



Exchanging the liquidity hypothesis: Delay discounting of money and self-relevant non-money rewards



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ABSTRACT

Evidence that primary rewards (e.g., food and drugs of abuse) are discounted more than money is frequently attributed to money's high degree of liquidity, or exchangeability for many commodities. The present study provides some evidence against this liquidity hypothesis by contrasting delay discounting of monetary rewards (liquid) and non-monetary commodities (non-liquid) that are self-relevant and utility-matched. Ninety-seven (97) undergraduate students initially completed a conventional binary-choice delay discounting of money task. Participants returned one week later and completed a self-relevant commodity delay discounting task. Both conventional hypothesis testing and more-conservative tests of statistical equivalence revealed correspondence in rate of delay discounting of money and self-relevant commodities, and in one magnitude condition, *less* discounting for the latter. The present results indicate that liquidity of money cannot fully account for the lower rate of delay discounting compared to non-money rewards.

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1. Introduction

Rewards available in the future are often valued less than smaller rewards that are immediately available. This tendency to devalue future rewards is known as *delay discounting*, and is associated with increased risk for many impulsive behaviors (Crean et al., 2000) including drug dependence (Reynolds, 2006; Yi et al., 2010a), excessive drinking (Petry, 2001; Vuchinich and Simpson, 1998), pathological and problem gambling (Dixon et al., 2003; Petry, 2001), lack of financial planning (Angeletos et al., 2001), overeating (Weller et al., 2008; Rasmussen et al., 2010), physical inactivity (Daugherty and Brase, 2010), HIV-risk (Odum et al., 2000; Chesson et al., 2006), and increased risk for mortality (Boyle et al., 2013). In contrast, low rates of delay discounting are associated with health-enhancing behaviors (e.g., wearing safety belts and sunscreen; Daugherty and Brase, 2010). Thus, a better understanding of delay discounting processes could inform approaches to enhance decision making associated with numerous health-relevant outcomes.

Typical delay discounting procedures ask individuals to choose between a smaller reward available immediately and a larger reward available following a delay. Until recently, most delay

discounting research with humans has focused on monetary rewards (Tsukayama and Duckworth, 2010; Frederick et al., 2002). However, an accumulating body of evidence indicates that delay discounting of consumable rewards such as food, tobacco, alcohol, and illicit drugs are discounted at a higher rate than a comparable amount of money (Bickel et al., 1999; Estle et al., 2007; Friedel et al., 2014; Giordano et al., 2002; Jiga-Boy et al., 2013; Odum and Rainaud, 2003; Odum and Baumann, 2007; Odum et al., 2006).

One early explanation for this pattern of results, particularly when observed for drug rewards, was that the reinforcing efficacy for immediately consumable rewards was elevated relative to money (Giordano et al., 2002; Madden et al., 1999) and triggered visceral responses (Loewenstein, 1996); in other words, oversensitivity to immediate rewards was particularly pronounced for drug rewards (Eppinger et al., 2012). While this likely explains part of the phenomenon, it has been proposed more recently (e.g., Estle et al., 2007; and others) that the lower rate of delay discounting for money is due to the fact that money retains utility over time because it is exchangeable for many things (see also Charlton and Fantino, 2008); i.e., money has the characteristic of *liquidity*.¹ According to this view, the functionality of less liquid commodities

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¹ The term *fungibility* has been used interchangeably in this literature with the term *liquidity*, though *fungibility* specifically refers to a commodity's capability to be mutually substituted for itself.

may fluctuate due to an “inconstancy of desire” (Estle et al., 2007; p. 62), and thus have a level of utility subject to diminishing.

Consider a non-liquid commodity such as a hamburger costing \$10 delayed by 1 week. Even an individual who typically enjoys hamburgers knows that s/he may not have an appetite for the hamburger when the week has passed and it is available to be consumed; this non-liquid commodity may be discounted at a steep rate. In contrast, an equivalent money amount could be used to purchase a variety of commodities consistent with his/her future needs or desires (including the hamburger). As a result of this liquidity, money is more likely to be discounted at a shallow rate. In summary, delayed money guarantees individual flexibility to maximize future utility, while a delayed commodity constrains individual capacity to maximize future utility. This liquidity hypothesis is supported by research that has found higher rates of delay discounting of commodities such as entertainment (Friedel et al., 2014).

Helpful in parsing these explanations is research implementing *cross-commodity* delay discounting tasks. Specifically, one study by Bickel et al. (2011) examined delay discounting of money and cocaine by cocaine-addicted individuals. Binary-choice delay discounting tasks were completed, where the immediate/delayed rewards were: money/money, cocaine/cocaine, money/cocaine, and cocaine/money. If oversensitivity to immediate drug rewards caused higher delay discounting of drugs compared to money, the highest rates of delay discounting would have been observed in cocaine/money and cocaine/cocaine conditions. In contrast, the rank order of delay discount rates (from highest to lowest) was: money/cocaine, cocaine/cocaine, cocaine/money, and money/money. These results provide evidence against the oversensitivity hypothesis and partial support for the liquidity hypothesis, as preference was typically biased toward the money alternative independent of delay (i.e., high and low rates of delay discounting in the money/cocaine and cocaine/money conditions, respectively).

1.1. Present study

A noteworthy feature of the study by Bickel et al. (2011) was that participants were treatment-seeking cocaine users who would putatively disprefer the availability of (particularly delayed) cocaine. Thus, the purpose of the present study was to explore a hypothesis similar, but distinct, from the liquidity explanation. Specifically, we believe that the higher rates of delay discounting for non-liquid commodities in much of previous research is due to the fact that, like delayed cocaine for individuals seeking to stop

using cocaine in the Bickel study, the delayed commodity may not have future utility for the individual. Even in studies where participants were allowed to specify a preferred item within a commodity category (e.g., preferred food item and alcoholic beverage; Odum and Rainaud, 2003), the commodity category likely constrained potential utility of the delayed commodity. Moreover, this constraint could have resulted in differences in motivation to maximize money and the commodity (the *motivational account* proposed by Paglieri et al., 2015). The present hypothesis is that delay discounting of self-relevant and utility-matched commodities, by virtue of minimizing constraint on commodities that have future utility at the individual level, will be equivalent to delay discounting of money.

In the first of two sessions, participants completed a conventional binary-choice (immediate vs. delayed) delay discounting of hypothetical money task. After completing this assessment, participants were asked to identify how they would spend the immediate and delayed sums of money in each binary choice of the delay discounting task. In the second session, the monetary amounts in the delay discounting task of session 1 were replaced with participant- and trial-specific commodities. As the self-relevant commodities are less liquid than money, greater delay discounting of commodities compared to money would be consistent with the liquidity hypothesis. We hypothesized equivalence in rate of delay discounting of money and self-relevant commodities, suggesting that liquidity alone cannot account for greater delay discounting of non-monetary commodities.

2. Method

2.1. Participants

Ninety-seven (97) undergraduate psychology students (Mean age was 19.45 years [2.46]; 73.3% female) from the University of Maryland, College Park, were recruited for a two-session study, and received course credit for participation.

2.2. Materials

2.2.1. Money delay discounting

The original 27-item Monetary Choice Questionnaire (MCQ; Kirby et al., 1999) uses 9 items to determine a delay discount rate for each of three magnitudes (small, medium, large). Each binary choice item requires the participant to indicate preference between a delayed amount of money (7–186 days) and a smaller, immediate amount of money. Because of some very short delays (e.g., 7 days) and significant overlap in the money amounts across the magnitude conditions in the MCQ, a modified delay discounting assessment was created with no magnitude condition overlap and only longer delays (89–186 days). The resulting 18-item money delay discounting (Money DD; Table 1) assessment included nine items based on the medium magnitude items from the original MCQ, with the delays for some items adjusted so that all delays were at least 89 days. In order to keep scoring identical to the MCQ, the amount of the immediate alternative was concurrently adjusted so that the associated rate of delay discounting (k) remained the same with the MCQ. The remaining nine items for a large magnitude condition were created by multiplying the amounts of the medium magnitude items by 10 while keeping the delays the same. Our rationale for magnitude conditions with minimal overlap was to allow for greater distinctions and flexibility in the subsequent commodity discounting assessment.

2.2.2. Commodity identification assessment

Following completion of the Money DD assessment, participants were asked to write specifically what they would do with each of

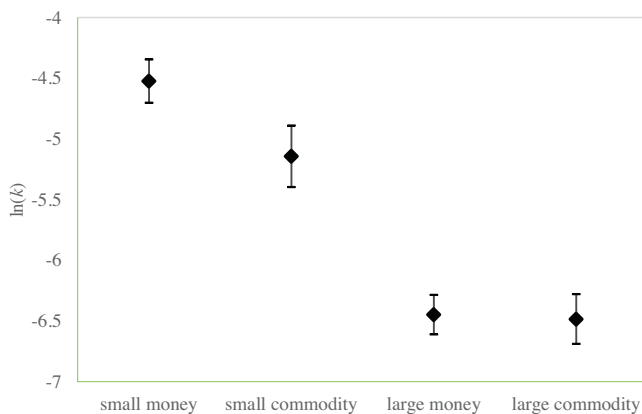


Fig. 1. Inferential Confidence Intervals (ICI) for statistical difference between delay discount rate ($\ln k$) for Money and Commodity at each magnitude. ICIs for the medium magnitude condition do not overlap, which indicates that Money DD and Commodity DD measures are different at the medium magnitude. ICIs for the large magnitude questionnaires do overlap, indicating that Money DD and Commodity DD measures are not different at the large magnitude.

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