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Concurrent validity of the alcohol purchase task in relation to alcohol involvement: protocol for a systematic review and meta-analysis

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ABSTRACT

Introduction Alcohol demand, as measured by an alcohol purchase task (APT), provides a multidimensional assessment of the relative reinforcing efficacy of alcohol. The objective of this meta-analysis is to critically appraise the existing literature on the concurrent validity of the APT by meta-analysing the cross-sectional relationships between indices of the APT (ie, breakpoint, O_{max}, P_{max}, elasticity and intensity) and alcohol-related measures. It also aims to examine methodological procedures used to obtain APT indices and individual variables as potential moderators on the assessed estimations.

Methods and analysis A comprehensive literature search conducted from inception to April 2020 will be conducted in the PubMed, PsycINFO, Web of Science and Scopus databases. Two authors will independently screen and extract data from articles using a predefined protocol search and extraction forms. Disagreements will be resolved through discussion with two additional reviewers. All results will be tabulated, and a random-effect meta-analysis will be conducted. Participants' sex, number of prices and APT methodological procedures will be examined as potential moderators on the observed effect sizes.

Ethics and dissemination Results of this meta-analysis will characterise the concurrent validity of the APT in the existing literature. Further, the results are anticipated to provide evidence on which index (or indices) is most robustly associated with alcohol use and severity. Ethics approval was not required for this study and the results will be published in a peer-reviewed journal.

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INTRODUCTION

Alcohol purchase tasks (APTs) have been increasingly used to quantify aspects of the incentive value of alcohol (ie, alcohol demand).[1 2] Framed from the perspective of behavioural economics, the APT measures participants' demand across a variety of prices, either as a trait-like process (ie, in a typical drinking situation) or as a state-like process (ie, right now) scenario.[3] Data from the APT allow generating a demand curve depicting the relationship between consumption and unit price.[4] More precisely, the value of the APT lies on its multidimensional characterisation of the incentive value of alcohol which captures, as per principal component analyses, the persistence (ie, O_{max} or maximum expenditure, price associated to the maximum expenditure or P_{max}, breakpoint defined as price at which consumption ceases and sensitivity of demand to increases in costs, known as elasticity) and the amplitude of demand (ie, intensity or consumption at no cost and O_{max}) facets.[5]

Importantly, alcohol demand has been found equivalent under real and hypothetical conditions, where participants do not consume substances purchased.[6] Accordingly, the use of a hypothetical APT has gained interest because of evidence of construct validity,[7] temporal stability[8] and higher efficiency[3] compared with more traditional operant choice procedures such as self-administration paradigms. More recently, there has been an interest in understanding the relative sensitivity of each demand indicator to detect substance-related outcomes and variables affecting them. APT indices correlate with self-reported measures of alcohol use,[9] heavy drinking,[10] problem drinking[11] and severity of alcohol use disorder (AUD) symptoms.[12]

The concurrent validity of the APT has previously been examined by Kiselica *et al* in a meta-analysis of 16 studies published up to 2015.[13] Results from this study raised concerns on the validity of certain APT indices, as intensity was the only index exhibiting a robust correlation with alcohol-related measures. More recently, Zvorsky *et al*[14] conducted an omnibus review of hypothetical purchase tasks, including 41 alcohol studies. However, a substantive limitation in that case was the fact that alcohol-related variables were collapsed together.

A further concern is that previous work has not closely examined variables affecting APT's construct validity, perhaps due to limited sample sizes. The only exception is the study conducted by Kiselica *et al*[13] who examined whether estimates differed as a function of drinking status (regular vs heavy drinkers). More recently, several potential moderators have been proposed by Kaplan *et al*[8] in a recent methodological review of the APT literature, suggesting that either the heterogeneity of participants (ie, adults or college-age participants) or task structural characteristics (ie, vignette framing, number of prices or amounts used) might impact on demand estimations. A recent meta-analysis on the concurrent validity of illicit purchase tasks has shown that sex and number of prices used are significant moderators of the relationship between P_{max}, breakpoint and quantity and severity measures.[15] Also, consistent with the evidence of sex differences in alcohol use and related problems,[16 17] some studies have reported sex differences in demand,[18 19] but with divergent results on both the significance and the directionality of associations between APT indicators, making the results tentative so far. Combining individual APT studies allow meta-analysing potential moderators in a more cost-effective and powerful approach than any single study could do. So far, more than 10 studies have been published since last comprehensive review of the APT published in 2019,[14] and because of the stressed methodological and conceptual limitations, a new meta-analysis is necessary.

Objectives

The primary objective of this meta-analysis is to estimate the magnitude of associations between each APT index (breakpoint, O_{max}, P_{max}, intensity and elasticity), quantity of alcohol use, heavy drinking episodes, alcohol-related problems and severity of AUD. Secondary objectives are to examine year of publication, sex, number of prices used in the APT and type of APT indices' transformation as potential moderators on the estimated associations. There is a critical need to document the extent to which methods of correcting non-normal distributions vary and affect demand estimations in systematic ways. Despite the log- and square-root transformations are widely used in the APT literature to deal with skewed data, they usually do not approximate to the normal distribution[20] and rather reduce variability on the right side of the distribution more than on the left side, potentially affecting

results. Finally, this study will analyse publication bias based on the individual estimations.

METHODS

A protocol detailing the planned search strategy, methods, outcomes and analyses was prepared following the reporting guidelines for Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P)[21] (see the PRISMA-P checklist in online supplementary file 1).

Search strategy

A comprehensive literature search (from inception to April 2020) will be conducted using PubMed, PsycINFO, Web of Science and Scopus databases using the following Boolean term combinations: (alcohol) AND (behavioral economic*) OR (purchase task) OR (alcohol demand) OR (reinforcing efficacy) OR (reinforcing value). Hand-searching will be carried out by two trained hand-searchers to manually scan references in meta-analysis/systematic reviews on the APT not captured by the primary literature search.

Inclusion/exclusion criteria

Studies will be eligible if meet the including criteria that follows: (1) the study is published in a peer-reviewed journal, (2) the article involves human participants, (3) alcohol demand is measured by a hypothetical purchase task and (4) the study provides cross-sectional correlations between at least one APT index and one alcohol-related outcome (ie, alcohol use, heavy drinking, alcohol-related problems, or severity of AUD). As the magnitude of demand indices in state APTs are influenced by experimental manipulations (eg, craving or stress induction),[2 22 23] only trait APTs completed under neutral conditions will be included. Commentaries, review articles and conference abstracts will not be included. Dissertations and theses will be discarded on the basis that they are not peer reviewed and to ensure the quality of published material. With the view to capturing potential moderators on the informed relationships, no restriction based on the presence of cooccurrent substance use or mental health disorders will be considered.

Patient involvement

No patient was involved in the design and conduct of this study.

Data extraction and management

Two review authors will independently export articles' data to a Microsoft Excel spreadsheet including the following information: study title, country, sample size, mean and SD of age, percentage of women, number of APT prices and range used, a brief description of the APT vignette used and type of index transformation if any. A calibration exercise will be performed to assure consistency in the data extraction procedure across reviewers. Discrepancies will be resolved through discussion with

two additional authors. In case correlations from eligible studies are not available, the corresponding author will be contacted to provide the necessary data for the meta-analyses. If raw databases are provided, prior to calculating demand indices, we plan to follow a pipeline procedure comprising: (1) the identification and removal of non-systematic APT data (ie, cases with same demand across all prices, increases in consumption on at least two instances or reversals from zero as indicated by at least three positive contradictions), (2) the identification of outlier values in both APT raw data and demand indices, (3) correction of kurtosis and/or skewness as per Tabachnick and Fidell's guidelines.[24] Specifically, each outlier value will be replaced by their next highest non-outlying value plus one unit. One whole unit will be considered for the observed indices (ie, breakpoint, O_{max}, P_{max} and intensity), whereas 100th will be added for the elasticity outliers (ie, 0.01) and (4) the examination of raw data and individual demand indices' distribution. If marked skewness and kurtosis are present, square-root or log transformations will be considered, as appropriate.

Data analysis
Descriptive methods
Study characteristics will be tabulated to inform settings, sample characteristics and APT structural features (ie, number and range of prices used). This table will be discussed qualitatively to identify potential sources of heterogeneity across different APT versions.

Meta-analysis approach
Pearson's effect size correlations will be used as primary effect sizes. Spearman's correlations will be converted to Pearson's to permit inclusion in the meta-analyses and to provide more accurate mean estimates, using the following formula: $r=2*\sin(r_s\frac{\pi}{6})$.[25] A set of separate meta-analyses will be conducted to examine the magnitude of the association between each APT index (intensity, O_{max}, P_{max}, elasticity and breakpoint) and alcohol-related variables (quantity of alcohol use, heavy drinking episodes, alcohol-related problems and severity of AUD).

Quantity of alcohol use will be operationalised as number of standardised drinks per day, whereas heavy drinking will be defined as per the individual studies (usually following the National Institute on Alcohol Abuse and Alcoholism definition of ≥5/≥4 daily drinks for men/women).[26] Alcohol-related problems refer to any measure of alcohol use consequences. Measures will include, but are not limited to, the Young Adult Alcohol Consequences Questionnaire.[27] Finally, severity of AUD will include diagnostic measures (eg, Diagnostic and Statistical Manual of Mental Disorders (DSM-5)) and other severity indicators such as the AUD identification test.[28]

Cochran's Q and I^2 will be computed to characterise heterogeneity; I^2 ≤25% suggests low heterogeneity, ~50% suggests moderate heterogeneity and ≥75% suggests high heterogeneity across studies.[29] Given the expected marked heterogeneity in study designs (ie, treatment-seeking or community samples) and methods (ie, variability in alcohol measures and APT structural characteristics), a random-effects model will be adopted. In order to identify systematic differences in the observed estimations by alcohol variable type and APT demand indices, the Q statistic associated with the between-group difference in mixed effects analyses will be adopted. Moderation effects of sex (the percentage of women included in each study), number of APT prices, year of publication and type of APT indices' transformation (square-root, log-based or none) on the obtained effect sizes will be explored by meta-regressions at a two-sided 95% CI (p<0.05).

Publication bias assessment
The publication bias on the estimated effects will be critically examined following prior guidelines.[30] There exist at least five different approaches to identify the presence of publication bias (for a review see Rothstein et al[31]). However, relying on one single measure of publication bias is not recommended. Accordingly, a multipronged approach will be considered for measuring the presence of publication bias in meta-analyses. More precisely the following publication bias indicators will be calculated: The fail-safe N (ie, number of missing studies that would render the observed effect sizes non-significant, with N values lower than 5*k+10 raising concerns, where k represents the number of included studies), the two-tailed Begg-Mazumdar (ie, rank correlation between the standard effect size and their variances), Egger (ie, asymmetry of the funnel plot), Dual and Tweedie's trim and fill approach (ie, computation of the effect sizes after imputation of missing studies). The dataset for meta-analysis is available from the corresponding author on reasonable request.

DISCUSSION
Ethics and dissemination
Ethics approval was not necessary for this study and its results will be published in a peer-review journal. This meta-analysis will update and critically appraise the literature on the cross-sectional relationships between APT indices and alcohol-related measures. The novelty lies on the examination of individual variables, APT structural characteristics and methodological procedures as potential moderators on the estimated effect sizes. This is a particularly relevant issue, given the increasing interest in refining APT measures. We will inform on which index (or indices) stands as more valid for accurately characterising alcohol use motivation. Importantly, correlations pertaining to the 'persistent' latent factor of alcohol demand (captured by O_{max}, P_{max}, breakpoint and elasticity) could inform on relevant variables to be considered in preventive/treatment interventions for alcohol use, either as primary targets or secondary outcomes of effectiveness. Ultimately, it is expected that this study will guide continued developments and refinement of APT

measures and methods to analyse demand indices that facilitate standardised practices.

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