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Short report

Further evidence of close correspondence for alcohol demand decision making for hypothetical and incentivized rewards

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ABSTRACT

Alcohol purchase tasks (APTs) are increasingly being used to assess behavioral economic demand for alcohol. Prior studies utilizing APTs have typically assessed demand for hypothetical outcomes, making the extent to which these hypothetical measures reflect preferences when actual rewards are at stake an important empirical question. This study examined alcohol demand across hypothetical and incentivized APTs. Nineteen male heavy drinkers completed two APTs – one for hypothetical alcohol and another in which one randomly-selected outcome was provided. Participants were given an opportunity to consume the alcohol associated with their choice on the incentivized APT during a self-administration period in a simulated bar environment. Results indicated generally close correspondence between APT versions, though participants were more sensitive to increases in price and tended to consume more at low prices on the incentivized version. Estimated consumption on the incentivized APT was highly correlated with the amount of alcohol consumed in the laboratory ($r = .87$, $p < .001$), suggesting that APT responses are valid indicators of actual drinking behavior. These results provide further evidence of congruence of demand-based decision-making when rewards are hypothetical vs. actually available. Implications for behavioral economic approaches to addictive behavior and directions for future research are discussed.

1. Introduction

Behavioral economic demand refers to the relationship between consumption of a commodity and its cost and has provided a useful framework for investigating how individuals with substance use disorders consistently overvalue addictive drugs relative to other rewards (Bickel et al., 2014). Demand curve analysis is typically used to translate price-level consumption values into indices of motivation, including intensity (i.e., consumption at zero cost), breakpoint (i.e., the first price that suppresses consumption to zero), O_{max} (i.e., the maximum expenditure across prices), P_{max} (i.e., the price at which demand becomes elastic, corresponding to the price at which O_{max} is reached), and elasticity (i.e., proportionate price sensitivity) (Hursh and Silberberg, 2008; Murphy and MacKillop, 2006). A final index, essential value (E.V.) is presumed to underlie demand elasticity independent of the scalar properties of the reinforcer itself (Hursh, 2014).

Demand can be readily assessed via self-report purchase tasks that ask individuals how much of an addictive commodity (e.g., alcohol, tobacco, illicit drugs) they would consume at escalating prices (Collins et al., 2014; Jacobs and Bickel, 1999; MacKillop et al., 2008; Murphy and MacKillop, 2006). Studies using alcohol purchase tasks (APTs), for instance, have found that alcohol demand is associated with quantity/frequency of alcohol consumption, alcohol use disorder severity, and treatment outcomes (e.g., Murphy and MacKillop, 2006; MacKillop et al., 2010a; MacKillop and Murphy, 2007). State-based APTs have also been developed for investigating dynamic influences on alcohol motivation (MacKillop et al., 2010b; Amlung et al., 2012). Demand indices obtained from these measures have been shown to complement subjective measures of alcohol craving following alcohol cue exposures and negative affect inductions (e.g., MacKillop et al., 2010b; Amlung et al., 2012; Amlung and MacKillop, 2014).

An important task parameter that differs across studies is the extent to which individuals experience the outcomes of their choices. Hypothetical measures are most common, though prior studies have increased the ecological validity of state-based measures by presenting choices for actual outcomes, using tasks that provide one of choices made (Amlung et al., 2012; MacKillop

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et al., 2012, 2014). While prior research has found close correspondence between preferences for hypothetical and actual rewards on other behavioral economic measures, such as delay discounting (Bickel et al., 2009; Madden et al., 2003; Johnson and Bickel, 2002), only one study to our knowledge has addressed this question for demand. Amlung et al. (2012) administered two APTs – one for hypothetical rewards and another for actual rewards in which one randomly-selected outcome was provided – and found high magnitude correlations between demand preferences on the hypothetical and incentivized APTs. Moreover, the association between self-reported consumption on the APT and actual alcohol consumption during a laboratory self-administration period was high (r = .87). High correspondence between self-reported consumption and actual consumption has also been reported using a cigarette purchase task (MacKillop et al., 2012).

Given that only one study to date has examined the congruence of hypothetical and incentivized APTs, more work is clearly needed in this area. As such, the goals of the present study were to further compare demand across hypothetical and incentivized APTs and to examine the correspondence between self-reported consumption and actual drinking during a laboratory self-administration period. The data come from a larger study examining the neural correlates of alcohol demand (see MacKillop et al., 2014). We hypothesized that there would be high correspondence between hypothetical and incentivized APT performance and similarly high correspondence between APT consumption and actual drinking.

2. Materials and methods

2.1. Sample

The present sample comprised 19 male heavy drinkers. Participants were recruited from the University of Georgia and surrounding Athens, GA community via flyers and newspaper advertisements. Inclusion criteria for the study were: (1) male; (2) 21–31 years of age; (3) heavy drinker status (i.e., drinking 21+ standard drinks per week); (4) right-handed; (5) use of a personal computer at least weekly; (6) not seeking treatment for alcohol problems; (7) no DSM-IV substance use disorder other than alcohol or nicotine use disorder, or other Axis I disorders; and (8) no contraindications for MRI scanning. Participants were primarily young adults (M age = 22.84, SD = 2.89), 79% Caucasian, and had a median income of $45–60,000 annually. Participants reported drinking an average of 33.99 drinks/week (SD = 10.91).

2.2. Assessment

Participants completed two versions of a state-based APT, one for hypothetical alcohol and money and another for real alcohol and money (Amlung et al., 2012). The assessments were designed to be administered in a functional magnetic resonance imaging (fMRI) environment (see MacKillop et al., 2014). Participants were asked how many drinks they would purchase at 22 randomized prices, ranging from $0.01 to $15.00/drink. Participants were given a $15 'bar tab' to be allocated to drink purchases or kept by the participant. Drinks available were the participants' typical alcoholic beverages, and the maximum number of drinks available was 8 'mini-drinks,' each approximately half the size of standard drinks (e.g., Drobes et al., 2003). For the hypothetical version, participants were told that they would not receive any alcohol or money from their choices, but were instructed to make decisions as if the alcohol and money were real (Amlung et al., 2012). For the incentivized version, participants were told that one of their choices would be randomly selected and provided during a self-administration period. Weekly alcohol consumption was assessed using a 28-day Timeline Follow-Back interview (Sobell and Sobell 1992). Demographic information (e.g., age, race, income, etc.,) was assessed using a self-report demographics form.

2.3. Procedure

These data were drawn from a larger neuroimaging study comprised of two testing sessions, a 1-h in-person screening and an 8-h testing session that included a MRI scan and alcohol self-administration/recovery periods (see MacKillop et al., 2014). All participants provided informed consent prior to enrolling in the study. During the in-person screening, participants were given a complete overview of the study, including an overview of the hypothetical vs. incentivized APT assessments (e.g., $15 bar tab, mini-drink size, and procedure for random choice of incentivized outcome) and an introduction to the bar lab environment.

During the second session, participants were reminded that they would be completing both hypothetical and incentivized APTs during the session prior to completing either assessment. Next, participants were administered the hypothetical APT on a laptop computer in a neutral lab room (e.g., 1 set of all 22 hypothetical price intervals). Participants then underwent a 1-h fMRI scan during which they completed 5 runs of the incentivized reward APT. Each run of the incentivized APT assessed all 22 price intervals yielding 5 consumption values at each price. These values were aggregated into a single mean consumption value per price. Following the scan, participants randomly selected one poker chip from a bowl with chips corresponding to the items on the actual reward APT (Kirby et al., 1999; Amlung et al., 2012). They were then given the alcohol and/or money associated with their choice for that item during a 60-min self-administration period in a simulated bar laboratory. This was followed by a recovery period, debriefing, and dismissal. All procedures were approved by the University of Georgia Institutional Review Board.

2.4. Data analysis

All variables were initially screened for missing data, outliers (Zs > 3.3), and distribution abnormalities (Tabachnick and Fidell, 2001). Prior to generating aggregate mean consumption values for the incentivized APT, we examined consistency of participants' responses across the five runs. First, intraclass correlations (ICCs) were calculated among the five consumption values at each price. Second, we generated the proportion of positive reversals in consumption from a lower price to an adjacent higher price within each run (e.g., Amlung and MacKillop, 2012). This value was subtracted from 1.0 to provide a measure of within-run response consistency. Within-run consistency was also calculated for the single hypothetical APT run. For both of the APT versions, we generated four observed demand indices (Murphy and MacKillop, 2006): intensity (i.e., consumption at minimum price), breakpoint (i.e., the first price that consumption was suppressed to zero), O_{max} (i.e., maximum alcohol expenditure) and P_{max} (i.e., the price associated with O_{max}). Elasticity of demand was derived using the following exponential equation provided by Hursh and Silberberg (2008):

$$\ln Q = \ln Q_0 + k(e^{-\alpha P} - 1) \quad (1)$$

where Q = quantity consumed, Q_0 = derived intensity, k = the range of the dependent variable (standard drinks) in logarithmic units, P = price, and α = elasticity of demand. GraphPad Prism 6 was used to fit the data to Eq. (1) using the program available through the Institute for Behavioral Resources website (ibrinc.org). The overall mean performance was first analyzed to find the best-fitting k parameter, which was determined to be 4.0 and was used across all individual demand curve fits. Finally, we utilized the macro pro-