., perishability, conditioned reinforcer, fungibility, metabolic, and self-relevance), it is quite possible that a fuller explanation may lie in any combination of these theories or in an altogether new theory. In the items studied to date, typically more than one dimension of the outcome differs. For instance, while items such as music CDs may be considered consumables, they do not have the same properties as food (i.e., the same CD can be consumed many times; whereas this is not the case with food), the same level of perishability (it is assumed here that music CDs are less perishable than food outcomes), and perhaps not the same level of fungibility. Also, while money can be thought of as a conditioned reinforcer exchangeable for a number of different outcomes (highly fungible), comparing money to food (non-fungible) does not separate whether the difference in rates of discounting are due to food having metabolic importance, being perishable, less fungible, or a combination of these factors.

The present study attempts to dissect the domain effect by systematically manipulating the degree of fungibility and perishability of various outcomes. We have conceptualized an outcome as fungible when the outcome can be exchanged for other items, and the more fungible the item, the greater variety of goods or services it can be exchanged for. We conceptualized an outcome as perishable when the outcome is prone to spoilage over time. A highly perishable outcome is one that must be consumed almost immediately to avoid spoil (e.g., fresh fruit, pizza) and a less perishable outcome is one that does not spoil as immediately (e.g., clothing). We would like to argue that the dimensions of fungibility and perishability are important, separable, and may provide a parsimonious approach that can be used to address factors that may contribute to domain effects.

The current study used commodities of money (fungible and non-perishable), visa gift cards (fungible and non-perishable), clothing store gift cards (fungible and non-perishable), jeans (non-fungible and non-perishable), grocery gift cards (fungible and non-perishable), candy (non-fungible and perishable), pizza gift cards (non-fungible and non-perishable), and pizza slices (non-fungible and perishable). While we recognize that there are likely

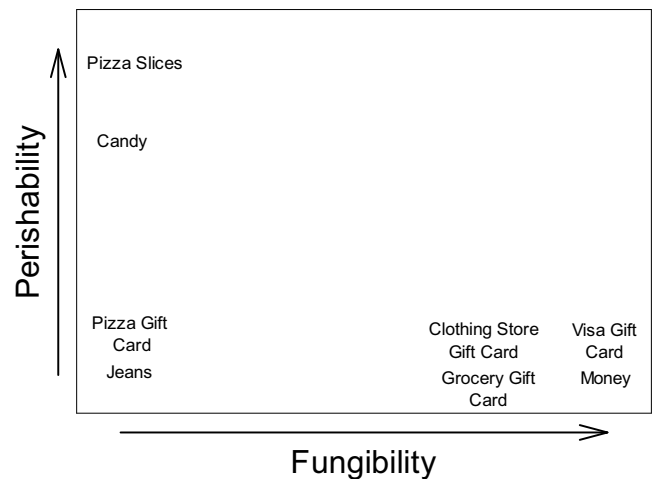


Fig. 1. Each commodity plotted as a function of its degree of fungibility and perishability.

to be some differences both in terms of the level of fungibility and/or perishability (as loosely conceptualized in Fig. 1), for purposes of comparison we have categorized each of the dimensions of fungibility and perishability on an ordinal scale of “high” and “non-.” Like has been observed previous studies, it was hypothesized that all outcome types would be discounted and that the pattern of discounting would be orderly and well described by a simple mathematical function (i.e., a hyperbolic-like function). It was also hypothesized, based on previous findings, that both fungibility and perishability would influence the rate of discounting with more fungible and non-perishable outcomes (e.g., money, Visa gift card) being discounted less steeply than outcomes that are both non-fungible and perishable (e.g., candy, pizza slices). We did not have specific predictions as to the rate of discounting with outcomes in the intermediary of fungibility and perishability (e.g., jeans, pizza gift card). In these cases, the relative contribution of fungibility and/or perishability on the rate of discounting was exploratory.

1. Method

1.1. Participants

A total of 91 college students, all of whom received a small amount of course credit upon completion, participated in the study. All participants were given a unique username and password that they used to log into and access a website. The website hosted an online decision making task that was developed for the present study and could be accessed from any computer connected to the internet. Participants had access to participate in the study at any point during an approximate two-week time period (the actual length of time varied across classes due to course scheduling). All participants were asked to make decisions involving hypothetical outcomes, and were randomly assigned to one of four separate conditions involving outcomes that varied in terms of their level of fungibility and perishability: Condition 1, money and Visa gift card ($n = 21$); Condition 2, clothing store gift card and jeans ($n = 29$); Condition 3, grocery gift card and candy bar ($n = 21$); Condition 4, slices of pizza and pizza gift card ($n = 20$).

1.2. Procedure

Immediately after logging into the website, participants were asked to provide informed consent and were provided with general instructions, which explained that the purpose of the study was to examine choices regarding various hypothetical outcomes.

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