

School of Experimental Psychology
12a Priory Road
BRISTOL BS8 1TU
United Kingdom

Tel: +44 (0) 117 331 0494
Fax: +44 (0) 117 928 8588
david.troy@bristol.ac.uk
www.bristol.ac.uk

STUDY PROTOCOL

Effect of glass shape on the pouring accuracy of liquid volume.

David M. Troy, Olivia M. Maynard, Matthew Hickman, Angela S. Attwood, Marcus R. Munafò

Note: The title of this study will appear as ‘Measuring the pouring accuracy of liquid volume’ on study documentation seen by participants to reduce demand characteristics influencing participant behaviour.

Background

Drinking glasses come in a variety of shapes, including many that are curved and/or slanted, and these physical characteristics of the glass may influence how difficult it is to gauge volume accurately. Previous research from our laboratory (Attwood, Scott-Samuel, Stothart, & Munafò, 2012) has indicated that social drinkers underestimate the midpoint of curved glasses to a greater degree than of straight glasses in a computerised task. Furthermore, speed of drinking was positively correlated with degree of perceptual error of the midpoint.

We collected pilot data during a public engagement event, where participants poured water into curved, tulip and straight pint glasses, suggested that pourings to midpoint in all glasses was underestimated compared to true midpoint volume (pourings refer to the attempt to pour liquid to half the volume a glass can hold). However, the degree to which this was the case appeared to differ across glasses; on average, pourings in straight glasses were the most accurate while pourings in curved glasses were the most inaccurate.

This study will investigate the effect of various glass shapes on pouring accuracy of liquid volume. If our findings suggest that pouring is more accurate in some glass shapes compared to others, studies could be designed to test whether the glasses that promote more accurate pouring of volume could slow drinking times of alcoholic beverages. The findings from this study will add to the literature and potentially inform consumer behaviour and public policy.

Study Objective and Hypothesis

Our primary objective is to examine whether glass shape affects pouring accuracy. We hypothesise that pouring will be more accurate in straight glasses compared to other glass shapes.

Study Design

This is a study investigating the effect of glass shape on pouring accuracy. The study will use a within-subjects design with one factor of glass shape. The primary outcome measure will be the amount of liquid in millilitres (ml) poured into four differently shaped glasses (straight, curved, tulip, inverted).

Study Site

School of Experimental Psychology, University of Bristol, 12a Priory Road, Bristol, BS8 1TU, United Kingdom.

Participants and Recruitment

Participants ($n = 96$) will be recruitment from passers-by in a café in the Experimental Psychology building at the University of Bristol. Participants will have the option of entering a draw for a £20 Amazon voucher for compensation for their time for participation.

Inclusion criteria

- Aged 18 or over.

Exclusion criteria

- Potential, in the opinion of the investigator, to be non-compliant with the study, unable to give informed consent or be aware of the purpose of the study.

Sample size determination

Pilot data ($n = 72$, unpublished) resulted in estimated midpoint pourings (ml) for straight ($M = 271$, $SD = 22$), tulip ($M = 268$, $SD = 34$) and curved ($M = 234$, $SD = 31$) glasses. This indicated an effect size of $dz = 1.37$ for curved vs straight and $dz = 0.10$ for tulip vs straight. We will power our study to detect the difference in poured volume between curved and straight glasses. Comparisons between tulip vs straight and inverted vs straight will be exploratory. In case the curved vs straight effect size is inflated, we will be conservative and recruit a sample size of 96 participants, which will provide 80% power at an alpha level of 5% to detect an effect size of $dz = 0.29$.

Randomisation

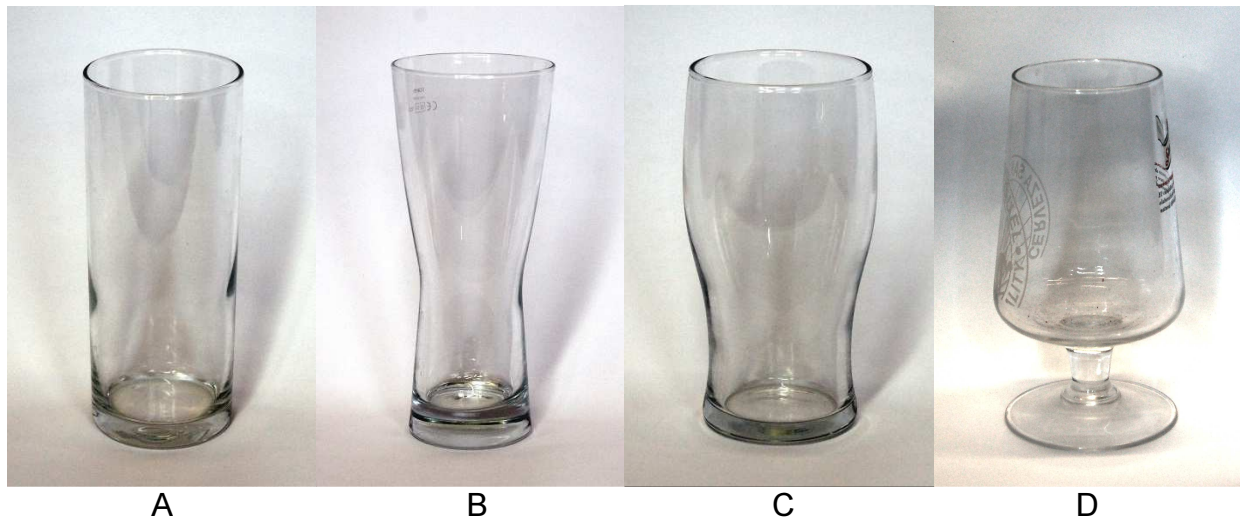
The order in which four glasses will be presented will include all permutations (24). An equal number of participants (4) will be randomly assigned to each order of treatment using random number assignment software.

Measures and Materials

Primary outcome: Liquid amount (ml) poured into glass.

Materials: Glasses to be used will be pint (volume: 568 ml) glasses and will be straight (Figure 1A), curved (Figure 1B), tulip (Figure 1C) and inverted (Figure 1D) in shape. A jug filled with water will be required for pouring and a Fisherbrand™ 500 5 ml denominated measuring cylinder will be required for measuring. A laptop will be used to record volume measurements.

Figure 1: Straight, curved, tulip and inverted pint glasses



The straight glass (A) is a Geo “highball” style glass supplied and designed by Arcoroc Professional, the curved glass (B) is a Tokyo style glass supplied and designed by Sahm, the tulip glass (C) is supplied by Pasabahce and the inverted glass (D) is San Miquel branded.

Procedures

A study stall will be set up in a café in the School of Experimental Psychology and passers-by will be asked if they would like to take part in an experiment. Individuals who are interested in taking part will be presented with the study information sheet and will have the opportunity to ask questions about the study. After written informed consent has been obtained, the participant will be asked for basic demographic information (i.e., age and sex), how many units of alcohol they drink a week and whether or not they drink beer. The experimenter will then place a glass (as per randomisation) in front of the participant. The participant will then be asked to “Fill the glass with water to half the volume it can hold”. A jug of water will be available to them. When the participant appears to be finished pouring, they will be asked if they are happy with their pouring. If they confirm, they can make no further alterations. The experimenter will then remove the glass from the participant’s sight and replace it with the next glass (as per randomisation). This procedure will be repeated until all four glasses have been presented. After all pouring is complete, liquid from a glass will be emptied into a measuring cylinder and recorded in an Excel spreadsheet. This will be repeated for all four glasses. Before leaving, participants will be asked to give final consent for their data to be used and will be asked if they want to enter a draw for a £20 Amazon voucher. If so, they will be asked for their email address. The winner will be picked by random number generator and will be informed after testing is complete.

Statistical Plan

All analyses will be conducted using SPSS Statistics Software (IBM SPSS Statistics for Windows, Version 23, IBM Corp). If any data violates assumptions of normality and homogeneity of variance, data will be transformed or the appropriate nonparametric test will be carried out. The best course of action will be decided dependent upon the pattern of the data (e.g., degree/direction of skew, kurtosis).

The primary outcome measure will be total liquid (in ml) poured into each glass and we will analyse these data in a series of paired-sample *t*-tests to compare the poured amount in each glass to the volume poured into the straight glass. A repeated measures ANOVA, with glass shape as a within-subjects factor, will examine differences in poured volume between glasses.

Ethical Considerations and Informed Consent

Ethics approval has been obtained from the Faculty of Science Research Ethics Committee at the University of Bristol (Approval Code: 14061638781). The study will be conducted according to the revised Declaration of Helsinki (2013) and the 1996 ICH Guidelines for Good Clinical Practice E6(R1). The investigator will explain the nature, purpose and risks of the study to the participant. The participant will receive the information sheet at the beginning of the study. There will be no time restriction on how long participants take to respond. Therefore, participants will be given sufficient time to read the information and consider any implications, and to raise any questions with the investigators prior to making a decision to participate. Written consent will then be obtained. Participants will be informed that they are free to withdraw at any time.

Data Management

All aspects of the Data Protection Act will be adhered to. Consent forms will be retained for 10 years by the School of Experimental Psychology after study completion. Participant email addresses will be stored in a covered box during testing and this will be stored in a secure locker between testing sessions.

Anonymised study data

Pouring data will be inserted into an electronic data sheet. Each participant data set will be anonymised by a unique numeric identifier and all missing data will be explained. At the end of the study, the finalised data sheet will be transferred to a designated University of Bristol Research Data Storage Facility for long-term archiving. Study data will be kept for a minimum of 15 years. At the appropriate time the data sheet will be locked and made open using the University of Bristol data repository.

Revoked data

If a participant decides that they do not want their data used after their participation they have the right to not give their final consent. In that case, their data will not be used. They will not be able to revoke the use of their data after the session as their identity will not be linked to their data.

Quality Control and Quality Assurance

The investigators will be responsible for data quality. After approximately 10% of data collection has been completed, the study will undergo an in-house quality assessment. During this monitoring process all CRFs and study documents will be assessed as well as the investigators laboratory management and participant engagement, and corrected where necessary.

Insurance

This study will be sponsored by the University of Bristol. The University has Clinical Research Insurance to cover the liability of the University to research participants. In the case of an accident or injury occurring, first aid and emergency procedures of the University will be adhered to. In the event that something goes wrong and a participant is harmed during the research study there are no special compensation arrangements. If a participant is harmed and this is due to someone's negligence then they may have grounds for a legal action for compensation against Bristol University or one of the other parties to the research, but they may have to pay their own legal costs.

Publication Policy

The findings from this research study may be published in an appropriate scientific journal (and made available open access), and/or presented at an appropriate meeting. Study data will be collected and held by the study investigators. The data will be made available for sharing via the University of Bristol data repository.

Study Personnel

David Troy
School of Experimental Psychology
12a Priory Rd
Bristol BS8 1TU
Tel: +44 (0) 117 331 0494
Fax: +44 (0) 117 928 8588
Email: david.troy@bristol.ac.uk

Olivia Maynard
School of Experimental Psychology
12a Priory Rd
Bristol BS8 1TU
Tel: +44 (0) 117 92 89943
Email: olivia.maynard@bristol.ac.uk

Matthew Hickman
School of Social and Community Medicine
Canynges Hall
39 Whatley Road
Bristol BS8 2PS
Tel: +44 (0) 117 928 7252
Email: matthew.hickman@bristol.ac.uk

Angela Attwood
School of Experimental Psychology
12a Priory Rd
Bristol BS8 1TU
Tel: +44 (0) 117 331 7450
Email: angela.attwood@bristol.ac.uk

Marcus Munafò
School of Experimental Psychology
12a Priory Rd
Bristol BS8 1TU
Tel: +44 (0) 117 954 6841
Email: marcus.munafò@bristol.ac.uk

Funding Source

This study is being funded by the Medical Research Council Integrative Epidemiology Unit, National Institute for Health Research's School of Public Health Research and the UK Centre for Tobacco and Alcohol Studies.

Conflicts of Interest

There are no conflicts of interest.

References

Attwood, A. S., Scott-Samuel, N. E., Stothart, G., & Munafò, M. R. (2012). Glass shape influences consumption rate for alcoholic beverages. *PloS one*, 7(8), e43007.