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Can Simply Answering Research Questions Change Behaviour? Systematic Review and Meta Analyses of Brief Alcohol Intervention Trials

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Abstract

Background: Participant reports of their own behaviour are critical for the provision and evaluation of behavioural interventions. Recent developments in brief alcohol intervention trials provide an opportunity to evaluate longstanding concerns that answering questions on behaviour as part of research assessments may inadvertently influence it and produce bias. The study objective was to evaluate the size and nature of effects observed in randomized manipulations of the effects of answering questions on drinking behaviour in brief intervention trials.

Methodology/Principal Findings: Multiple methods were used to identify primary studies. Between-group differences in total weekly alcohol consumption, quantity per drinking day and AUDIT scores were evaluated in random effects meta-analyses. Ten trials were included in this review, of which two did not provide findings for quantitative study, in which three outcomes were evaluated. Between-group differences were of the magnitude of 13.7 (−0.17 to 27.6) grams of alcohol per week (approximately 1.5 U.K. units or 1 standard U.S. drink) and 1 point (0.1 to 1.9) in AUDIT score. There was no difference in quantity per drinking day.

Conclusions/Significance: Answering questions on drinking in brief intervention trials appears to alter subsequent self-reported behaviour. This potentially generates bias by exposing non-intervention control groups to an integral component of the intervention. The effects of brief alcohol interventions may thus have been consistently under-estimated. These findings are relevant to evaluations of any interventions to alter behaviours which involve participant self-report.

Introduction

The contribution of behavioural risk factors, such as physical inactivity, tobacco smoking, and unhealthy alcohol use, is estimated to be at least 20% of the total global burden of disease [1]. Accordingly there is increasing investment in the development of behavioural interventions. Attempts to influence behaviour have also gained a new prominence in wider public policy, for example in efforts to combat climate change and domestic terrorism. Trials and other evaluation studies typically involve asking study participants about their own behaviour over time, which in some cases may be validated with objective measures. Such data are fundamental to the behavioural sciences [2]. This process of reporting on one’s own behaviour may itself induce reflection and actual change and this was the original reason for the introduction of control groups in behavioural research a century ago [3]. The Hawthorne effect, wherein participants change their behaviour in response to being monitored, has been widely discussed for three quarters of a century [4,5,6] and has entered “the folklore of behavioural science” [7]. Accounts of unexpected improvements apparently due to research assessments are often invoked as possible explanations for null findings in trials across a wide range of behaviours [see for example [8]]. As the technological capacity for monitoring behaviour grows, for example through the use of pedometers in relation to walking, so does the need to better understand this phenomenon [9].

Longstanding recognition of the Hawthorne effect and the possible implications of answering questions in the context of research study assessments have not, however, led to any substantial tradition of experimental study in health sciences or elsewhere. Alongside some interesting non-experimental studies [10,11,12], there exist somewhat isolated trials of the effects of questionnaire completion on disparate health outcomes [13,14,15,16,17,18,19,20,21]. This situation has changed recently in the field of brief alcohol intervention trials in which individualised feedback, advice and brief counselling are evaluated for public health benefit [22,23]. Assessment effects may have greater bias potential in these studies because of similarities with the evaluated interventions, which invariably require assessment, and because effect sizes are themselves small, their value deriving...
from potential for wide dissemination [24]. Assessment effects and brief interventions may also operate by similar mechanisms, acting upon the self-regulation of behaviour [21]. There have been no systematic reviews which investigate whether answering questions on a particular behaviour, which may be intrinsic to intervention study, subsequently impacts upon that behaviour. The objective of the present study is therefore to evaluate the size and nature of effects observed in randomized manipulations of the effects of answering questions on drinking behaviour in the non help-seeking populations who participate in brief intervention trials.

**Methods**

**Study design & data collection**

We excluded assessments undertaken with the specific purpose of changing behaviour, as these were judged likely to involve additional components, which may or may not have been reported. We are thus studying the effects of research assessments only. Peer-reviewed journal publications in any language were included and studies undertaken in alcohol treatment services excluded. There were no other selection criteria. This review has been reported in accordance with the PRISMA statement and was undertaken without a published protocol [25].

There have been many reviews of the brief alcohol intervention literature and we used these to identify relevant studies for this review (‘A’ in Figure 1). We contacted experts both individually and via three groups, the International Network on Brief Interventions for Alcohol Problems (INEBRIA), the Kettil Bruun Society for Social and Epidemiological Research on Alcohol, and the Research Society on Alcoholism (also included in ‘A’ in Figure 1). We searched PubMed using the terms “assessment” AND “alcohol” AND “reactivity”, with the final database searches taking place on 8th February 2011. The flowchart in Figure 1 summarises this process. Nine studies were excluded when the reports revealed the presence of non-assessment intervention components. Finally, three studies were excluded when author contact ascertained that assessments were undertaken specifically for intervention purposes [26,27,28].

![Figure 1. Participant flowchart.](https://doi.org/10.1371/journal.pone.0023748.g001)

**Outcomes & analyses**

Various outcome measures are used in this literature. *A priori* we decided to select outcomes for quantitative study according to their availability: (1) overall total alcohol consumed within the past week or a typical recent week was reported or could be derived in all studies which provided quantitative data; (2) quantity consumed per drinking day was missing in only two cases; and (3) the WHO Alcohol Use Disorders Identification Test [29] (AUDIT) scores were available in half of the studies which provided quantitative data. It would have been possible also to have investigated the pooled effect on binary AUDIT outcome, though this was judged repetitious. All eight studies reported since 2005 provided unpublished data for inclusion in the meta analysis, with the authors of the earlier studies no longer having access to the raw data. These methods precluded certain forms of bias within studies, such as selective reporting of outcomes. All other outcomes were evaluated in a minority of available datasets. Outcomes 1 and 2 were converted into grams of ethanol [30].

Between-group mean differences in outcomes in the follow-up samples and their standard errors were calculated. Two trials had multiple follow-up intervals (at 1, 6 and 12, and 6 and 12 months respectively [31,32]). Assessment effects were known to have been reported at 1 month and 12 months respectively and prior to analyses we decided that it was appropriately conservative to use the 6 month data as a summary measure in both studies to simplify the analyses. All data were meta-analysed in STATA version 10 with outcomes pooled in random effects models using the method of DerSimonian and Laird [33]. The I-squared statistic was used to evaluate the extent of heterogeneity [34].

**Results**

Ten trials were identified for inclusion in this systematic review [31,32,35,36,37,38,39,40,41,42,43]. Two of these trials, including one study which reported outcomes separately by gender [39,40,41] did not provide findings for meta-analysis as outcome data were unreported and datasets were no longer accessible (see below). The characteristics of the included studies are presented in Table 1. One trial was not individually randomised, allocation being cluster randomised in weekly groups for each general practitioner, though it was not described as such because the terminology was not in common use at that time [35].

Detailed information is presented in Table 2 on the assessment procedures being evaluated, blinding, and the consequent nature of the experimental contrasts employed. In some trials the experimental manipulations involved comparisons of longer versus shorter assessments [31,32], whilst in others assessment was compared with minimal screening [35,36,37], or brief assessment with a screening instrument versus no screening at all [38]. The extent and nature of blinding and other potentially important aspects of study design were also variable across the studies. Table 3 comprises a summary of the primary study outcomes as they were reported. It is noteworthy that few of the statistically significant between-group differences attributed to answering questions are included in the present meta-analyses.

Meta-analytic findings are presented in Figures 2, 3, 4. For past week alcohol consumption (Figure 2), the pooled effect marginally exceeds the 5% probability threshold (z = 1.94, p = 0.053) and is equivalent to approximately 1.5 UK units, and just over 1 standard drink in the USA [30]. No statistical heterogeneity is observed in relation to this effect. These studies are, however, clinically heterogeneous. Five studies took place in university student populations with pro-active recruitment of volunteers [31,32,36,38,42] and three among adults attending clinical
The studies by Daeppen and colleagues [37] and Cherpitel and colleagues [43] both took place in Emergency Departments where evidence of brief intervention effectiveness is more uncertain than in general practice [44]. The Daeppen study also differs clearly from other studies in Figure 4, introducing heterogeneity and reducing the pooled estimate of effect from approximately 1.5 to 1 point ($z = 2.21, p = 0.027$). Twelve month AUDIT data from the study by Kypri and colleagues [32] were used because this outcome was not assessed at the 6-month follow-up interval. The three studies with the largest estimated effects on past week drinking all involved alcohol-only assessments [32,35,38].

The trial by Anderson and Scott reported findings separately for men and women [40,41]. Both published reports of this trial contained the statement that “there were no significant differences between the control group who received no assessment and the

### Table 1. Characteristics of studies included in meta-analyses.

<table>
<thead>
<tr>
<th>Country</th>
<th>Setting</th>
<th>Study design</th>
<th>Population age, gender composition</th>
<th>Eligibility/screening criteria</th>
<th>Exclusion of dependent drinkers</th>
<th>Baseline sample size</th>
<th>Baseline drinking levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richmond et al. 1995</td>
<td>Australia, General Practice</td>
<td>2 arm comparison nested within 4-arm trial</td>
<td>19–70 (mean 37.7); 43% women</td>
<td>&gt;210/350 g ethanol per week for men/women</td>
<td>Yes (physical dependence score ≥10 or MAST &gt;20)</td>
<td>Control: 93 Assessment: 93</td>
<td>Drinks/week: Control: Mean 37.5 (SD 19.9) Assessment: Mean 34.7 (SD 18.2)</td>
</tr>
<tr>
<td>Kypri &amp; McAnaly 2005</td>
<td>New Zealand, University primary healthcare clinic</td>
<td>2 arm comparison nested within 3-arm trial</td>
<td>17–24 years (mean 20.2); 49% women</td>
<td>None</td>
<td>None</td>
<td>Control: 72 Assessment: 74</td>
<td>Drinks/week: Control: Mean 19.3 (SD 11.2) Assessment: Mean 18.1 (SD 8.9)</td>
</tr>
<tr>
<td>Carey et al. 2006</td>
<td>USA, University</td>
<td>2 arm comparison nested within 6-arm trial</td>
<td>18–25 years (mean 19.2); 67% women</td>
<td>1+ episodes of heavy drinking (men: ≥5 drinks; women ≥4 drinks) in an average week or 4 episodes in the last month; class status not senior</td>
<td>None</td>
<td>Control: 81 Assessment: 89</td>
<td>Drinks/week: Control: Mean 3.6 (SD 2.3) Assessment: Mean 3.7 (SD 2.8)</td>
</tr>
<tr>
<td>Daeppen et al. 2007</td>
<td>Switzerland, Emergency Department (ED)</td>
<td>2 arm comparison nested within 3-arm trial</td>
<td>18 years and over (mean 36.7); 22% women</td>
<td>Score of ≥8 on AUDIT</td>
<td>None</td>
<td>Control: 335 Assessment: 343</td>
<td>a) Days drinking/ wk b) Drinks per occasion: Control: a) Mean 3.6 (SD 2.3) b) Mean 3.7 (SD 2.8) Assessment: a) Mean 3.5 (SD 2.4) b) Mean 3.8 (SD 2.4)</td>
</tr>
<tr>
<td>Kypri et al. 2007</td>
<td>New Zealand, University healthcare clinic</td>
<td>2 arm comparison nested within 4-arm trial</td>
<td>17–29 years (mean 20.2); 52% women</td>
<td>1+ episodes of heavy drinking (men: ≥5 drinks; women ≥4 drinks) in the preceding 2 weeks</td>
<td>None</td>
<td>Control: 146 Assessment: 147</td>
<td>AUDIT score Control: Mean 15.1 (SD 5.5) Assessment: Mean 14.9 (SD 5.0)</td>
</tr>
<tr>
<td>McCambridge &amp; Day 2008</td>
<td>Britain, University</td>
<td>2 arm comparison nested within 5-arm trial</td>
<td>18–24 years (mean 20.6); 67% women</td>
<td>None</td>
<td>None</td>
<td>Control: 204 Assessment: 217</td>
<td>History of Trauma Scale positive (Control: 12% Assessment: 10%)</td>
</tr>
<tr>
<td>Walters et al. 2009</td>
<td>USA, Emergency Department (ED)</td>
<td>2 arm comparison nested within 3-arm trial</td>
<td>18–38 years (mean 19.8); 66% women</td>
<td>None</td>
<td>None</td>
<td>Control: 75 Assessment: 72</td>
<td>Heavy drinking episodes Control: Mean 2.9 (SD 1.6) Assessment: Mean 3.3 (SD 1.9)</td>
</tr>
<tr>
<td>Cherpitel et al. 2010</td>
<td>Poland, Emergency Department (ED)</td>
<td>2 arm comparison nested within 5-arm trial</td>
<td>18 years and over (39% &lt;30 years); 16% women</td>
<td>Presentation to ED 4pm–midnight, RAPS4 positive screen or ≥11 drinks per week for men, ≥6 for women or ≥4 drinks for men per drinking day, ≥3 for women</td>
<td>None</td>
<td>Control: 147 Assessment: 152</td>
<td>Drinks per drinking day* Control: Mean 5.5 (SE 0.4) Assessment: Mean 5.6 (SE 0.4)</td>
</tr>
</tbody>
</table>

*1/6 measures of consumption, dependence and prior treatment in both groups. Abbreviations: MAST = Michigan Alcohol Screening Test; AUDIT = Alcohol Use Disorders Identification Test. doi:10.1371/journal.pone.0023748.t001
### Table 2. Details of experimental contrasts.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Participants blind to...?</td>
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<td></td>
</tr>
<tr>
<td>Study design</td>
<td>Not clear</td>
<td>Yes</td>
<td>Not clear</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Group assignment</td>
<td>Not clear; judged likely</td>
<td>Yes</td>
<td>Not clear</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Focus on drinking</td>
<td>Controls: Yes</td>
<td>Partially (other health behaviours assessed)</td>
<td>No</td>
<td>Partially (other health behaviours assessed)</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Hypothesis</td>
<td>Yes</td>
<td>Yes</td>
<td>Not clear; judged likely</td>
<td>Not clear; judged likely</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Content of experimental conditions</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Control</td>
<td>Health and Fitness Questionnaire: QF of drinking last 3 months, weight, smoking, exercise habits</td>
<td>Blood pressure measured, demographic details</td>
<td>Demographic details, height, weight, Daily Drinking Questionnaire, maximum number of drinks in last 4 weeks, AUDIT non-alcohol measures</td>
<td>Screening only: 3 alcohol questions within a 10-item lifestyle questionnaire</td>
<td>Demographic details, AUDIT, number of drinks consumed in heaviest episode in last 4 weeks, + an 8-page leaflet on the effects of alcohol (online)</td>
<td>General health &amp; sociodemographic questionnaire</td>
<td>Demographic questions only</td>
<td>RAPS-4 +3 questions on drinking (drinking days per week, drinks per average drinking day, maximum drinks in one occasion in past month)</td>
</tr>
<tr>
<td>Assessment (As for controls +)</td>
<td>Drinking history; 7-day diary; MAST; physical dependence score</td>
<td>Age first drink, drank in last 12 months (Y/N), largest amount drunk in the last 4 weeks, AUDIT non-alcohol measures</td>
<td>TLFB calendar for past 90 days: sequential assessment of alcohol use, drug use and sexual behaviour</td>
<td>AUDIT, 7-day TLFB non-alcohol measures</td>
<td>4 weeks later: 14-day retrospective diary, APS, AREAS, perceived peer drinking norms</td>
<td>AUDIT</td>
<td>Alcohol consumption, related problems, protective behaviours, readiness to change, and perceived norms</td>
<td>Drinking in 6 hours before injury, feeling drunk at time of injury, attribution to alcohol, 30-day TLFB, SIP, readiness to change</td>
</tr>
<tr>
<td>Estimated times in minutes (control/assessment)</td>
<td>3/15</td>
<td>5/15</td>
<td>7/30</td>
<td>2/30</td>
<td>3/10</td>
<td>5/8</td>
<td>5/30 minutes (latter only repeated 3 m &amp; 6 m)</td>
<td></td>
</tr>
<tr>
<td>Medium of assessment administration</td>
<td>Not clear</td>
<td>Computer (Internet) self-completion</td>
<td>Face-to-face interview</td>
<td>Face-to-face interview</td>
<td>Computer (Internet) self-completion</td>
<td>Pen and paper self-completion</td>
<td>Computer (Internet) self-completion</td>
<td>Face-to-face interview</td>
</tr>
<tr>
<td>Non-alcohol content in assessment</td>
<td>None</td>
<td>Physical activity, fruit, vegetable consumption, smoking, mental health (from SF-36)</td>
<td>Drug use and sexual behaviour</td>
<td>Injury Severity Scale, presenting conditions, Quality of Life (SF-12)</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Other features of assessment</td>
<td>Collateral interviews were conducted</td>
<td>Consent given for saliva sample</td>
<td></td>
<td></td>
<td></td>
<td>Breath testing for assessment group; List of AA groups and treatment services given to all</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reimbursement/Payment</td>
<td>Not stated</td>
<td>All participants given a pen (value NZ$0.50) at invitation to follow-up</td>
<td>Paid US$20 and US$25 for 6 m and 12 m follow-up assessments.</td>
<td>None</td>
<td>Participants given sandwich voucher (NZ$4.95) when invited for follow-up</td>
<td>Paid £10 upon successful follow-up.</td>
<td>Psychology course credit or US$20 at baseline; US $20 at 3 and 6 mo. for assessment group only, US$40 at 12 mo. for all</td>
<td>Not stated</td>
</tr>
</tbody>
</table>
group who received assessment" and provided no further outcome data. Statistical power to detect differences was limited. If it is assumed that retention was equivalent in the non-assessed group and the assessed group, estimated total sample sizes at follow-up were 46 women and 109 men. Among men this provides approximately only 18% power to detect a small effect of 0.2 standard deviations. The trial by Gentilello and colleagues [39] did not refer to relevant outcomes in the published report. E-mail contact with the lead author ascertained that analyses had been undertaken and no differences in outcome detected between assessed and non-assessed groups (L. Gentillelo, personal communication). Again assuming that attrition was not different between assessed and non-assessed groups (L. Gentillelo, personal communication). Again assuming that attrition was not different between the randomised groups, this sample of 307 provides approximately 41% power to detect a difference of 0.2 standard deviations.

### Discussion

Ten trials of the effects of answering questions in research assessment procedures within brief alcohol intervention studies were identified. Outcome data were pooled on three specific measures of drinking behaviour drawn from eight trials with data available. This revealed somewhat equivocal evidence of small effects on two of the three outcomes across the studies as a whole. Evidence of assessment reactivity appears stronger if one restricts attention to the student literature. The possible effect on past weekly total consumption was not detected to a statistically significant level in any of the eight primary studies. This pattern of findings is behaviourally plausible where reduced overall alcohol consumption is caused by less frequent drinking with a consequent

### Table 3. Study outcomes.

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Numbers analysed</td>
<td>Control, Assessment</td>
<td>Control, Assessment</td>
<td>Control, Assessment</td>
<td>Control, Assessment</td>
<td>Control, Assessment</td>
<td>Control, Assessment</td>
<td>Control, Assessment</td>
<td>Control, Assessment</td>
</tr>
<tr>
<td>6 m: 72, 66</td>
<td>6 m: 79, 88</td>
<td>6 m: 66, 69</td>
<td>12 m: 59, 72</td>
<td>12 m: 126, 126</td>
<td>12 m: 144, 156</td>
<td>12 m: 66, 63</td>
<td>12 m: 91, 99</td>
<td></td>
</tr>
<tr>
<td>Outcome measures</td>
<td>Drinks last 7 days</td>
<td>Drunk/week</td>
<td>Drinks/drinking day</td>
<td>Heavy drinking days</td>
<td>heavy drinking days</td>
<td>Peak estimated BAC previous month</td>
<td>RAPI</td>
<td>Days drinking/week</td>
</tr>
<tr>
<td>Duration of follow-up</td>
<td>6 m</td>
<td>6 weeks</td>
<td>1 m, 6 m, 12 m</td>
<td>12 m</td>
<td>6 m, 12 m</td>
<td>2–3 m</td>
<td>12 m</td>
<td>12 m</td>
</tr>
<tr>
<td>Summary of reported findings*</td>
<td>0/1 statistically significant differences</td>
<td>0/2 statistically significant differences</td>
<td>3/15 statistically significant differences</td>
<td>1 m</td>
<td>Drinks/wk</td>
<td>Drinks/drinking day</td>
<td>Peak BAC</td>
<td>0/6 statistically significant differences</td>
</tr>
</tbody>
</table>
| 7/25 statistically significant differences | 0/7 statistically significant differences | *In all cases, statistical significance defined as p<0.05. Abbreviations: APS = Alcohol Problems Scale; AREAS = Academic Role Expectations and Alcohol Scale; AUDIT = Alcohol Use Disorders Identification Test; BAC = blood alcohol concentration; LDQ = Leeds Dependency Questionnaire; RAPI = Rutgers Alcohol Problem Index; SF-12 = Short Form-12; SF-36 = Short Form-36; SIP = Short Index of Problems; RAPS-4 = Rapid Alcohol Problems Screen (4items). doi:10.1371/journal.pone.0023748.t003
reduction in risk as assessed with the AUDIT, with quantity per drinking occasion remaining unaltered.

Five of the eight studies included in the meta-analysis were undertaken in healthcare settings and five of the studies involved university students, with two studies taking place in student health services [32,36]. The generalisability of these findings thus warrants careful scrutiny. This point is also reinforced by the detection of the two unpublished studies in general medical settings with no statistically significant effects, which incidentally gives reason for confidence in the completeness of our identification methods. Whilst the study by Anderson and Scott [40,41] had very limited capacity to detect effects, this was much less true of the study by Gentilello and colleagues [39].

The methodological quality of included studies has not been formally assessed, making caution further necessary, as biases in trials will produce biased pooled effect estimates in meta-analyses. For example, though attrition is generally low, it is higher in some studies than in others and even small differences between groups across studies may introduce bias. We chose a single follow-up interval in the studies by Carey et al. [31] and Kypri et al. [32] and eschewed evaluation of binary AUDIT outcome which was statistically significant in the study by Walters and colleagues.

![Figure 2](image2.png)

**Figure 2. Meta-analysis of the effects of answering questions on total weekly drinking.**
doi:10.1371/journal.pone.0023748.g002

![Figure 3](image3.png)

**Figure 3. Meta-analysis of the effects of answering questions on quantity per drinking day.**
doi:10.1371/journal.pone.0023748.g003
[42] in favour of continuous AUDIT score which was not. Close inspection of the data in the tables and figures suggests that both these decisions lead towards more conservative estimates of the effects of answering questions. We also deliberately ignored statistically significant effects within the primary studies on outcomes which have not been employed consistently across the studies.

Findings of a small effect on drinking behaviour are coherent with data on various other outcomes in the relatively few individual trials that exist in the wider health sciences [13,14,15,16,17,18,20,21]. These too have generally identified small effects, though they include one study which found no effects [20], and also one study which identified a large effect [19]. This pattern is found also in the wider non-health social science literature. For example prior questionnaire completion exerts a measurable small effect on voting behaviour [45,46], as well as in laboratory-based social psychology experiments [47].

The outcome data in the present study were all self-reported, necessarily so given the target behaviour, and other investigations of this phenomenon also rely on such data [13,14,15,18]. Importantly, however, studies do exist which identify effects of similar magnitude upon objectively assessed behaviours [16,17,21]. For example, the large effect obtained in a dental study was on plaque coverage ascertained using photography [19]. Furthermore, Godin and colleagues [17] observed both registrations at blood drives and blood donations, neither requiring self-report data, and effects have also been detected on attendances for screening in other studies [16,21]. Intriguingly, a large effect on the amount of money deposited in an honesty box was also unobtrusively obtained in an experiment stimulating a sense of being observed [48].

Given the under-development of this area of study, there are many potential sources of bias which remain to be investigated to permit clear and confident causal inferences. Notwithstanding these cautionary remarks, what are the implications of the findings from the present study? The magnitude of an apparent assessment effect quantified here is small, though that should not be interpreted to mean that it is unimportant. The difference in past week consumption represents approximately 35% of the known effect of brief alcohol intervention in primary care [22]. As assessment is an integral component of a brief intervention, contamination has occurred, attenuating estimates of intervention effects. Brief interventions may thus be much more effective than has been previously understood. The present study needs to be replicated when the literature has further developed and the equivocal nature of the overall findings and the apparent discrepancies between student and non-student populations resolved. There is also a need to study whether answering questions on other behaviours generates similar reactivity in trials. The present findings suggest this form of contamination may be more common than has previously been appreciated.

The small effects potentially attributable here to answering questions have been detected as unwanted artefacts of the research process. Almost all these questions are concerned with measurement of behaviour and its consequences. These questions have thus not been designed to elicit thinking about change, and thus to promote actual behaviour change. This is true also of the wider literature with the exception of the studies by Sandberg and Conner [21] and Godin and colleagues [17], in which questions specifically about anticipated regret and implementation intentions were asked. It is likely that selecting questions for their behaviour change potential may produce greater effects than have been seen here.

Answering questions appears to exert a subde influence on subsequent self-reported drinking behaviour among students. Other aspects of the research process such as randomisation [49,50,51] and consent [52,53] also have psychological impacts. Their implications for subsequent behaviour remain to be evaluated [54], and may cumulatively generate greater bias. This impairs our ability to rule out reactivity to the research conditions themselves as a possible explanation for observed between-group differences in trials, thereby impeding secure inferences on the true effects of behavioural interventions [55]. These uncertainties are ironically produced by the unintended and largely overlooked consequences of undertaking research itself. Whilst behavioural science has had some awareness of these issues for some

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**Figure 4. Meta-analysis of the effects of answering questions on total AUDIT scores.**

doi:10.1371/journal.pone.0023748.g004
considerable time, rapid advances in understanding are now well overdue [56].

Acknowledgments

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References


Author Contributions

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