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The development of a context specific survey to measure drinking occasions

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Blog posts

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Conference presentations

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Acronyms and Abbreviations

A&E: Accident & Emergency

ABV: Alcohol By Volume

AIC: Akaike Information Criterion

AUDIT: Alcohol Use Disorders Identification Test

BAC: Blood Alcohol Concentration

BAL: Blood Alcohol Level

BIC: Bayesian Information Criterion

BMI: Body Mass Index

BrAC: Blood breath Alcohol Concentration

B-YAACQ: Brief Young Adult Alcohol Consequences Questionnaire

CI: Confidence Interval

DAGs: Directed Acrylic Graphs

DMQ: Drinking Motives Questionnaire

DMQ-R: Drinking Motives Questionnaire-Revised

DMQ-R-SF: Short Form of DMQ-R

EMA: Ecological Momentary Assessment

GDPR: General Data Protection Regulation

HDOs: Heavy Drinking Occasions

HED: Heavy episodic drinking

IAC: International Alcohol Control Study

ICAT: Internet-based, Cell phone-optimised Assessment Technique

LSHTM: The London School for Hygiene and Tropical Medicine

MEDLINE: (Medical Literature Analysis and Retrieval System Online)

NHS: National Health Service

NIHR SPHR: The National Institute for Health Research School for Public Health

PANAS: Positive and Negative Affect Schedule

PANAS-X: Expanded Positive and Negative Affect Schedule

PPI: Patient and Public Involvement

SES: Socio-Economic Status

ShARRP: Sheffield Addiction Recovery Research Panel

SMS: Short Messaging Service

SPT: Social Practice Theory

TAS: Transdermal Alcohol Sensor

TPB: Theory of Planned Behaviour

UK: United Kingdom

US: United States of America

1. Summary

Background

Extensive research has examined how contextual characteristics of drinking occasions, such as why and where an individual drinks, independently influence alcohol-related outcomes. Limited research has considered *which* characteristics should be measured and *how* they should be measured. This thesis aimed to undertake literature-based and primary research to develop and test a context-specific survey to measure the characteristics of drinking occasions.

Methods

Firstly, a systematic review identified and assessed the data collection techniques used within the event-level literature to measure occasion characteristics. Secondly, a content analysis of discussion forums identified the most mentioned characteristics of heavy drinking occasions within posts to online alcohol support discussion forums. Thirdly, drawing on the findings from the first two studies, the process of developing and testing a context-specific drinking occasion survey, using expert and public input and cognitive testing is described. Finally, the survey is used to collect and analyse cross-sectional data to identify which occasion characteristics are associated with consumption amongst heavy drinkers and their heavy drinking occasions.

Results

Whilst no gold-standard data collection approach was found, retrospective drinking diaries were identified as most appropriate for the current research due to good compliance rates and low participant burden. In identifying which characteristics should be measured, why, where, who, when, and what individuals drank were salient within discussions of their heavy drinking occasions. Through expert and public input, several changes to survey design led to the creation of a context-specific survey. In using the survey, contextual characteristics accounted for

significantly more variance in consumption than individual characteristics within heavy drinkers' occasions and their heavy drinking occasions.

Conclusions and recommendations

Through an iterative development and testing process this thesis produced a novel context-specific drinking occasion survey which contains key characteristics relevant to heavy drinking. Future research should use this survey to provide a comprehensive analysis of the drinking occasion characteristics that account for variation in consumption.

2. Introduction

In the UK, 29.2 million adults aged 16 and above consume alcohol, with 24% of adults in England and Scotland drinking above the recommended guidelines of 14 units per week(1). Furthermore, on their heaviest drinking days, 27% of UK drinkers engage in heavy episodic drinking (HED) (2), defined as men and women consuming over 8 and 6 units of alcohol respectively in a single drinking occasion, with a unit defined as 10ml or 8g of pure alcohol (3). Excessive alcohol consumption has been identified as a causal factor in over 60 medical conditions (4), including cancers of the mouth, bowel, and liver (5) with the government estimating that treating alcohol-related problems costs the National Health Service (NHS) £3.5 billion per year (6). In addition to the health-related harms, excessive alcohol consumption is also associated with increased social harm, in that individuals may face family disruption, problems at work, and financial difficulties as a result of their heavy drinking (7). Given the wide range of negative consequences associated directly and indirectly with heavy alcohol consumption, reducing excessive consumption and its associated negative consequences is a priority within the domains of both policy (8) and public health research (9).

Traditionally, alcohol research has sought to understand the influences on alcohol consumption, alcohol-related harms, and the effect of alcohol policy by measuring the quantity and frequency of consumption within a given period to establish individuals' typical or average drinking behaviours (10). Whilst examining typical drinking behaviours has elicited many useful findings, this approach has limitations. To only examine an individual's average consumption is somewhat reductive and risks overlooking the heterogeneity and variation in drinking behaviours, in that individuals may drink more on certain days or within specific occasions (11,12). In response to these critiques (13) a growing body of research has examined how the contextual characteristics of a drinking occasion, otherwise known as where, when, what, with whom, and why an individual drinks, can influence alcohol-related outcomes

(11,12). By measuring the characteristics of a drinking occasion, also known as event- or occasion-level characteristics, researchers can examine the heterogeneity of drinking practices and how these are embedded into daily life. Throughout this thesis the terms ‘event-level’ and ‘occasion-level’ are used interchangeably.

Measuring the characteristics of drinking occasions has been done in a number of ways. A substantial body of literature has used qualitative methodologies, such as focus groups and one-to-one interviews, to examine how drinking cultures of certain groups relate to their cultural and social practices (14–17). In exploring how alcohol is associated with the construction of gender identities, Emslie et al. (16) used focus groups of pre-existing friendship groups to explore the way in which each gender discusses their drinking occasions. Through using this approach, the authors found that amongst women in early mid-life, drinking alcohol allowed them to express their identity outside their roles as mothers and allowed them to embody a younger and carefree identity, albeit temporarily. Whilst these approaches are useful in developing our understanding of how drinking practices form drinking cultures, the use of complementary quantitative methodologies to examine drinking occasions is desirable, as the data collected and statistical analyses allow for different types of conclusions to be drawn and reliably extrapolated across populations. Where quantitative methods have been adopted, various contextual characteristics have been associated with increased consumption such as attending multiple drinking locations (18), drinking in large and mixed gender groups (19), and playing drinking games (20). In determining the extent to which these factors influence drinking behaviours, Demers et al. (21) found that 51% of variance in alcohol consumption was explained by contextual characteristics, suggesting that not measuring occasion-level characteristics will limit the explanatory power of analyses.

Whilst the influence of drinking occasion characteristics on alcohol-related outcomes is well established (14–17), the characteristics measured within the research are far from

comprehensive. A recent mapping review of 278 studies assessed which contextual characteristics of drinking occasions had been measured (22). Day of the week, venue type, and number of people present were found to be measured the most, with availability of food, number of venues visited, and alcohol expectancies measured the least, with the research primarily focusing on student populations in the US (22). Furthermore, when examining how individual studies measure these characteristics, it is evident that there is a lack of consistency between how these are measured, both in terms of what occasion-level characteristics are measured and which data collection techniques are used. These inconsistencies in the reporting of event-level measures may be because there is little agreement or guidance about which characteristics of a drinking occasion should be collected, or which research designs are the most appropriate to use. This is in stark contrast to the guidance provided when using traditional methods to measure alcohol consumption such as quantity frequency measures, with clear standards for what should be included as a minimum when collecting data on average and typical drinking behaviours (23,24).

Although occasion-level alcohol research has provided important insights in relation to drinking contexts and consumption outcomes, few studies have considered how the method used impacts reliability, validity, and participant burden. This is perhaps more evident when examining the range of different research designs used in event-level data collection (25–27). Whilst such methodological diversity can yield interesting insights when used strategically, diversity due to a lack of evidence on best practice is more likely to hinder the comparison of findings, the interpretation of consistencies, and differences in conclusions. As current approaches to quantitatively measure drinking occasions are heterogeneous in nature, there is a need for clear guidance to establish the best way to measure drinking occasions to ensure the data collected is more comparable and robust across studies and therefore useful to future researchers and policy development.

2.1 Outline of Thesis

This PhD therefore aims to drive forward occasion-level alcohol research by undertaking literature-based and primary research to determine the most suitable measures for measuring the context of a drinking occasion, to determine which contextual factors should be measured, and to develop and test a data collection method for collecting occasion-level data.

The first part of the thesis provides an overview of what is already known in this field. Specifically, chapter three establishes how a drinking occasion has previously been defined within the literature in reference to theories such as Social Practice Theory and the Socio-Ecological Model. Chapter four reviews existing research conducted on drinking occasions and establishes which concepts have previously been measured within a drinking occasion, in addition to the measurement approaches taken. The literature discussed within this chapter draws on studies identified within a recently published mapping review by Stevely et al.(22) .

The remaining chapters are dedicated to the four empirical studies undertaken within this PhD. Chapter five presents a systematic review of the data collection techniques used to measure drinking occasions and aims to assess them in terms of their methodological strengths and limitations. This was undertaken to identify the best method of measuring drinking occasions.

Chapter six presents a content analysis of online alcohol support discussion forums, which identifies the most commonly mentioned contextual characteristics of heavy drinking occasions by analysing existing user-initiated posts on online discussion forums. Alongside extensive literature reviews this analysis informed which contextual factors were captured in the developed survey. This is the first study to use this design in this area and therefore provides novel data.

Chapter seven details the development stages undertaken to create a novel context-specific survey which captures the contextual characteristics of drinking occasions. Informed by the key methodological findings from chapters five and six, this chapter details the process undertaken to create and test this survey. Development of the context-specific survey was informed by expert review and consultation with a Patient and Public Involvement (PPI) panel. To assess the validity and usability of this survey, the first draft of the developed survey underwent cognitive testing. Key changes made to the developed survey at each stage of the development process are highlighted in this chapter.

Chapter eight, the final empirical chapter of this thesis, uses the survey developed in chapter seven to collect cross-sectional quantitative data on heavy drinker's (defined as those drinking above the low-risk guidelines of 14 per week(28)) general drinking occasions and their heavy drinking occasions (HDOs) (defined as males and females drinking over 8 and 6 units respectively in a single occasion). The work presented in this chapter identifies the contextual characteristics associated with on-trade (e.g. in a bar or restaurant etc.), off-trade (e.g. within the home etc) and mixed-trade (drinking in both on- and off-trade) general drinking occasions and HDOs within a sample of heavy drinkers. As such, this study identifies which characteristics are most associated with heavy drinking and suggests areas for policy development and research intervention.

Chapter nine completes this thesis by discussing the overall findings, outlining the strengths and limitations of the thesis, and highlighting recommendations for practice and research. Chapter ten presents the conclusions of the thesis.

3. Conceptualisation of a Drinking Occasion

This chapter aims to establish how a drinking occasion is conceptualised through both theory and research. This chapter first examines how a drinking occasion is defined within the existing literature, before discussing which theoretical approaches have been used to conceptualise what a drinking occasion is. Drawing on empirical research, the common types of drinking occasions which occur within the UK are presented. This chapter will provide considerations for what aspects of a drinking occasion should be measured, which in turn will influence the decisions made later within the PhD, specifically when designing the context specific drinking occasion survey in chapter seven.

3.1 What is a drinking occasion?

Given that certain patterns of alcohol consumption are associated with greater physical and psychological harm (29,30), accurately and reliably measuring alcohol use is important within public health research. As previously stated, measuring drinking behaviours by examining average or typical consumption is not sufficient in capturing the different ways in which people drink (11), with research adopting these methodologies often conceptualising alcohol use as a single behaviour (12).

In research examining which factors influence drinking behaviours and related outcomes, there has been a predominantly individualised approach (12), wherein alcohol consumption has been theorised as the result of an individual's intentions (31,32), or in order to achieve a specific goal (33). Whilst adopting an individualised approach can elicit valuable insights into drinking behaviours (34–36), this approach can be considered reductive, with external influences (such as environmental factors) on consumption often overlooked. In response to these critiques, there has been a shift in recent years to examine the context in which drinking occurs, otherwise known as where, when, what, with whom, and why an individual drinks (11). This requires

researchers to move beyond a focus on individuals and instead to focus their attentions at an occasion level.

Research examining the types of drinking occasions that commonly occur have often used typological analysis methods, such as latent class or cluster analysis (11,37–39), in which a set of distinct but related categories which lie within the data are identified within the topic of study (40). In a 2016 paper creating a typology of UK drinking occasions, Ally et al. (11) identified eight distinct types of drinking occasions within the UK. Within this typology, most drinking occasions within the UK appeared to involve drinking at low risk levels, with increasing and high risk drinking only occurring within some occasion types. Within 'Mixed-location heavy drinking', identified by Ally et al. (11) as a high-risk occasion type, characteristics of this occasion included drinking at a range of on-trade and off-trade locations, the occasion taking place on a Friday or Saturday night, and the reason for the occasion likely to be an "opportunity to chill out", to "have a laugh", and to "spend quality time with people".

If different types of drinking occasions are the focus of analysis, it is imperative to have a clear definition of a drinking occasion. The term 'occasion' is paired frequently with drink-related terms throughout the literature. Whilst the term binge drinking and heavy episodic drinking occasion have both been defined in terms of drinks or units consumed (3,41), there appears to be multiple perspectives and definitions in use, but little agreement or sustained scientific debate. When defining binge drinking, the National Institute for Alcohol Abuse and Alcoholism presented an occasion as consuming multiple drinks "*at the same time or within a couple of hours of each other"* (42). In constructing a typology of drinking occasions Mustonen, Mäkelä and Lintonen (37) developed a definition whereby a drinking occasion is defined as a period of drinking with no more than two hours between drinks, with Ally et al. (11) also applying this definition in their work on typologising UK drinking occasions.

In their definition, the National Alcohol and Drug Knowledge base (43) acknowledge that a drinking occasion may include drinking across multiple locations; however, the length of a drinking occasion is defined as the time when an individual's Blood Alcohol Level (BAL) is above zero, with the drinking occasion being over when a BAL of zero is reached. Whilst this definition allows for a drinking occasion to be quantitatively measured, depending on the number of units an individual drinks, the occasion length may extend substantially beyond the point in which drinking ceases, which for heavy drinkers may be into the next day. In further establishing the complexity of defining a drinking occasion, Room and Dawson (23) argue that what an individual may consider as a drinking occasion is quite varied given cultural differences.

Additionally, researchers may define a drinking occasion based on the aims of their study. For example, if a researcher is interested in examining shifts in drinking context a new drinking occasion may be defined by a change in drinking venue or partner as opposed to being temporally defined (23). The lack of clarity and consensus within the literature on how a drinking occasion should be operationalised is problematic, with the only commonality being that alcohol should be consumed. A lack of clarification regarding what constitutes a drinking occasion hinders progress in this research area as comparing findings across studies becomes challenging, which in turn makes data synthesis difficult. Examining how drinking occasions have been theoretically conceptualised may assist in establishing what contextual aspects of a drinking occasion should be measured within context-specific drinking occasion surveys.

3.2 Theoretical conceptualisations of a drinking occasion

Theoretical conceptualisations of a drinking occasion are limited. In a recent review of existing event-level research on drinking occasions only a minority of papers had used an explicit theoretical framework (22). When theory was used, it tended to be in the form of psychological models, such as the Theory of Planned Behaviour (32) and Motivational models (44–46).

Whilst these theories are useful in developing our understanding of why people drink, within these theories, behaviour is typically viewed as the outcome of a series of rational decisions an individual makes based on several internal attributes such as their intentions, motivations, and goals. By using these theories alone, external influences (such as context) are not accounted for (12,32). In the remaining section of this chapter, several theories which have been used to inform the selection of characteristics within the literature are discussed.

One theory which has been explicitly applied to the study of drinking occasions is Social Practice Theory (SPT; (11,12,22,47)). Originating within sociological theories of practice, SPT provides an alternative approach to viewing behaviour, wherein the focus of attention shifts from individualised accounts of behaviour which focus on rational or deliberate behaviour, to focusing on the routinized and automatic behaviours in which a group of people engage in, otherwise known as the 'practice' (12). As such, SPT focuses on the behaviour itself and how it is performed, rather than the individual engaging in the behaviour (12,48).

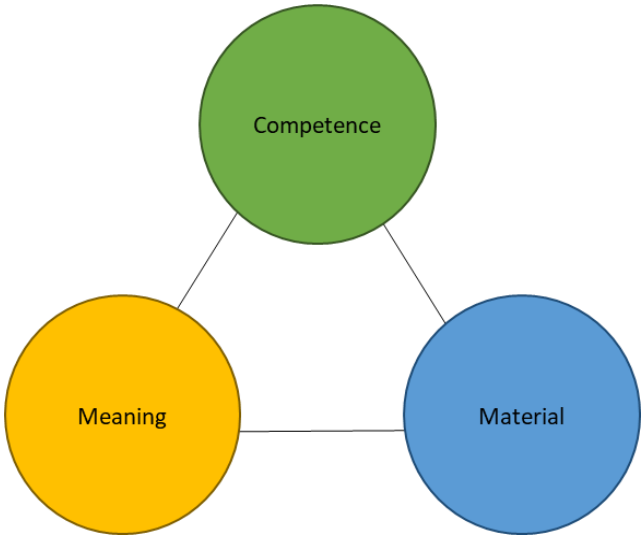

Figure 1: Social Practice Theory (Reproduced from Shove et al., 2012, page 25) demonstrating how a practice is formed

Whilst many traditional and contemporary theorists have been instrumental in the development of SPT (49), SPT as conceptualised by Shove, Panzar and Watson (48) has been applied to the study of drinking occasions (12,22). In their account, Shove et al. (48) (see Figure 1) theorised

that practices are comprised of three core elements: *materials, competencies and meaning*. In applying SPT to the study of drinking practices, Meier et al. (12) defined each of these elements in relation to alcohol, with *materials* referring to the equipment or resources needed such as the glassware or the physical structure of a bar, *competencies* referring to the procedures or skills needed to engage in the practice, such as knowing how to toast, for example knowing how to clink your glass without breaking it. Finally, Meier et al. (12) defined *meaning* as the shared understandings between those who engage in or observe the practice such as drinking for the purpose of relaxation. In considering how SPT could be applied as a theoretical framework to study drinking occasions, Meier et al. (12) also incorporated Southerton's principles of temporality (50,51) whereby drinking practices are considered temporally, in both the action of drinking (i.e. duration, tempo) and their relation to other practices, such as paid work and eating. The authors theorised that examining the emergence, persistence, and decay of practices, and how practices compete and are related with each other over time, may provide new insights into alcohol trends, their social patterns, their associations with alcohol-related harms, and how they are impacted by alcohol-related policies.

Whilst theories specifically addressing the components of a drinking occasion may be limited, other theories do exist in which the role of the social and environmental context of drinking is explored. One such theory is the socio-ecological model (52,53) a theory-based framework which attempts to explain how the interplay between individual and contextual factors determine behaviour. This framework suggests that our drinking behaviours are not just affected by individual-level characteristics such as gender or alcohol expectancies (54), but are influenced by the drinking context such as spatial, social, and situational characteristics (55). To expand on how these characteristics influence engagement in health behaviours such as alcohol consumption, McLeroy et al. (52) developed a hierarchical framework which documented the influence of the following factors: intrapersonal factors, interpersonal factors,

institutional factors, community factors, and public policy. In the application of this theory in explaining alcohol use, previous research has applied an ecological perspective to examine how community factors such as outlet density influence drinking behaviours, specifically within young adult populations (56,57).

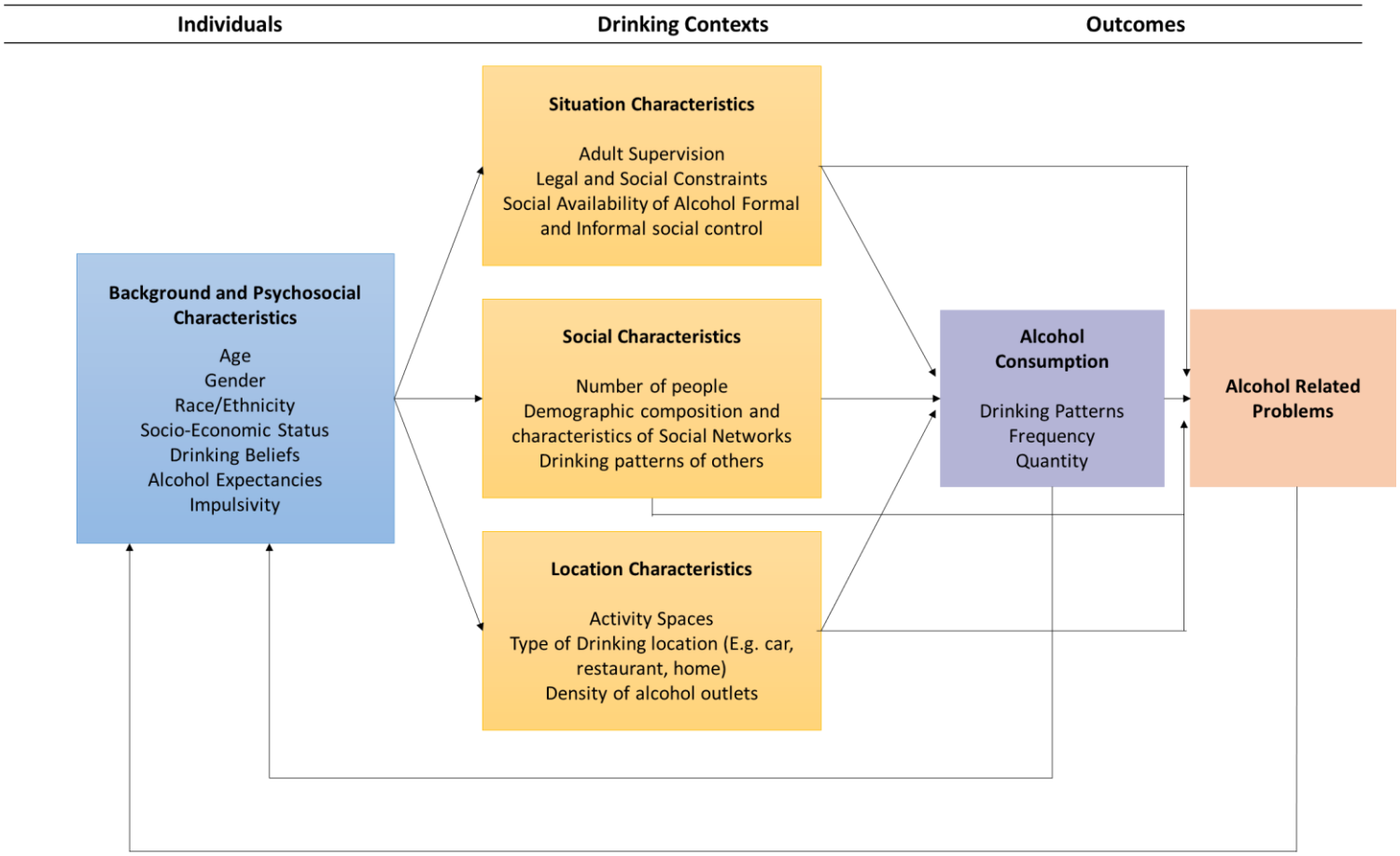

Figure 2: Social Ecology Model of Alcohol Consumption – Reproduced from Freistheler et al. (2014)

Within the wider literature adopting an ecological perspective, social ecological theories of alcohol have examined the specific role that a drinking context has in the aetiology of alcohol use and alcohol-related problems (57). In establishing the interplay between individual and situational characteristics and their influence on alcohol consumption and related outcomes, Freistheler et al.(55), adopted a social-ecological framework (see Figure 2). By using this framework, the authors were able to demonstrate how certain aspects of a drinking context,

such as proximity to drinking locations and outlets, may influence alcohol consumption and related problems independently of individual characteristics.

Psychological theories have also been applied to understand how context may influence drinking behaviours. Social Learning Theory (58) is one theory of how drinking behaviour can be learnt by observing and interacting with individuals in a specific social context. In a study applying Social Learning Theory to examine changes in female drinking when moving from high school to university, alcohol consumption increased for all participants, with sorority pledged females showing the highest increases in all measures of consumption (59). This indicates that there may be contextual characteristics specifically related to being a member of a fraternity or sorority organisation which increase consumption. Social Norms Theory has also been used to address student alcohol use patterns, with the theory aiming to understand both interpersonal and environmental influences on drinking. In examining how perception of others' drinking may influence consumption in different drinking locations, Lewis et al. (60) found that students perceived the typical same sex student as consuming more alcoholic drinks in comparison to their own consumption in all drinking contexts, with alcohol consumption in fraternity or sororities parties particularly overestimated.

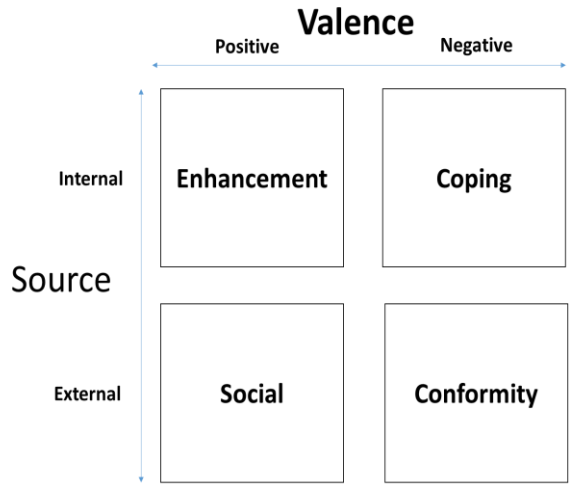

Figure 3: Cooper (1994) Conceptualisation of four drinking motives based on Cox and Klinger's (1988) Motivational Model of Alcohol Use

Lastly, within the drinking occasion literature a collection of papers apply motivational models to explain why individuals engage in certain drinking behaviours. Cox and Klinger's (46) motivational model of alcohol use theorises that the final pathway to alcohol consumption is motivational, in that an individual's decision to drink will be based on whether they believe drinking will lead to a positive or a negative outcome. Additionally, individuals may be motivated to drink as they believe doing so will provide them with an internal or external reward (46). Developing upon Cox and Klinger's (46) motivational model, Cooper (44) proposed the Drinking Motives Questionnaire Revised (DMQ-R), by creating four motives for alcohol use; drinking for enhancement, conformity, coping, and social reasons (see Figure 3). In establishing how different motivations to drink can influence alcohol consumption and related outcomes, research has found that drinking to cope with negative life events and stressful situations is associated with a more problematic style of drinking amongst adolescents and young adults (27,61,62). Whilst the DMQ-R has been extensively validated for use within adolescents and young adults (63) relatively limited work has been conducted to assess the validity of this scale when administered within the general population (64–66). Whilst theories of motivation can account for global drinking behaviours, motivations are not often studied at the event-level (67,68). Furthermore, the motive for the drinking occasion and the motive to drink within that occasion are not studied separately. This may be problematic, given that the occasion-level motive for the drinking event may be to relax with friends, but the individual-level motive to drink within the event may be to cope with negative mood.

In summary, this chapter first outlines how drinking occasions have been defined in practice, highlighting the disparate definitions applied and the limitations of this for knowledge transfer between studies and disciplines. Much of the work on defining drinking contexts has been done without explicit reference to theory. Therefore, throughout the second half of this chapter, different theories are outlined and their application to the study of drinking occasions explicitly

discussed. These theories will inform the development of a tool to measure drinking contexts throughout the rest of this thesis.

4. Existing research on drinking occasions: Characteristics measured and research methodologies

This chapter first discusses the existing quantitative research identified in a recent mapping review examining which contextual characteristics of a drinking occasion are associated with drinking behaviours. In particular, this chapter explores which populations and characteristics have been subject to most research attention and compares the different approaches taken within the literature. This chapter will then discuss the data collection techniques most commonly used in the study of drinking occasions. By establishing how drinking occasion characteristics have been measured previously, this chapter informs the development of all studies within this PhD.

4.1 Contextual characteristics associated with drinking occasions

Over the past couple of decades, the volume of event-level research examining drinking occasion characteristics has increased, with a marked surge since 2014 (22). Within this body of literature, numerous studies have examined how the contextual characteristics of a drinking occasion are both directly and indirectly associated with drinking behaviours and harm-related outcomes (47). In establishing the extent to which situational characteristics influence drinking behaviours, Mustonen et al. (69) found that 53% of the variance in blood alcohol levels within a sample of the Finnish general population was explained by differences in occasion characteristics, such as drinking late at night and drinking across locations.

A recent mapping review of the drinking occasion literature found a broad range of contextual characteristics studied in relation to consumption and related outcomes (22). Below, selected key contextual characteristics identified within this literature are discussed.

Drinking Location

One of the most studied occasion-level characteristics is the drinking location, with a focus on the differences between on- and off-premise drinking dominating the literature (11,22,70) Traditionally, drinking in on-premise establishments, such as bars, has been associated with heavier drinking patterns, higher intoxication, and an increased risk of acute alcohol-related harm (e.g. injuries) in comparison to off-premise locations such as the home (71,72).

Within on-premises locations, research conducted in Australia has found that both high risk consumption and harmful outcomes were most likely for those who had not eaten prior to drinking (73), and where music was the main entertainment within the establishment (74). In examining the serving practices occurring within bars, Clapp et al. (75) observed that within a short time period most bars served excessive amounts of alcohol, with 90% of pseudo-patrons making test purchases served a vodka shot, beer, and two long island ice teas within a 60-minute period. Additional findings from research conducted in bars and nightclubs has shown that an increased volume of music resulted in a reduced amount of time consuming a standard drink of beer (76) and increased total consumption in patrons (77,78).

On-premises drinking has been associated with increased experiences of aggression (79,80), particularly the harassment of young women, with a study finding that group members ranked as having a lower social status were more likely to be subjected to sexual aggression when engaging in heavy drinking (81). In addition, on-premises locations have been studied in relation to their role in alcohol-related traffic accidents, with studies finding that alcohol sold from on-premises locations (70), particularly those selling large quantities of beer and spirits (82), was associated with the most drink-driving related accidents and offences.

Whilst it is clear that drinking in on-premises locations increases the likelihood of individuals engaging in heavy drinking, since the turn of the millennium there has been a societal shift towards individuals consuming alcohol within the home (83), with a report published on data

collected prior to COVID-19 by Public Health Scotland finding 73% of all alcohol sold in Scotland was at off-trade establishments (84). Findings from an online survey in Australia examining young adult's alcohol purchasing patterns on Saturday evenings, revealed that the majority of this population exclusively purchased their alcohol from off-license outlets (e.g. shops), with these individuals as likely to engage in heavy episodic drinking as those buying from on-license premises only (85). Similar results have been found within young adult samples within the UK and the US (86,87), with individuals from the general population reporting that their preferred drinking location is in the off-trade (88). When examining the contextual characteristics influencing consumption in off-premises drinking, research has predominantly focused on college drinking and parties, with characteristics such as themed parties, the presence of illicit drugs and drinking games predictive of increased breath alcohol concentration (BrAC) (89,90). In contrast there is a lack of quantitative research examining the contextual characteristics associated with off-premises alcohol consumption within middle aged and older adults. The lack of research in this age group is problematic as population surveys found adults aged 45-64 were the age group to most regularly drink above the low-risk weekly guidelines (91). Additionally, there is evidence to suggest that the Covid-19 pandemic may have led to an increase in both high-risk drinking and frequency of consumption amongst middle aged drinkers (92).

In examining the contextual characteristics that span across both on- and off-premises occasions, research has found that drinking within multiple locations is associated with both an increased overall consumption (93) and increased blood alcohol content (BAC)(69,94). Associated with drinking in multiple locations, the practice of pre-drinking, otherwise termed as pregaming or preloading, has received much research attention, mainly within the US college literature (95). Pre-drinking, classified as drinking alcohol prior to attending an event

(96), is consistently associated with increased alcohol consumption, intoxication, and experience of alcohol-related harms across studies on young adults (97–99).

Drinking Company

In seminal work conducted in 1983 examining drinking location and drinking company, Harford (100) found that individuals reported consuming more alcohol when drinking at a bar with friends in comparison to any other setting, including private homes and restaurants. Additionally, reports from patrons attending nightclubs and bars have found that drinking in larger groups (101) resulted in increased alcohol consumption. In experimental studies examining the effects that others have on drinking behaviours, the effects of modelling have been demonstrated. Larsen et al.(102) observed that when drinking with a confederate partner, students drank more alcohol when the confederate was also drinking an alcoholic drink. The need for approval may partially account for social modelling effects, with heavy drinkers who had a high need for social approval imitating their partner's light and heavy drinking behaviours (103). Additionally, group composition has been found to influence consumption, with drinking in mixed gender groups associated with more drinks per hour compared to single sex groups (19).

Drinking Motives and Mood

Outside of situational characteristics, other contextual factors associated in the wider literature with drinking outcomes are drinking motivations and mood (61,104,105), with most studies examining these associations conducted in the domain of psychology (22). In assessing how drinking motives may predict event-level alcohol consumption, Thrul and Kuntsche (106) found that female's endorsing enhancement motives for drinking drank more per hour, with the number of friends present significantly increasing consumption in females who reported higher drinking to cope motives. Drinking motives were found to have no moderating effects

on consumption amongst males. It should however be noted that within this study (106), drinking motives were measured at baseline, and not at the event-level, whereas drinking motives may change dynamically throughout an occasion and an individual's drinking motive may differ from the occasion level motive. In a further study (62) examining the role of drinking to cope, negative mood and alcohol consumption at the event-level within college students, it was found that heavier evening drinking tended to occur on days when individuals both experienced more anxiety and reported more endorsement of event-level drinking to cope measures.

Special Occasions

Within the American literature, 21st birthday celebrations are notoriously associated with heavy drinking (107), with students reporting consuming more alcohol on the week of their 21st birthday compared to a typical week (108). Certain activities taking place within a 21st birthday may explain why drinking is increased, with Neighbors et al. (109) finding that those playing drinking games had higher estimated BACs and experienced more negative consequences, such as memory blackouts and being hungover. Outside of 21st birthday celebrations, public holidays and weekends have also been associated with increased consumption and intoxication (110).

Summary

Whilst the characteristics of drinking occasions discussed above are not by any means comprehensive, they provide evidence that context does influence drinking behaviours. In a recent review of the contextual characteristics measured within the event-level literature, Stevely et al.(22) established which papers examined the following contextual aspects of a drinking occasion: meaning, timing, company, venue, and situational characteristics. The authors found that most papers only measured a limited range of contextual characteristics.

Additionally, most papers only examined one type of characteristic (22) with day of the week, affect/mood and venue type the most frequently measured. Whilst it is encouraging that event-level studies are measuring drinking occasion characteristics, as they have been demonstrated to explain more variance within consumption than individual factors (21,69), it is a significant weakness that these measurements are not done in a more consistent manner. If characteristics such as drinking motivations are not operationalised or conceptualised in the same way across studies, they will likely not be measured in a consistent or standardised manner across studies. This lack of standardisation threatens both the reliability and validity of findings by limiting how the findings of separate studies can be compared, and the conclusions which can be made. Furthermore, Stevely et al. (22) stated that there was a lack of theoretical underpinning in studies measuring contextual characteristics. As discussed above, this lack of theory is evident throughout the event-level literature and is a substantial limitation to the study of drinking occasions, as there often appears to be no clear basis for selecting certain contextual characteristics over others.

From examining the content of questions within studies, the measurement of characteristics is not done optimally. For example, there are many validated scales which measure drinking motivations such as the DMQ, DMQ-R and the short form of the DMQ (DMQ-R-SF) (44,45,111). Whilst studies conducted in a laboratory setting appear to incorporate these validated scales (112), very little of the research conducted outside of this setting appears to use validated measures (94,113). Whilst it may be argued that administering validated questionnaires is unfeasible in certain research designs, as it may increase participant burden (114), there is limited evidence to sustain this explanation (115). Given that Kuntsche et al.(116) have suggested that failing to use validated motives scales may limit the comparability and validity of findings, as characteristics may be conceptualised and therefore measured in

different ways, it is imperative that validated measures should be employed when feasible in event-level research.

Additionally, there is a lack of consistency in how specific characteristics are operationalised. Within studies measuring the contextual characteristic of a drinking occasion, location is defined in a variety of ways. For example, Kypri et al.(117) asked students to select which of four locations they had consumed alcohol at within the past seven days: (1) pub, bar or nightclub, (2) student flat or house, (3) hall of residence or (4) other locations. This is in contrast to Mustonen et al. (69), in which location is asked as a binary variable, with participants able to select having their last drinking occasion in: (1) home environment, or (2) a licensed premises. This lack of consistency in measuring characteristics is problematic when comparing findings between studies.

Finally, whilst some studies do examine activities occurring within a drinking occasion (33,118,119), a limited set of research currently examines how a drinking occasion is embedded within individual's daily lives, for example the activities an individual engages in prior to and after the drinking occasion, which may influence their consumption (29). The majority of the literature examining events surrounding a drinking occasion have been conducted in US college students, where research has examined how engaging in pre-drinking as a component of a drinking event can increase the likelihood of heavy consumption (95). In a study examining college student's weekly consumption patterns. Wood, Sher, and Rutledge (120) found that the rates of alcohol consumption on a Thursday night were moderated by having to attend an early morning class on a Friday. Even though most research measuring the temporality of drinking occasions is conducted within US college students, the findings from these studies suggest that by adopting a holistic approach we may be able to identify how activities prior to or after a drinking occasion may influence consumption.

4.2 Data collection techniques used to measure drinking occasions

Within existing research examining drinking occasion characteristics, a variety of methodologies are utilised (22). Whilst diversity of methods may elicit differing insights into how contextual factors influence drinking behaviours, it is problematic when methods are chosen with no clear rationale due to no 'gold standard' of data collection method identified. In this section, the most common research designs identified in the mapping review by Stevely et al. (22) are discussed in relation to their use in the collection of contextual data within drinking occasions.

4.2.1 Drinking Diaries

Drinking diaries are a technique frequently used to record alcohol consumption, with most studies employing a daily diary design, whereby information on drinking behaviours is collected daily. Within the study of drinking occasions, two diary types have been used: prospective and retrospective diaries.

Retrospective drinking diaries involve participants recording, often by self-report measures, their alcohol consumption after the drinking event. Retrospective daily diaries are often completed with a one-day recall period (62,121), although many studies allow a grace period where any missed entries can be completed. When examining how retrospective diaries can be applied to the study of drinking occasions, Kypri et al. (72,117) created a location-specific retrospective diary measure, where individuals were asked to recall how many standard drinks they had consumed in four locations over the past seven days. Whilst retrospective drinking diaries are seen as a low cost and relatively burden free method of data collection (122), concerns remain that the data collected may be compromised by recall bias, with Ekholm (123) finding that the precision of recall declines substantially after two to three days. Reflecting on this study, it is important to note that whilst the accuracy of recall may decline, all data

collection methods tend to underestimate alcohol consumption(124,125); therefore, recalling recent drinking is still a valid measure within the standards of alcohol epidemiology (126).

An alternative to retrospective diaries is the prospective diary, where individuals record their alcohol consumption as it occurs or as soon afterwards as it is feasible to do so (127). A benefit of this method is that as recall periods are shorter, the influence of recall bias should be minimal. In examining how daily retrospective and prospective drinking diaries differ in drinks reported, Patrick and Lee (128) found that a greater number of drinks were reported in prospective diaries in comparison to retrospective measures.

Whilst daily diaries when administered over an extended time period can establish temporal variations within drinking behaviours, these methods rely on self-reported consumption. A danger of self-report measures is that respondents have a tendency to underestimate their alcohol consumption, particularly within heavy drinking populations (124,129) Under-estimations of consumption have also been demonstrated in other methods relying on self-report, with survey data failing to capture 40-60% of the alcohol reported in sales data (130–132). Whilst daily diaries may have some flaws, they are a useful tool which can easily be administered to measure the contextual characteristics of a drinking occasion.

4.2.2 Laboratory studies

Laboratory studies allow for drinking behaviour to be studied in a controlled experimental environment, where researchers can manipulate specific situational characteristics in order to examine the influence on consumption behaviours. In examining which contextual variables have been manipulated within experimental studies, research has found that classical background music (133), drinking with a heavy drinking partner (134,135) and feeling excluded from a social group (136) resulted in increased alcohol consumption.

Many studies have used bar-room laboratories, where drinking behaviour is examined in an environment mimicking a bar, to make research more ecologically valid. Within laboratory studies, ad-libitum taste-test measures are often used, in which participants are asked to taste a selection of drinks and rate them on a set of adjectives (137). The taste-test task has been established as a valid measure of consumption within a laboratory environment (138) as it allows the researcher to directly measure the amount of alcohol consumed, and therefore calculate the units of alcohol consumed, given that they will know the ABV of the drink and the number of millilitres drunk.

As laboratory studies can manipulate and control for specific characteristics, they are suitable for examining how various characteristics of occasions may influence consumption. Additionally, in comparison to other designs, when measuring the effects of stressors, laboratory studies are able to administer both subjective and objective physiological measures of stress, such as measuring cortisol levels to determine if participants have exhibited a biological stress response (139). Whilst lab-based studies are able to successfully demonstrate how contextual factors may influence drinking behaviours, drinking behaviour within the laboratory is well-established as not being a true reflection of drinking in a real-world setting, possibly due to the notable differences in drinking practices, such as paying for drinks (140). In a study examining male beer drinking behaviour in the laboratory and a real barroom, Strickler et al.(141) found that in comparison to the laboratory setting, those drinking in the barroom drank significantly more and also had an increased sip rate. Furthermore, all particpants within the study knew their drinking behaviours were being observed in both locations, which may have potentially made participants drink in a more socially desirable way. Given that laboratory studies of drinking are a research-intensive method and do not completely reflect drinking in a real-world setting, with research tending to simulate on-trade settings such as barrooms, they are not a preferable choice for the study of drinking occasions.

4.2.3 Ecological Momentary Assessment (EMA)

EMA methods allow for multiple within-individual assessments of real-time drinking behaviours in near to real-time (142). Within this method, three different approaches have been utilised in the collection of real-time data (143). Firstly, some studies have used interval-contingent designs, whereby measures are administered at set intervals, with research using this design typically collecting data hourly on weekend evenings (18,144,145). Secondly, signal-contingent designs administer random assessments within a specified timeframe (146,147), for example four random assessments within a 24-hour period. Lastly, event-contingent designs require the respondent to complete an assessment each time they experience an event of interest (148,149), for example every time a participant drinks with a partner.

As technology has advanced, EMA studies have progressed from paper-based diaries to being administered using a variety of digital devices (150) such as handheld computers (146,151,152) and smart phones (18,153,154). In combining the advantages of using both internet-based questionnaires and mobile phones in research, Kuntsche and Labhart (155) developed the internet-based, cell phone-optimised assessment technique (IACT), to collect event-level data on how environmental, social, and individual characteristics influence consumption. Using a hyperlink embedded within a text-message, the ICAT has been used to collect data on young adult's drinking occasions such as drinking location, drinking partners and present mood (97,155,156). In their initial development of the ICAT, Kuntsche and Labhart integrated an optional qualitative component, in which approximately 15% of participants provided feedback on the usability of the ICAT. In analysing the feedback, the authors reported that respondents felt the ICAT was an accessible system and therefore resulted in a low participant burden (155). However, it should be noted that the ICAT was only tested on 237 undergraduate participants, potentially limiting the generalisability of these findings.

In addition to technological developments allowing for EMA methods to be implemented using mobile devices, developments have also been made in wearable devices such as transdermal alcohol sensors (TAS), which can be used to remotely track and monitor consumption by measuring alcohol secreted through skin (157). These wearable technologies have been used in conjunction with EMA methods to provide objective measurements of alcohol consumption (153). In an exploratory study examining the feasibility of using TAS and EMA methods to measure event-level data within a bar-crawl study, Clapp et al.(158) administered hourly EMA assessments from 12pm to 5pm and 9pm to 12am within a single day previously associated with heavy drinking. Participants were required to wear the TAS for 24 hours, with each hourly assessment electronically linked with the respondent's geographical location. In combining these methods, the authors were able to continuously and accurately monitor drinking behaviours. In other studies evaluating the respondent's experiences of wearing TAS devices the findings have been mixed, with a study reporting low levels of compliance, in that participants regularly removed the devices due to discomfort or stigma associated with wearing one (159). Evidence of TAS device malfunction has additionally been expressed within the literature (158,159), with Luczak et al. (160) in a two-week study finding only 38% of their sample to have complete and decipherable data. However, research by Greenfield, Bond and Kerr (161) found TAS devices to be a valid measurement of alcohol consumption.

EMA methods are of great benefit in the study of drinking occasions, as they allow contextual characteristics to be examined in near real-time as they evolve across an occasion. However, some researchers have argued that as measurements are required on a regular basis, often every hour, EMA protocols may enact a high participant burden (159,162). In a recent mixed-methods study examining the experience of using an EMA smartphone application to collect contextual drinking data, Labhart et al.(163) found certain elements of the EMA protocol to increase participant burden. By examining completion rates and detailed feedback, the authors

found that whilst completing questionnaires and submitting geospatial data caused relatively little burden, submitting photographs and videos to the application within their drinking occasion was perceived by some as inappropriate and disruptive to ongoing social activities. In a review of EMA methods used to collect situational drinking data, Wray et al. (162)noted a potential for this technique to cause behavioural reactivity, a phenomenon whereby due to providing repeated measurements on their behaviour over a period of time, individuals become aware of their consumption and may alter their behaviour as a result. Finally, EMA methods have been critiqued regarding the questionable levels of compliance displayed in some studies. In a recent meta-analysis examining compliance to EMA protocols, Jones et al. (164) found a pooled compliance of 75.06%, below the recommended gold standard of 80% (165). Whilst EMA methods are an innovative technique to collect in vivo contextual drinking data, potential issues regarding participant burden, measurement reactivity, and compliance may limit its suitability for use in general.

4.2.4 Field studies

In order to overcome the issues associated with measures of retrospective self-report, field-based studies have been suggested as an alternative for accurately measuring drinking behaviour and the contexts it occurs within (89). As field studies capture drinking in a real-time naturalistic environment, researchers have argued these studies are more ecologically valid, with Piasecki (159) arguing that they are instrumental in both theory generation and testing.

One of the earliest field-based approaches applied to the study of drinking occasions is participant observation. Researchers using this technique have employed covert observation within drinking establishments, allowing for groups of drinkers to be observed in a naturalistic environment (101,166). In a study examining groups of young adults drinking in bars, Knibbe (101) found that drinking rates were higher in larger groups and when the main accompanying activity was talking. Whilst observational studies can add value to the study of drinking

occasions at the group level, human error may result in the researcher failing to observe key factors within the drinking occasion as the venues where observations take place are large and bars can get crowded.

An alternative method is intercept surveys, where drinkers are approached and questioned on their consumption practices whilst still participating in the drinking occasion. Whilst this technique has been used within the UK (73,167) and Australia (168,169), most of this literature has focused on US college drinking (75). Within the US college literature, intercept surveys have been used to capture drinking events occurring within off-premises locations, typically parties (20,25,89,90). In attending student parties occurring at off-campus locations, Clapp et al. (90) used both participant observation and intercept surveys to examine the relationship between BrAC and both environmental and individual characteristics. In their analyses, characteristics such as playing drinking games and number of past heavy episodic drinking occasions were found to significantly contribute to an elevated BrAC, whilst drinking to socialise was significantly associated with a lower BrAC.

In critiquing the use of intercept studies in drinking occasions, Labhart et al. (97) argue that a single face-to-face interview is not capable of accurately measuring the drinking occasion's trajectory, with intercept studies only providing a snapshot of the occasion. Portal surveys have often been used to provide an account of how the contextual characteristics may influence a drinking occasion. In defining portal surveys, Voas et al. (170) state that they are a form of intercept sampling, designed to capture at risk individuals upon entry and exit to venues where alcohol is consumed. Within the drinking occasion literature, portal surveys are most commonly used outside on-premises locations such as bars and nightclubs, with individuals being surveyed upon entry and exit. Similarly to the intercept studies of Clapp et al. (25,90) and Croff et al. (89), Clapp et al. (75) and Carlini et al. (77) used in-person portal surveys and within-premises observations to establish how environmental and individual characteristics

influence drinking outcomes within bars and nightclubs. Additionally, portal surveys often capture consumption occurring prior to attending the drinking venue, with many studies capturing pre-drinking behaviours (98,171,172).

Whilst a critique of intercept and portal studies is that individuals providing drinking data are often intoxicated and may therefore not give reliable accounts of their drinking behaviour (173), the majority of studies do use breathalysers to objectively estimate blood alcohol concentration. While using breathalysers may allow for validation of the number of drinks reported and can indicate how intoxicated an individual is, blood alcohol readings cannot provide any additional contextual details associated with drinking, such as what activities occurred alongside drinking and when drinks were consumed etc.

Additionally, intercept and portal studies are usually used on weekend evenings (81,89,168,174), with data collection typically beginning in early evening and ending at approximately 2am (75,175,176), which is the closing time for most establishments included in the US College drinking literature. Whilst this time period of data collection may allow for capturing individuals as they engage in heavy alcohol consumption, early evening assessments are unlikely to accurately record event-level peak intoxication. Furthermore, literature suggests that alcohol-related harms occur more frequently in urban areas which have high concentrations of licensed establishments (177,178), particularly as intoxicated individuals leave venues. It can therefore be argued that by concluding data collection prior to or as establishments close, the true extent of alcohol-related harms experienced as a result of the drinking occasion may not be captured using these methods (179).

Finally, within the event-level alcohol literature, studies using field methodologies typically tend to capture drinking occasions within on-trade rather than off-trade locations. Whilst studies using these methods have captured drinking within off-trade locations (20,25,89,90),

the types of occasion captured are largely limited to student parties within America. Reflecting on this, researchers using these methods are currently not capturing the off-trade drinking occasions of middle-aged and older adults. The lack of research in this age group is problematic as population surveys have found middle-aged adults regularly drink above the low-risk weekly guidelines (91). Additionally, there is evidence from the US to suggest that older adults have experienced an increase in 12-month alcohol use and high-risk drinking (180).

Whilst each individual research design and data collection method can make different contributions to the study of drinking occasions, to date no method has been established as the gold standard. Furthermore, dependent on the given research question the research design chosen may influence the validity of the findings. For example, if a researcher wanted to examine how group dynamics influence drinking behaviours within an occasion, the more appropriate research design may be to covertly observe individuals within a naturalistic drinking environment such as a bar.

In evaluation of the research methodologies discussed above, it is evident that there is a need to clarify which data collection methodologies are most suitable to the study of drinking occasions. The research presented in this chapter has demonstrated that measuring drinking at the event-level is beneficial in capturing harmful drinking practices. Given that reducing excessive consumption and the negative consequences associated with it is a priority within both health research and governmental policy, it is imperative that valid and reliable measures for collecting data on drinking occasions are developed and that the best methods for different types of questions or research settings are identified.

4.3 Research aims, questions and objectives

4.3.1 Research aim

The overarching aims of this thesis are to identify the most suitable method for measuring the contextual characteristics of drinking occasions and to determine the salient characteristics which should be measured in order to develop and test a data collection method for the quantitative study of occasion-level alcohol use.

4.3.2 Research questions

1. What data collection methodologies have been used in the study of drinking occasions and what are their relative benefits in terms of reliability, validity, and feasibility in relation to each method?
2. What are the most salient contextual characteristics discussed on online forums in relation to heavy drinking occasions, and which of these should be measured in future research?
3. What questions should be asked, what measures should be used, and what is feasible to ask within a drinking occasion survey, and do participants consider Qualtrics to be a suitable platform to administer the survey?
4. Within a sample of heavy drinkers, what contextual characteristics are associated with the number of units consumed within their (i) general drinking occasions and (ii) heavy drinking occasions (defined as drinking more than 6/8 units in a single occasion for women/men), and (iii) whether contextual or individual level characteristics explain more of the variance in the number of units consumed?

4.3.3 Research objectives

A systematic review of research methods used to measure contextual characteristics of drinking occasions (Chapter 5)

1. To identify which data collection techniques have been used to examine the contextual characteristics of drinking occasions.
2. To assess how each identified technique performs on key measures of reliability, validity, and feasibility.
3. To provide recommendations regarding which data collection techniques should be used when measuring the contextual characteristics of drinking occasions.

Identifying the key contextual characteristics of heavy drinking occasions: A qualitative content analysis of online alcohol support discussion forums (Chapter 6)

1. To identify and describe the most frequently mentioned contextual characteristics of heavy drinking occasions within user-initiated posts to three online discussion forums.
2. To assess the value of using user-generated posts on alcohol support discuss forums in adding to what is already known about the contextual characteristics of heavy drinking occasions.

Developing and testing an event-level survey of drinking occasion measures (Chapter 7)

1. To use findings from chapters three, four, five, and six to identify which contextual characteristics could be measured within an online survey of drinking occasions.
2. To identify existing validated measures or when necessary, develop new questions which are suitable to measure the contextual characteristics of drinking occasions within an online survey.
3. To assess whether the questions used to measure the contextual characteristics of a drinking occasion are feasible by:
    a. Sending the survey to international experts in event-level analysis of alcohol consumption and getting feedback on the contextual characteristics measured.

b. Conducting a PPI group with members of an established alcohol research advisory group to determine whether the questions are comprehensible.
c. Conducting cognitive interviews as participants complete the Qualtrics questionnaire to assess whether the questions used to measure the contextual characteristics of a drinking occasion have face validity and to identify any technical challenges to using the Qualtrics online survey platform, the preferred option, in the collection of event-level data.

Given the context in which data collection occurred, any face-to-face data collection techniques would have been impractical given the COVID-19 pandemic restrictions (181). To date, most studies collecting data on event-level alcohol consumption used online modalities. Within the wider research literature there is evidence of greater self-completion rates in web-based surveys (182,183). The use of online surveys in research has clear advantages as data can be collected quickly, remotely, and at a relatively low cost and burden to participants (184).

In deciding which online platform should be used to host the survey, at the time of data collection Qualtrics was the only GDPR compliant survey platform recommended by the University of Sheffield's ethics committee and therefore identified as the most suitable platform (185). Qualtrics is an internet-based survey platform which offers a dynamic interface for survey design and includes features to help reduce participant burden such as the ability to include filter questions to route participants to only questions which apply to them (186). Qualtrics is also widely used as a survey platform to collect data within a range of government and academic research projects (186,187).

What are the contextual characteristics associated with consumption by Heavy Drinkers and their Heavy Drinking Occasions? A comparison between on-, off-, and mixed-trade occasions (Chapter 8)

1. To identify which contextual characteristics are associated with the number of units consumed by heavy drinkers within:
    a. On-trade general occasions
    b. Off-trade general occasions
    c. Mixed-trade general occasions
2. To identify which contextual characteristics are associated with the number of units consumed within:
    a. On-trade HDOs
    b. Off-trade HDOs
    c. Mixed-trade HDOs
3. To assess whether contextual or individual level characteristics explain more of the variance of units consumed in:
    a. On-trade HDOs
    b. Off-trade HDOs
    c. Mixed-trade HDOs

4.3.4 Methodology for PhD

Reflecting on this PhD's diverse research questions, the research conducted used a variety of both quantitative and qualitative methodologies and analytical methods, otherwise termed as a mixed-methodology approach (188,189). In taking a mixed methods approach, the results from each methodology were integrated within this research project to answer the research questions

(190,191), with Yardley and Bishop (192) arguing that to gain a complete understanding of humans it is imperative to use a mixed methods design.

Whilst it is widely agreed that adopting a mixed methodology allows for a deeper and broader understanding of the phenomenon in comparison to using a single methodology (193,194) this approach has received criticism from those who believe it lacks a philosophical paradigm (195). Criticism of a mixed methodological approach has been particularly prominent from those who hold purist ontological and epistemological assumptions, wherein there is a belief that combining both methodologies within research is inappropriate because they are incompatible (196,197). When considering each methodological approach separately, it is not surprising that a mixed methods approach has received this critique. Quantitative methods traditionally have adopted a positivist approach (198), in which the objective of the research is to empirically test how society operates (199). This is in contrast to qualitative studies in which a broader range of epistemologies is typically adopted (200), whereby researchers believe that in order to understand behaviour we must establish how individuals view and experience the world (201,202).

Whilst quantitative and qualitative methods may on the surface appear incompatible, many authors have defended the use of mixed-methods within research projects, with Creswell and Plano Clark (200) stating that mixed-methods designs are comprised of multiple phases of research, each having their own paradigmatic orientation. As a result of mixed-methodology critiques, pragmatism has been suggested as an appropriate paradigm in conducting mixed methods research (190,191,195). First proposed in the late 19th century, pragmatism is defined by Frey (203) as adopting a worldview where a focus is placed on what works, rather than what is objectively true or real. Pragmatists do not believe in linking methodological choices to epistemology and ontology, instead believing that research methods should be chosen based on which most effectively answer the research question (189,204,205). Furthermore, in their

support of using a pragmatic paradigm in social research, Greene (206) argue that by incorporating multiple methods into research, we can gain a better understanding of complex social phenomena. Therefore, adopting a pragmatist stance is particularly suited to mixed-methods research, as it allows for the researcher to select a methodology most appropriate to the research question (191,207).

Within this PhD, adopting a pragmatic paradigm was of particular benefit for the following reasons. Firstly, as the PhD consisted of four sequential studies, each with diverse research questions, adopting a single methodology would have limited the explanatory power of studies in answering the research question. Secondly, by adopting a pragmatic approach where flexibility of method is allowed, this PhD was able to use a sequential exploratory design. Sequential exploratory designs are a mixed-method technique where the quantitative and qualitative components of the thesis interlink to inform the development of occasion-based measures. Taking this approach allows for the quantitative data collected within this thesis to confirm and validate the results of the qualitative research vice-versa (190,208). To illustrate how the chapters of the thesis will interlink, a schematic diagram of the thesis and the chapters included within it is displayed in figure 1.

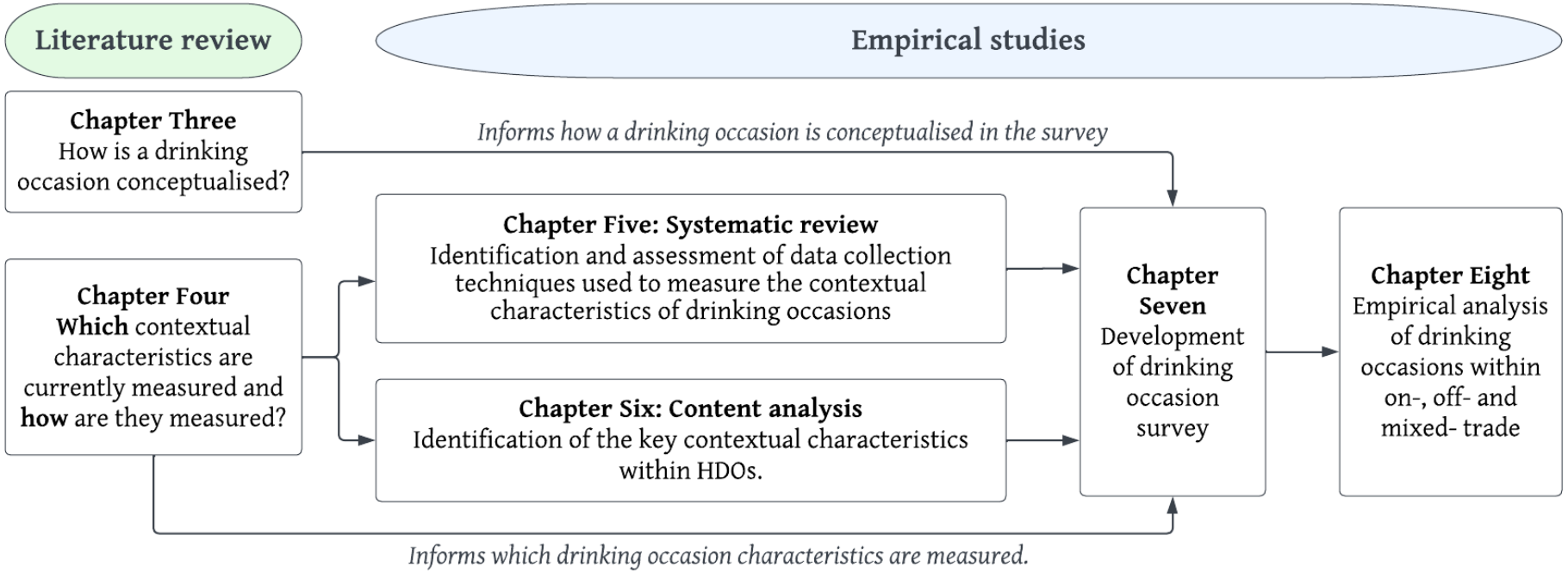

Figure 1. Schematic diagram of chapters within thesis

5. A systematic review of research methods used to measure the contextual characteristics of drinking occasions.

This chapter presents research submitted for publication to peer-reviewed journals during my studies. As this chapter is intended as a standalone publication, this chapter may repeat information included in previous chapters. This chapter consists of a systematic review which identifies the data collection methodologies used to collect event-level data on drinking occasions throughout the literature. The aim of this chapter was to identify and assess data collection techniques used to measure the contextual characteristics of drinking occasions. This chapter informed the selection of data collection methodology chosen in the development of the drinking occasion survey within chapter seven, in addition to other key methodological considerations taken within the thesis.

5.1 Submitted paper

Title: A systematic review of research methods used to measure the contextual characteristics of drinking occasions.

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Conflict of Interest

MO is a paid scientific consultant for ‘One Year No Beer’, a public limited company providing behaviour change and lifestyle services that receives no funding from alcohol producers, retailers or related organisations excepting small producers of alcohol-free products.

Abstract

Background

Researchers increasingly use event-level methods to understand drinking occasions. Little research has assessed how these methods perform on methodological competencies and how this influences data quality.

Objective

To systematically review methods used to measure the contextual characteristics of drinking occasions and assess how these perform on measures of reliability, validity, and feasibility.

Method

The review expanded a previous mapping review of relevant event-level alcohol literature through new searches of Ovid MEDLINE, Ovid PsycInfo and Web of Science Social Citation Index. Eligible papers measured at least one characteristic of drinking occasions and reported event-level alcohol consumption within the general population. We extracted the data collection methodology, mode of administration (where appropriate), and measures of feasibility, reliability, and validity.

Results

We identified eight main data collection techniques used across 316 eligible studies. Within 38 of these studies two techniques were used. The most used techniques were prospective diaries (*n*=81, 22.9%), specific-event recall (n=72, 20.3%) and experimental (*n*=57, 16.1%). Performance on methodological competencies varied across measures. Studies using experimental methods had the highest response rates and methods recalling specific events had lowest attrition. Studies using ecological momentary assessment methods typically had low average response rates and high attrition. Few studies reported measurement error or participant burden, and only 28.8% included validated event-level measures.

Conclusions

No single methodological approach was superior across measures of reliability, validity, and feasibility, with substantial variation in performance within and between methods. Future event-level research should measure and improve reporting of methodological competencies, including reactivity and participant burden.

Keywords: Alcohol Drinking, Data collection techniques, Drinking occasions, Event-level research.

Introduction

Excessive alcohol consumption has been identified as a causal factor in over 60 medical conditions (5), with treatment for alcohol-related problems estimated to cost the National Health Service in England £3.5 billion per annum (6). As such, reducing alcohol consumption and associated harms is a priority within both public health research and policy (8,9). Within academic research and population health surveys, alcohol consumption is typically measured by examining an individual's average consumption in grams, standard drinks, or units over a time period (typically days, weeks, or months) (24,131). Whilst examining typical drinking behaviours has elicited many useful findings, it is somewhat reductive and risks overlooking variation in people's drinking behaviours, thus limiting our understanding of how certain drinking patterns or practices are associated with alcohol-related harms (11,12,209,210). In response to these critiques, a growing body of research has applied event-level methods to understand how the contextual characteristics of drinking occasions affect consumption, in order to inform wider analyses of alcohol consumption, harm, and policy (11,12). A recent mapping review of the event-level alcohol literature found studies measuring a wide range of contextual characteristics, such as occasion timing, drinking companions, and drinking locations, studied in relation to consumption (22). The review also noted that authors used a wide range of data collection methodologies to measure event-level alcohol consumption, with no standardised or 'gold standard' method easily identifiable. This paper therefore aims to identify the predominant data collection techniques used to measure the contextual characteristics of drinking occasions, and to assess their methodological quality within event-level alcohol research.

Data collection techniques used in this area tend to be highly heterogeneous (22,29); retrospective diaries, ecological momentary assessment (EMA), and in-street intercept surveys are commonly used for the measurement of event-level drinking data (5). Whilst data collected

using these methods has provided valuable insights into drinking contexts and experiences of alcohol-related harms (55,72,211), researchers have also considered the methodological limitations of specific methods (164). For example, retrospective accounts of drinking often underestimate the amount of alcohol consumed compared to methods using shorter recall periods, such as EMA (212). Whilst methods that capture drinking in near real-time such as EMA are considered by many to be reliable and valid (213), they may impose a higher participant burden which may result in low study compliance (162). The methods used also differ substantially in terms of the contextual information collected. For example, in-street intercept studies usually only provide a snapshot of one time-point within a single drinking occasion (97), therefore the trajectory of the occasion may not be accurately captured (e.g. pace of drinking, all venues visited).

Whilst previous literature has highlighted the limitations of specific methods and research designs, few studies have systematically assessed how these data collection techniques perform on competencies such as compliance, reactivity, and participant burden, and how this may influence the validity, reliability, and quality of the event-level drinking data that they capture. There is reason to believe that many studies in this domain do not use well-validated research methods. Brooks et al. (214) identified 19 measures of behaviour and harm and found that none of these included validated scales at the event-level. It is apparent that there is a need to clarify which data collection methodologies are most suited to the study of drinking occasions.

Drawing on a previous mapping review of event-level alcohol literature examining the contextual characteristics of adults' drinking occasions (22), this systematic review aimed to (a) identify which data collection techniques have been used to examine the contextual characteristics of drinking occasions and (b) assess how each identified technique performs on key measures of reliability, validity, and feasibility. In assessing data collection techniques,

this review also aimed to (c) provide recommendations regarding which data collection techniques should be used when measuring the contextual characteristics of drinking occasions.

Methodology

Search strategy

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta analyses guidelines (PRISMA, Moher et al., 2009) and the review protocol was pre-registered on Open Science Framework prior to data analysis (https://osf.io/mqnh7). This review drew on papers identified within a published mapping review of the event-level literature (22), and more recently published papers identified from the updated search. The search strategy and eligibility criteria for this review are described in Stevely et al. (22) in detail. To briefly summarise, the search strategy was entered into Ovid MEDLINE, Ovid PsycInfo and the Web of Science Social Citation Index (SSCI). These databases were searched from the earliest available dates to 8th January 2019 by Stevely et al.(22) and then extended to the 29th November 2021 for the current review. The search terms captured three key concepts (see Table S1, supplementary material): alcohol consumption (e.g. alcoholic drinking or alcoholic beverage*), occasion-based research (e.g. event-specific or assessment), and contextual characteristics of a drinking occasion (e.g. motivation* or venue*).

Eligibility Criteria

Population

Eligible papers included studies of drinkers within the general population or population subgroups, such as heavy drinkers or young adults. This thesis intended to measure drinking occasions within the general population. As this review aimed to assess how methods performed on measures of reliability, validity, and feasibility, the decision was made to exclude

studies where the sample was exclusively formed of underage drinkers, pregnant women, and homeless populations. This was done for a number of reasons. Firstly, studies were excluded where drinkers may have faced qualitatively different risks of harm or drinking contexts in comparison to the general population (216). As such, the methods chosen in these studies may have been selected based on the specific populations and their needs, rather than methodological best practice. Additionally, drinking within these populations may be subject to increased stigma in comparison to the general populations, for example, drinking whilst underage and drinking whilst pregnant (217). As such, there may be additional barriers to collecting information about the drinking occasions of these populations compared to a general population sample, as methods may inflict a higher participant burden on these participants, which may lead to higher attrition rates based on the sample population rather than the method used.

Exposure

To be included, studies needed to quantitatively measure one or more contextual characteristics of drinking occasions, in addition to measuring event-level alcohol consumption. Stevely et al. (22) identified the contextual characteristics during the development of the search strategy and organised these into six distinct categories: meaning, timing, venue, company, situation (e.g. crowding), or drink type.

Outcome

Eligible studies needed to examine the association between contextual characteristics in one of these six categories and at least one event-level consumption outcome, such as whether alcohol was consumed within the occasion, the amount consumed, or the perceived or actual level of intoxication. In the review by Stevely et al. (22) two papers assessed only alcohol-related harm

outcomes (e.g. A&E attendance for Alcohol Use Disorder), and therefore were removed from the current review.

Study designs and reporting

Only original research studies were eligible; therefore reviews, commentaries, or editorials were excluded. Studies needed to be published in English and use event-level data collection methods including but not limited to recall of specific occasions, experimental procedures, and up to 7-day retrospective diaries. Papers were excluded if they did not identify drinking occasions of individuals or groups, such as studies measuring venue-level characteristics only. Studies describing the effects of interventions or treatment were not within the scope of this review and therefore the search strategy excluded papers in which the term 'brief intervention' was present in the abstract or 'effectiveness' in the title.

Data screening and extraction

Papers published up to the 8th January 2019 were initially screened by Stevely et al.(22), and then rescreened by the primary author of this review (OS). To update the search by Stevely et al.(22), papers published until 29th November 2021 were searched for and screened by the primary author of this review (OS). A second reviewer (JB) independently re-assessed a sub-set of the 316 studies (*n*=20) to check papers were correctly included. There was no disagreement between reviewers regarding inclusion.

Data extraction

The research team had access to Stevely et al.'s (22) data extraction form. From the data initially extracted by Stevely et al. (22), the present review uses information pertaining to data collection method, setting, population and country. The current review additionally extracted demographic and study design characteristics: mean age of sample, gender composition, and mode of administration.

Furthermore, information about feasibility, reliability, and validity was also extracted for each method used within each study. To assess the reliability and validity of the data collection methods, the following measures were extracted: the recall period in relation to the drinking event/s; whether the papers explicitly reported measurement error or reactivity (i.e. when behaviour is altered in direct response to the data collection technique); and whether validated event-level measures were used. Measures were classified as validated if they had undergone psychometric validation and the full validated scale was used within the study. Where validated event-level measures were found within studies, a basic description of the measure was extracted.

To assess feasibility, three measures of participant compliance were extracted: (i) response rates (percentage of eligible participants taking part in the study from the total number of participants contacted); (ii) attrition rates (percentage of participants who dropped out of a study from those who consented); and (iii) strict compliance (percentage of assessments returned in relation to the total number of assessments requested). Measures of participant burden were also extracted if they were available. Some papers reported participant burden explicitly, for example stating within the paper that brief measures were used. For others, and when available, proxy measures of burden were extracted, consisting of the number of times a measure was administered, the average time taken to complete a measure, whether training of the researcher or participant was required, and if participants received payment.

If a paper consisted of multiple studies with differing designs or samples, each study was extracted and analysed separately. Only methodological information was extracted. The results of the included papers were not extracted as they were not relevant to the purposes of this systematic review.

Quality Assessment

To assess the risk of bias, all studies underwent quality assessment by one reviewer (OS) using the NIH NLBI Quality Assessment Tool for Observational Cohort and Cross-Sectional studies (218).

Analysis and Reporting

The findings from this systematic review were summarised using descriptive statistics and narratively synthesised. Papers with two data collection techniques were allocated to both categories, meaning some studies were duplicated within methodological analysis. As this review provides a narrative synthesis of findings and not a meta-analysis, the duplication of studies is not problematic.

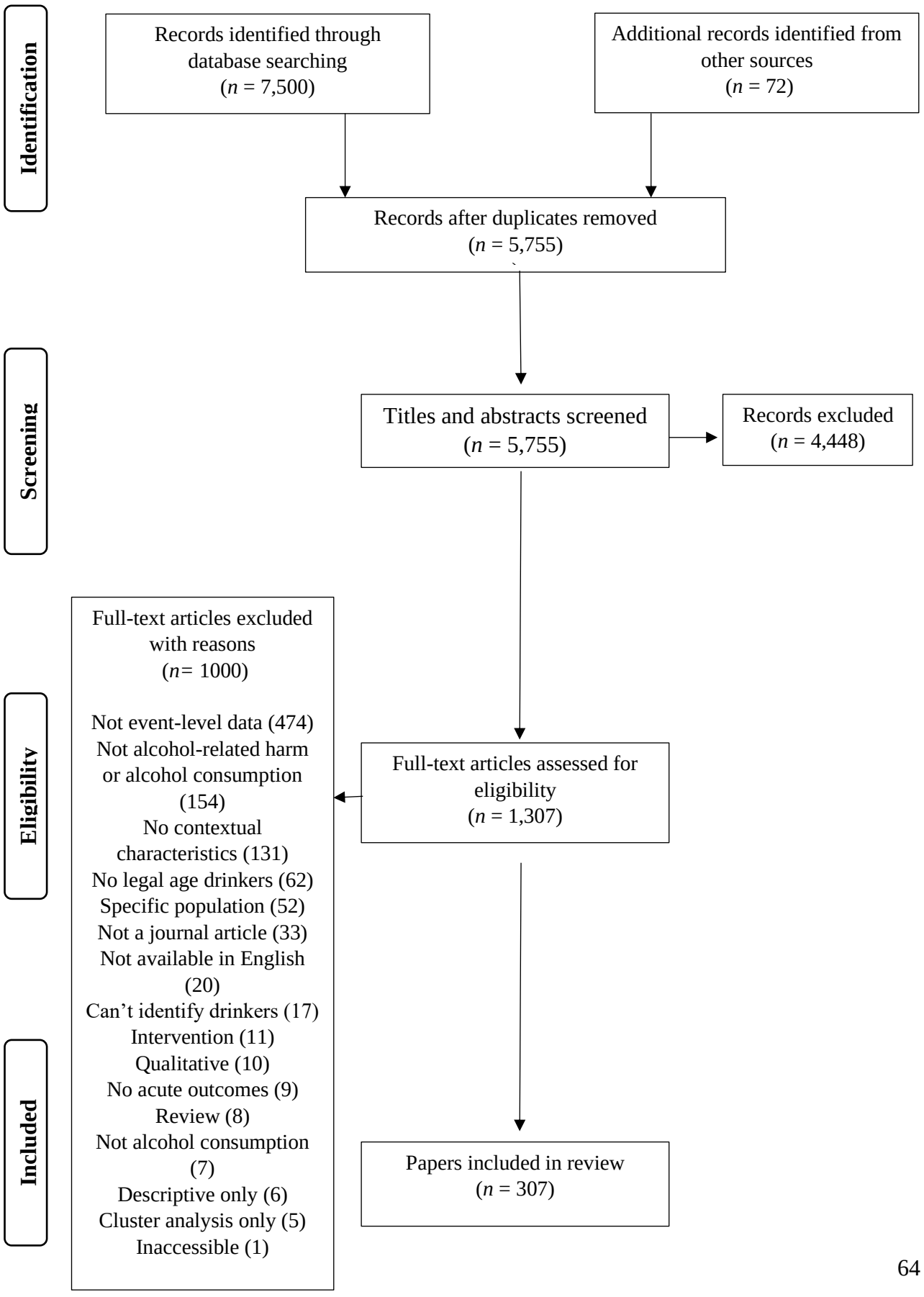
Results

A summary table of the included literature is available in the Appendix (Table S2, Supplementary materials).

Search Results

Three-hundred and seven papers were included (Figure 1), with 276 papers identified by Stevely et al.(22) and an additional 31 papers identified from the updated searches. Ten papers consisted of multiple studies in which different data collection techniques or samples were used. As a result, this systematic review includes 316 separate studies from the 307 papers identified. Of the papers included within this review, a subset (*n*=38, 12.0%) used two data collection techniques, (e.g. field and experimental methods (141)).

Figure 1. PRISMA diagram



Descriptive summary of included studies

Of the 316 studies included, the earliest studies were published in 1975. Most studies included both female and male participants (*n*=273, 86.4%), with a minority of studies using female (*n*=15, 4.8%) or male (*n*=22, 7.0%) only samples. Gender of participants could not be extracted from six papers. Student (*n*=141, 44.6%) and young adult drinkers (*n*=51, 16.1%) were amongst the most studied populations, together comprising just over 60% of all studies. Among studies reporting the sample's mean age (*n*=233, 73.7%), the mean reported age of participants across studies was 24.2. Most studies were conducted within the USA (*n*=194, 61.0%), with several studies also conducted in Australia (*n*=27, 8.5%), Canada (*n*=17, 5.4%), Switzerland (*n*=18, 5.7%) and England (*n*=13, 4.1%).

Quality Assessment

The quality of the included papers was generally good. Most studies clearly defined and specified their study populations. Studies using experimental designs also accounted well for the impact of potentially confounding variables (*n*=46, 80.7%). The key quality concern related to reporting of response rates and use of validated measures with only 28.2% (*n*=89) of studies reporting response rates and only 28.8% (*n*=91) of studies using validated outcome measures to capture contextual characteristics of drinking occasions.

Data collection techniques

Table 1 displays the data collection techniques and modes of administration identified in the review.

Eight different data collection techniques were identified: (1) *EMA (N=49)*: where multiple assessments of drinking occasion characteristics are collected in real-time across one or more specific time periods (e.g. three evenings); (2) *Retrospective Diaries (N=30):* where drinking occasion characteristics are measured retrospectively, often by asking about drinking over the

previous 7 days; (3) *Prospective diaries (N=81):* where drinking occasion characteristics from up to the past 24 hours are measured; (4) *Experimental (N=57):* where drinking occasion characteristics are measured and manipulated within a controlled environment; (5) *Field (N=28):* where drinking occasion characteristics are measured in a naturalistic environment; 6) *Portal/intercept (N=32):* where drinking occasion characteristics are measured at one or two time points during a single drinking occasion often at or around the entrance/exit of drinking venues; (7) *Specific-Event recall (N=72):* where characteristics of a specific retrospective drinking occasion are reported (e.g. drinking at a football game within the past 6 months); and (8) *Administrative data (N=5):* where data about drinking occasions is extracted from records held by organisations or health care services (e.g. patient records).

Prospective diaries were the most commonly used (*n*=81, 22.9%). Most studies exclusively used one data collection technique to measure drinking occasions (*n*=278, 88.0%). Thirty-eight studies used a secondary data collection technique, with field studies the most commonly used (*n*=16, 42.1%), in conjunction with portal/intercept studies (*n*=9, 23.7%) and experimental designs (*n*=4, 10.5%).

Modes of Administration

The mode of administration of at least one data collection techniques was not reported in seven of the 316 studies (2.2%). Nineteen different modes of administration were identified, with the most common being online, such as web-based surveys, followed by face-to-face, physiological measures and self-administered questionnaires. Most studies used multiple modes of administration: 169 had a second (e.g. using both SMS and online modes of administration: e.g. Groefsema et al (219)), 46 had a third, and seven had a fourth mode of administration. As seen in Table 1, the chosen mode of administration was found to vary by data collection technique.

Table 1: Percentage of modes of administration used within the 8 identified data collection techniques

	All data collection techniques	EMA	Retrospective Diary	Prospective diaries	Experimental	Field	Portal/ Intercept	Specific-Event recall	Administrative
Number of studies of technique	***(n=354[1])***	***(n=49)***	***(n=30)***	***(n=81)***	***(n=57)***	***(n=28)***	***(n=32)***	***(n=72)***	***(n=5)***
Modes of administration	***(n=604)***	***(n=82)***	***(n=39)***	***(n=120)***	***(n=130)***	***(n=55)***	***(n=74)***	***(n=97)***	***(n=7)***
Self-admin Questionnaire	9.3%	6.1%	-	<1%	31.5%	1.8%	2.7%	6.2%	-
Online	19.9%	19.5%	48.7%	38.3%	3.1%	5.5%	2.7%	29.9%	14.3%
Face to face	13.7%	1.2%	12.8%	9.2%	<1%	27.3%	37.8%	21.6%	14.3%
Handheld Computer	5.1%	20.7%	-	5.0%	-	1.8%	8.1%	1.0%	-
Paper and Pen	7.1%	3.7%	15.4%	13.3%	<1%	3.6%	1.4%	12.4%	28.6%
Observation	7.0%	-	-	-	16.9%	25.5%	8.1%	-	-
Text Message	3.0%	14.6%	2.6%	2.5%	0.8%	1.8%	-	-	-
Telephone	4.8%	2.4%	7.7%	7.5%	<1%	1.8%	-	12.4%	14.3%
Physiological Measures	10.8%	7.3%	-	4.2%	8.5%	27.3%	33.8%	3.1%	-
Smart phone App	4.5%	19.5%	2.6%	4.2%	1.5%	-	4.1%	-	-
Taste Test	7.8%	-	-	-	34.6%	3.6%	-	-	-
Household survey	<1%	-	-	-	-	-	-	5.2%	-
Email	1.7%	1.2%	-	5.8%	<1%	-	-	1.0%	-
Postal	1.5%	-	5.1%	3.3%	-	-	-	3.1%	-
Computer-assisted phone	<1%	-	-	-	-	-	-	1.0%	-
Medical Record	1.0%	-	2.6%	-	-	-	1.4%	2.1%	28.6%

[1] This review includes 316 separate papers. 38 of these used 2 data collection technologies and so have been included twice in the statistics reported. The overall total is therefore 354 techniques from 316 studies.

Classroom Questionnaire	<1%	-	-	-	-	-	-	1.0%	-
Web-enabled mobile	<1%	1.2%	2.6%	-	-	-	-	-	-
Interactive voice recorder	1.5%	2.4%	-	-	-	-	-	-	5.8%

Reliability and Validity

Recall period

Studies using EMA (*n*=32, 65.3%), experimental (*n*=53, 93.0%), and field (*n*=15, 53.6%) methodologies typically did not require participants to recall past behaviour, with behaviour observed or recorded in real or near real-time. Portal/intercept studies (*n*=25, 78.1%) typically asked participants to recall drinking occasions experienced within the current day or evening. Studies using prospective diaries typically adopted a 24-hour recall period (*n*=47, 58.0%), whilst retrospective diary designs most frequently asked participants to recall drinking occasions occurring over the past week (*n*=16, 53.3%). Studies asking participants to recall a specific occasion (e.g. victim of aggression in bars (79)), tended to have the longest recall period: 24 studies (33.3%) asked individuals to recall an event with no enforced time limit, whilst a further 17 (23.6%) adopted a recall period of up to a month prior. Eight studies did not report the time period over which participants recalled their drinking occasions.

Reactivity

Of the included studies, only six (1.7%) investigated whether participants were subject to the effects of reactivity. Three of these used EMA, with one finding limited evidence of reactivity within reports (220). The other two EMA studies reported more substantial reactivity effects: Simons, Willis, and Neal (221) found an inverse relationship between the number of days participants submitted reports and the number of drinks recorded, whilst Fairbairn et al. (153) reported that participants reported altering their drinking when monitored with a transdermal alcohol sensor. Three prospective daily diary studies assessed for reactivity. Two papers reported that participants reported fewer alcohol-related consequences over the course of the 30-day study period (222); another described how participants reported a temporary reduction in their alcohol consumption within the first few weeks of a longitudinal study (223).

Measurement Error

Most papers did not explicitly report on measurement error, of the included studies, only 10 (3.2%) reported an occurrence of measurement error within their research, of which seven were related to technical difficulties with equipment used to capture drinking occasions, resulting in missing data.

Validity of event-level measures

Less than a third (*n*=91, 28.8%) of studies used validated event-level measures. Retrospective daily diaries were the most likely to use validated measures (*n*=30, 34.1%), followed by studies using experimental data collection procedures (*n*=24, 26.4%). Across all study designs, validated measures tended to measure affect and mood (*n*=38, 41.8%), either by using the PANAS-X/PANAS (*n*=22, 24.2%) or through Larsen and Diener's eight factor mood circumplex (*n*=16, 17.6%). A limited number of studies used validated scales at the event-level to measure stated drinking motives (*n*=5, 5.5%), and when these validated scales were used, they were adapted versions of the DMQ-R ((44), modified DMQ-R (224) and the DMQ-R-SF (111).

Feasibility

Compliance

Table 2 presents the average response, attrition, and strict compliance rates by data collection technique.

Table 2: Average Response Rates, Attrition Rates and Compliance rates across data collection methods

Methods	*N*	**Average Response Rates**			**Average Attrition Rates**			**Average Strict Compliance**		
		%	SD	*n*	%	SD	*n*	%	SD	*n*
EMA	*47*	43.0%	44.3	4	7.9%	15.3	34	77.1%	17.1	37
Retrospective Diary	*30*	60.5%	25.3	20	2.8%	6.8	18	84.6%	16.4	25
Prospective diary	*81*	69.1%	14.6	15	5.1%	8.7	45	84.9%	12.9	69
Experimental	*57*	94.2%	8.2	2	1.4%	4.1	53	95.8%	9.3	52
Field	*28*	56.2%	26.6	12	3.7%	7.5	18	88.4%	16.1	12
Portal/Intercept	*32*	63.8%	25.6	21	8.5%	10.2	29	91.7%	10.1	30
Specific Recall	*72*	61.5%	19.0	39	0.65%	1.9	45	93.5%	13.7	53
Administrative data	*5*	84.5%	9.6	4	0.0%	0.0	3	71.4%	35.6	2
All studies	*316*	62.0%	23.1	89	4.1%	9.1	214	88.40%	13.84	258

Response rates

Eighty-nine studies (28.2%) reported response rates. Studies using specific-event recall (*n*=39, 61.5%), portal/intercept (*n*=21, 63.8%) and retrospective diary (*n*=20, 60.5%) data collection techniques were most likely to report response rates. In general, response rates varied widely both between and within methods. Studies using experimental techniques reported the highest average response rates, with studies using EMA data collection techniques having the lowest. It should be noted however that only a small proportion of papers using EMA and experimental data collection techniques reported response rates within these studies, and that the recruitment strategy taken within studies often differed (e.g. some samples were self-selected, whereas other samples were recruited based on stratification).

Attrition rates

Two hundred and fourteen studies (67.7%) reported how many participants withdrew before completing the study. Attrition rates varied substantially between data collection techniques, with studies using portal/intercept and EMA methods reporting the highest average attrition. Additionally, studies using other data collection techniques such as experimental and specific-event recall also reported low attrition rates, with administrative data studies reporting low or even zero attrition.

Strict Compliance

Strict compliance was extracted or calculated from most studies (*n*=258, 81.7%). Again, there was a high degree of variability both within and between methods. Experimental studies reported the highest average strict compliance rates, with only EMA and administrative data studies having an average rate below the recommended gold standard of 80% (165).

Participant Burden

Explicit measures of burden

Fifteen (4.7%) of the studies explicitly reported on participant burden, with eight (53.3%) of these studies using EMA methods. Four EMA studies sought to reduce participant burden by deliberately keeping daily assessments brief and including few questions about contextual characteristics (225–228). In the two diary studies considering participant burden, one reported designing a shorter survey to reduce attrition within the study (229) and the other only collected data within college terms and not whilst students were on holiday (72). Of the two prospective diary studies considering participant burden, Linden-Carmichael et al. (230) attempted to reduce participant burden by measuring protective behavioural strategies using a single item, while Sacco et al. (231) was the only study to report that a participant had dropped out due to finding the protocol too burdensome.

Proxy measures of burden

As few papers explicitly measured or reported participant burden, the following criteria were extracted as proxy measures based on existing literature (232–234).

Number of times measured

Two studies did not clearly report how many times event-level measures were administered (0.6%). Within studies that did so, 152 administered measures once (48.1%), with specific-event recall (*n*=67, 93.1%), experimental (*n*=41, 72.0%), field (*n*=17, 60.7%) and portal/intercept studies (*n*=20, 62.5%) most likely to administer measures once. EMA methods administered multiple assessments per day, either on an hourly basis (*n*=13, 27.7%) or through a combination of signal (when participants are asked at set intervals (e.g. every two hours to report what drinks they consumed) and self-initiated event-contingent (when participants

provide assessments when an event has occurred, e.g. they have had a drink) (*n*=28, 59.6%). Prospective diary studies were most regularly administered daily (*n*=64, 79.0%).

Time taken

Most studies did not report how long it took for participants to complete each measure (*n*=206, 65.2%). Of the 110 (34.8%) studies that reported this, studies using EMA (M=5.9 minutes, SD=7.1) and prospective diary methods (M=6.6 minutes, SD=7.2) took the shortest time to complete. Measures administered using diary (M=12.5 minutes, SD=2.5) and field (M=20.7 minutes, SD=16.3) data collection techniques were also relatively quick. In comparison, specific-event recall (M=37.6 minutes, SD=29.3) and experimental (M=72.9 minutes, SD=43.9) data collection techniques both on average took over thirty minutes to complete.

Paid

One hundred and thirty studies (41.1%) did not pay or explicitly report paying participants. Of the 186 (58.9%) studies which did so, 12 (6.5%) did not explicitly state the amount paid, 71 studies (38.2%) paid participants a fixed sum of money and 103 (55.7%) varied the compensation offered. In those varying the compensation, some studies adhered to a payment schedule in line with study compliance (26,144,235), while other studies entered participants into a prize raffle (236–238). Most studies using EMA (*n*=43, 87.8%), experimental (*n*=38, 66.7%) and prospective diary (*n=66,* 81.5%*)* data collection methods paid participants.

Training

Eighty-nine studies (28.2%) reported training either participants (*n*=32, 10.1%), researchers (*n*=55, 17.4%) or both (*n*=2, 0.6%). Studies using experimental (*n*=12, 13.5%), field (*n*=12, 13.5%) and portal/intercept (*n*=17, 19.1%) data collection methods were more likely to report training researchers, whereas studies using EMA (*n*=20, 22.5%) and prospective diary methods (*n*=14, 15.7%) were more likely to train participants on using the mode of administration or on

how to comply with the protocol. The two studies requiring both participants and researchers to be trained used EMA methods (104,147).

Discussion

We identified and assessed the data collection techniques used to measure the contextual characteristics of drinking occasions. Eight different data collection techniques were identified within the existing literature. The most frequently used were single occasion recall, prospective diaries, and experimental designs, with administrative data used only in a few studies. Whilst a minority of studies used EMA, their use has markedly increased since 2014 (22) . The findings also suggest the data collection methods vary widely in their performance on key measures of reliability, validity, and feasibility. It is important to note that many of the papers did not explicitly report on these measures, which limits the extent to which each method can be evaluated. As such, no sole method can be recommended as the 'gold standard' within event-level data collection. Rather, the strengths and weaknesses of the methods and recommendations for their application are discussed below.

Reporting of compliance was particularly poor, with few studies giving response and attrition rates. Where strict compliance rates could be extracted or calculated, compliance varied significantly within methods, as evidenced by the high standard deviations in Table 2. Although studies using either experimental, portal/intercept, and specific occasion recall data collection methods had average strict compliance rates of over 90%, these studies were more likely to administer measures only once, and this may have made compliance more likely. However, a recent meta-analysis on compliance with EMA protocols within substance users conducted by Jones et al. (164) reported that the number of assessments per day did not influence pooled compliance. To improve compliance rates, researchers using EMA should consider offering substantial incentives and communicating the burden associated with the research protocol

clearly to participants prior to their involvement. In cases where attrition is high within studies, researchers should explicitly report attrition and consider following-up non-compliant respondents to find out why they dropped out from the study. Different sociodemographic groups are also likely to have different perceptions and responses to increased participant burden and researchers should consider the methods they use when targeting particular groups, as outlined in Table 3. For example, if the population of interest is older participants or participants with more competing demands (e.g. lower socioeconomic status (SES) or working parents) then a less burdensome method such as retrospective diaries may be more appropriate.

Papers explicitly reporting on reactivity, measurement error, and participant burden were scarce, with only one paper reporting participants to have experienced burden in relation to the method used (231). Methods such as EMA or daily diaries, which administered repeated measures or continuous measures throughout a study, were more likely to assess participant reactivity (153,222,223). Due to the scarcity of studies that explicitly reported these measures, we cannot offer any firm conclusions regarding the performance of each data collection technique. It is likely that many studies included will have experienced issues relating to participant burden, measurement error, and reactivity, but have not explicitly reported this.

Table 3: Methodological considerations and recommendations for future event-level alcohol research

	Reliability	*Validity of measures*	*Compliance*	*Participant Burden*	*Summary and recommendations*
EMA	Recall of drinking occasions was short, often in real-time or near real-time (past 60 minutes).	Validated scales were used in about 20% of studies, with abridged versions of scales chosen.	Low response rates. High attrition rates. Strict compliance below 80%.	Assessments were typically administered multiple times a day over the study period, with each assessment typically very quick to complete. Participants were often paid an amount of money dependent on their compliance and required training to participate in these studies.	EMA methods are suitable for capturing drinking occasions in real-time. Assessments using this method typically were the quickest to complete, however, this method also administered multiple assessment daily, with most studies requiring participants to undertake training. Therefore, participant burden can be considered high. Future research should consider developing and incorporating validated measures suitable for EMA methods. Given issues with compliance, participants should be paid adequately and have the time burden of studies explicitly explained to them.
Retrospective diaries	Recall of drinking occasions was typically up to a week after the event.	Some of these studies used validated event-level measures to capture drinking occasion characteristics, with abridged versions of scales often chosen.	Medium response rates. Low attrition rates. Strict compliance above 80%	Moderate time to complete Assessments were typically administered once, with average assessments taking under 15 minutes. Participants were often paid a fixed amount of money, with typically no training required.	Diary methods are suitable for capturing past drinking occasions. Studies using this method typically took less than 15 minutes to complete and were often only administered once, enacting a low participant burden. Aside from specific event recall, this method had the longest recall period from the 8 identified data collection techniques. Future retrospective drinking diary studies should carefully consider the length of recall used and use cues to aid recall such as dates and times of drinking events.

Prospective diary	Drinking occasions were typically recalled from the current day or previous day.	These studies were most likely to use validated event-level measures.	Medium response rates. High attrition. Strict compliance above 80%.	Assessments were typically administered once a day, with each assessment typically very quick to complete. Participants were often paid and required training to participate in these studies.	Prospective diary studies are suitable for capturing drinking occasions soon after they occur, but not while the individual is likely to be intoxicated. These studies typically had good response rates and strict compliance to protocol. Attrition rates were slightly higher than other techniques, potentially due to the amount of times assessments were administered. Most studies required participants to undertake training. Therefore, participant burden can be considered high. Given this, future research should ensure participants are paid adequately and have the time burden of studies explicitly explained to them.
Experimental	Drinking occasions were typically captured in real-time.	Validated measures tended to be used within experimental studies, often within controlled laboratory environments.	Highest response rates. Low attrition rates. Highest average strict compliance.	Assessments were typically administered once. These studies on average took the longest to collect data, taking over 1 hour. Most studies paid participants, with some studies requiring researchers to be trained.	Experimental data collection techniques are suitable for capturing drinking occasions within a controlled environment where researchers may wish to manipulate an aspect of the drinking occasion (e.g. mood). While studies using these methods typically used validated measures, these studies on average took the longest to complete, with studies on average taking over 1 hour to complete. Future experimental studies should be cautious of how much participant burden is enacted on participants. Within these studies a range of validated measures were used. While the use of validated measures is useful, researchers should

					be mindful of how many measures of drinking occasion characteristics are collected within these studies. Additionally, as drinking is occurring within a controlled environment, considerations of ecological validity should be given.
Field	Drinking occasions were typically captured in real-time.	Few of these studies used validated measures.	Poor response rates. Medium attrition rates. Strict compliance above 80%	Assessments were typically administered once. On average, studies took about 20 minutes to collect event-level data. Most studies did not pay participants, with some studies requiring researchers to be trained.	Field studies are suitable for capturing drinking occasions within a naturalistic environment. These studies typically capturing drinking occasions whilst the event was occurring, with data collection on average taking 20 minutes. However, as most methods used observation techniques, limited individual characteristics were collected within these studies, with a lack of validated measures used. Additionally, these methods typically had poor response rates, with participants often not paid. Future research should consider paying participants adequately for their time.
Intercept/Portal	Drinking occasions were typically captured in real-time or recalled from the previous evening.	Few of these studies used validated measures. When using validated measures, typically abridged measured were used.	Medium response rates. Highest average attrition rates. Strict compliance about 90%	Assessments were typically administered once or twice on the same evening whilst respondents were drinking. Participants typically not paid. Typically required researchers to be trained.	Intercept/Portal studies are suitable for capturing drinking occasions whilst they occur, with this method capable of capturing change within a drinking occasion. Whilst response rates and strict compliance within these studies are good, these studies typically experience the highest attrition. Additionally, participants are typically not paid, with researchers often trained in the data collection method.

					Future research should be cautious of the researcher burden enacted. To improve attrition rates, participants should be offered incentives to return to the study.
Specific Recall	Recall of drinking occasions was typically longer than other methods, with most studies capturing the event after one month has passed.	Few of these studies used validated measures.	Medium response rates. Average attrition below 1%. Strict compliance above 90%.	Assessments were primarily administered once, with assessments on average taking over 30 minutes to complete. Most studies did not pay participants.	Specific event-recall studies are suitable for capturing past drinking occasions where researchers want to study a specific phenomenon of interest (e.g. aggression in bars). These studies tended to have the lowest attrition rate, potentially due to most studies only measuring event-level data once. However, response rates tended to be quite low, with participants typically not paid and studies on average taking over 30 minutes. Future research should consider paying participants adequately for their time.
Administrative data	Depending on the type of administrative data, recall of drinking was typically up to a week.	None of these studies used validated measures.	High response rates. Lowest average attrition. Strict compliance below 80%.	Assessments were typically administered at one time point only. Participants were typically not paid and did not require training.	The use of administrative data to capture drinking occasions is suitable when resources to collect data are limited or when researchers need large sample sizes, given the high response rates. Given administrative data is typically collected as part of health questionnaires (e.g. A&E admission data), there is low participant burden associated with this method. However, administrative data is often secondary data, researchers have a lack of control on what contextual characteristics they can measure within these studies. Additionally, none of these

	studies in this review used validated event-level measures. Future research wanting to use administrative data should consider using an additional data collection technique in parallel (e.g. retrospective diaries or specific event-recall).

Strengths and limitations

This review is the first to evaluate the methodological considerations of data collection techniques identified by a systematic search of event-level alcohol research. The review was pre-registered prior to data analysis, and a subset of studies were checked by an independent assessor to ensure the inclusion and extraction of data was reliable. The search strategy used within this review was appropriately broad to enable the identification of papers across a highly heterogenous evidence base published in a wide range of disciplinary journals. However, the interdisciplinary nature of this topic means it is possible that some research was missed.

A key limitation of the review is that the population for most included studies comprised of young adult or student samples. Whilst this is not surprising given a large proportion of event-level research is conducted on alcohol consumption within younger populations, this lack of diversity may limit how generalizable the review's findings are to other populations, particularly as older populations may find complex protocols more burdensome (239). Finally, given that most papers did not explicitly report measures of reliability and participant burden, this review relies on proxy measures, such as recall periods and time taken to complete assessments, meaning these findings should be interpreted with caution.

Implications

Our review finds the event-level literature on alcohol drinking occasions provides little empirical evidence on the reliability, validity, and feasibility of its measures and data collection techniques. To permit future reviews to assess methodological strengths and limitations, researchers should aim to be more transparent on issues encountered when disseminating research. Specifically, we recommend including explicit measures of reactivity, measurement error, and participant burden when disseminating research findings from event level studies. Table 3 summarises the key methodological considerations and recommendations for future

event-level alcohol research arising from our analysis and will provide a useful framing for researchers to consider when implementing different methodologies. For example, given the issues outlined with compliance in EMA studies, the time burden should be outlined in advance and attractive financial incentives offered where possible when using EMA methods. Furthermore, within this review validated event-level measures were used in less than a third of the included literature, with a previous review finding a similar lack of validated event-level measures (214). This highlights the importance of developing and validating measures for use in event-level alcohol research in the future.

Conclusion

This paper outlines the reliability, validity, and feasibility of eight data collection techniques used in event-level alcohol research. The literature is heterogeneous, with a lack of standardisation in the collection of event-level alcohol research. In assessing the studies on key measures of reliability, validity, and feasibility, no single approach was found to be methodologically superior, with high levels of variation both between and within methods. Studies using experimental data collection methods were found to have the highest average response rates, with studies utilising specific event-recall tending to have the lowest average attrition rates. In comparison, EMA methods tended to have both low average response rates and high attrition rates. Based on these findings, we outline methodological considerations and recommendations for future event-level research using the eight identified data collection techniques. However, key measures of reliability and validity were often underreported, and this limits our ability to evaluate each of the eight techniques fully. As such, we also outline several factors that future studies should explicitly measure and report to advance scientific research methods in this area such as reactivity, measurement error, and participant burden.

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5.2 Supplementary Material

S1 – Search strategy used in the Mapping review by Stevely et al. (2019)

Concept	Search terms		
Alcohol consumption (.mp.) (TS & TI)	bing* adj3 (drink* or consum* or intoxicat*)	alcohol* adj3 (drink* or consum* or intoxicat* or related)	heavy adj3 drink* (alcoholic beverage*) alcohol-related
Alcohol consumption MEDLINE	exp Alcohol Drinking/		
Alcohol consumption PsycInfo	exp Alcohol drinking attitudes/	exp Alcohol drinking patterns/ exp binge drinking/	exp drinking behavior/ exp social drinking/
Occasion-based research (.af.) (TS & TI)	ema ecological momentary assessment experience sampling diary diaries event-level event level drink* adj2 event* event-specific event specific event-contingent event contingent referral event occasion-based occasion based drink* practi?e*	practi?e theor* theor* of practi?e* (element* adj2 practi?e*) (recent* adj2 occasion) (recent* adj2 occasions) recent* adj2 event last adj2 occasion last adj2 occasions last adj2 event barroom bar-room bar room experimental setting experimental condition	icat (adj assessment) text message* portal survey rhdo ivr (interactive voice response) daily survey* handheld assessment tool* daily retrospective daily process realtime real time real-time daily account*
Contextual characteristics (.mp.) (TS & TI)	cocaine crack cocaine cannabis hashish marijuana cannabinoids (tetrahydrocannabinol) heroin ecstasy XTC amphetamines speed GHB MDMA	cider* alcopop* premixed pre-mixed pre mixed rtd* ready-to-drink* ready to drink* (flavoured alcoholic beverage*) (flavored alcoholic beverage*) drink* adj3 (motive* or	urge desire (pre-loading and alcohol) (pre-loading and drinking) (front-loading and alcohol) (front-loading and drinking) (drinking before drinking) intention* social interaction* social support

	venue* location* barroom bar-room bar* home pub restaurant* street drink* nightclub club hotel tavern* bottle store* wine shop* shebeen* company companion* peer* friend* colleague* family partner wife husband spouse parent* beverage choice* beverage preference* beverage type* beverage-type* drink choice* drink type* drink-type wine* spirits beer*	motivation* or meaning* or expect?nc* or reason*) alcohol* adj3 (motive* or motivation* or meaning* or expect?nc* or reason*) day of the week Monday* Tuesday* Wednesday* Thursday* Friday* Saturday* Sunday* weekend* week-end* week end start-time start time duration night-time night time day-time day time daytime meal time* meal-time* mealtime* drink* adj3 mood alcohol adj3 mood stress affect anxiety craving	(subjective intoxication) subjective effect* (subjective experience*) (perceived intoxication) occasion adj3 type (occasion adj3 reason) party adj3 type party adj3 reason social purpose (purpose adj3 occasion) year* holiday* birthday* semester* gender composition gender ratio sex composition sex ratio male only female only mixed sex mixed gender football rugby rowing match day* sport* patron age patron sex patron ethnicity patron race drinking game*
Contextual characteristics – situation (.mp.) (TS & TI)	dancing crowd* buy* adj3 round* facilities lighting atmosphere	Music volume loud discount* offer* promotion*	marketing advertising BOGOF drink* adj3 free alcohol* adj3 free
Exclusions for: MEDLINE	Therapeutics/ Psychotherapy/ Intervention.ti.	Brief intervention.ab.	Effectiveness.ti.
PsycInfo	Treatment/ Psychotherapy/	Brief intervention.ab.	Effectiveness.ti.

	Intervention.ti.
SSCI (TS & TI)	intervention effectiveness

S2 - Summary table of included studies (N=316)

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
EMA						
Griffin (240)	2021	Ecological Momentary Assessment	Physiological Measures Smartphone Application	General/Healthy Adult	United States	Number of standard drinks consumed
Labhart (241)	2021	Ecological Momentary Assessment	Smartphone Application	Young Adults	Switzerland	Number of drinks consumed
Labhart (220)	2020	Ecological Momentary Assessment	Smartphone Application	Young Adults	Switzerland	Number of drinks consumed
Xu (242)	2020	Ecological Momentary Assessment	Smartphone Application	Adults using stimulants with HIV	United States	Alcohol consumed: yes or no
Stevenson (243)	2019	Ecological Momentary Assessment	Handheld Computer	Students	United States	Number of drinks consumed
Groefsema (144)	2019	Ecological Momentary Assessment	Online Text-Message	Young Adults	The Netherlands	Number of drinks consumed
Jones (244)	2018	Ecological Momentary Assessment	Laboratory-based Questionnaires Smartphone Application	Risky Drinkers	England	Units of alcohol consumed
Simons (245)	2018	Ecological Momentary Assessment	Handheld Computer	Young Adults	United States	Number of drinks consumed eBAC (Matthews and Miller (246))
Bae (247)	2017	Ecological Momentary Assessment	Text-Message Smartphone Application	Young adult heavy drinkers	United States	Quantity of alcohol consumed
Clapp (158)	2017	Ecological Momentary Assessment	Physiological Measures Text-Message Online	Students	United States	Number of standard drinks consumed
Goodman (248)	2017	Ecological Momentary Assessment	Online	Students	United States	Number of drinks consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Labhart (18)	2017	Ecological Momentary Assessment	Smartphone Application Online	Young Adults	Switzerland, Lausanne and Zurich	Number of drinks consumed
Thrul (19)	2017	Ecological Momentary Assessment	Online Text-message	Students	Switzerland	Number of drinks consumed
Dvorak (146)	2016	Ecological Momentary Assessment	Handheld Computer Laboratory-based Questionnaires	Students	United States	Number of drinks consumed
Groefsema (219)	2016	Ecological Momentary Assessment	Online Text-Message	Young Adults	The Netherlands	Number of drinks consumed
Patrick (249)	2016	Ecological Momentary Assessment	Telephone Interactive Voice Response	Students	United States	Number of standard drinks consumed
Simons (250)	2016	Ecological Momentary Assessment	Handheld Computer	Students	United States	Number of drinks consumed eBAC (Matthews and Miller (246))
Thrul (106)	2016	Ecological Momentary Assessment	Online Text-message	Students	Switzerland	Number of drinks consumed
Kuntsche (251)	2015	Ecological Momentary Assessment	Text-Message Online	Students	Switzerland	Number of drinks consumed
Mohr (252)	2015	Ecological Momentary Assessment	Handheld Computer	Risky Drinkers	United States	Number of standard drinks consumed
Peacock (225)	2015	Ecological Momentary Assessment	Smartphone Application	Young Adults	Australia	Number of drinks consumed
Thrul (253)	2015	Ecological Momentary Assessment	Smartphone Application Online	Students	Switzerland	Number of drinks consumed
Dvorak (27)	2014	Ecological Momentary Assessment	Handheld Computer Online	Students	United States	Number of drinks consumed
Dvorak (151)	2014	Ecological Momentary Assessment	Handheld Computer Laboratory-based Questionnaires	Student risky drinkers	United States	Number of drinks consumed
Goldstein (147)	2014	Ecological Momentary Assessment	Handheld Computer	Young Adults	Canada	Mean number of drinks consumed per occasion

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Labhart (254)	2014	Ecological Momentary Assessment	Text-Message Online	Students	Switzerland	Number of standard drinks consumed
Labhart (255)	2014	Ecological Momentary Assessment	Text-Message Online	Students	Switzerland	Number of standard drinks consumed
Piasecki (226)	2014	Ecological Momentary Assessment	Handheld Computer Laboratory-based Questionnaires	General/Healthy Adult	United States	Number of drinks consumed eBAC (Matthews and Miller (246))
Simons (221)	2014	Ecological Momentary Assessment	Handheld Computer	Students	United States	Number of drinks consumed
Kuntsche (156)	2013	Ecological Momentary Assessment	Online Text-Message	Students	Switzerland	Number of drinks consumed
Labhart (97)	2013	Ecological Momentary Assessment	Text-Message Online	Young Adults	Switzerland	Number of standard drinks consumed
Kuntsche (145)	2012	Ecological Momentary Assessment	Online Text-Message	Students	Switzerland	Number of drinks consumed
Witkiewitz (227)	2012	Ecological Momentary Assessment	Online Web-enabled mobile phone	Student smokers	United States	Number of drinks consumed
Ray (228)	2010	Ecological Momentary Assessment	Handheld Computer	Risky Drinkers	United States	Number of drinks consumed eBAC
Simons (152)	2010	Ecological Momentary Assessment	Handheld Computer Online	Students	United States	Number of drinks consumed eBAC (Matthews and Miller (246))
Schroder (256)	2009	Ecological Momentary Assessment	Telephone Interactive Voice Response	Students	United States	Was alcohol consumed? (Yes/ No)
Armeli (149)	2007	Ecological Momentary Assessment	Handheld Computer Paper and Pen Survey	Risky Drinkers	United States	Number of standard drinks
Todd *(Study 2)* (257)	2003	Ecological Momentary Assessment	Handheld Computer	General/Healthy Adult	United States	Number of standard drinks consumed
Swendsen (104)	2000	Ecological Momentary Assessment	Handheld Computer Paper and Pen Survey	General/Healthy Adult	United States	Number of standard drinks consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Prospective Diary						
Gunn (229)	2018	Prospective Diary	Online	Students	United States	Number of standard drinks consumed Length of time spent drinking eBAC (Matthew and Miller (246))
Kilwein (258)	2018	Prospective Diary	Online	Students	United States	Number of drinks consumed (DDQ; Collins, Parks and Marlatt, 1985)
Braitman (259)	2017	Prospective Diary	Online	Students	United States	Number of daily standard drinks consumed
Bryan (260)	2017	Prospective Diary	Online	Adult Female	United States	Estimated number of drinks consumed eBAC (Matthews and Miller (246))
Fiala (261)	2017	Prospective Diary	Face To Face Interview	General/Healthy Adult	Czech Republic	Number of alcohol units per occasion
Mallett (262)	2017	Prospective Diary	Online	Students	United States	Was alcohol consumed? (Yes/No)
Merrill (263)	2017	Prospective Diary	Online	Students	United States	Number of standard drinks consumed
Mustonen (69)	2016	Prospective Diary	Face to Face Interview	General/Healthy Adult	Finland	Estimated BAL (Widmark equation)
Connor (264)	2014	Prospective Diary	Online	Students	New Zealand	Number of standard drinks consumed
Kushnir (110)	2014	Prospective Diary	Telephone	General/Healthy Adult	Canada	Number of drinks consumed daily
Rowland (265)	2012	Prospective Diary	Paper and Pen Survey Postal	General/Healthy Adult	Australia	Number of standard drinks consumed
Buettner CK (266)	2011	Prospective Diary	Online	Students	United States	Number of drinks consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Kypri (117)	2010	Prospective Diary	Online	Students	New Zealand	Number of standard drinks consumed
Tremblay (267)	2010	Prospective Diary	Online	Students	Canada	Number of standard drinks consumed
Champion (268)	2009	Prospective Diary	Online	Students	United States	Number of drinking days
Lewis (108)	2009	Prospective Diary	Online	Students	United States	Number of standard drinks consumed
Heeb (269)	2008	Prospective Diary	Telephone Paper and Pen Survey	General/Healthy Adult	Switzerland	Number of standard drinks consumed
Lopes (270)	2008	Prospective Diary	Paper and Pen Survey Postal	Over 40's	Portugal	Number of drinks consumed
Kypri (72)	2007	Prospective Diary	Online	Students	New Zealand	Number of standard drinks consumed
Experimental						
Hershberger (271)	2021	Experimental	Laboratory-based questionnaires Taste Test	Adult Electronic Nicotine Delivery System Users	United States	Quantity of alcohol drunk (ml)
Oberlin (272)	2021	Experimental	Laboratory-based questionnaires Physiological measures	Adult Electronic Nicotine Delivery System Users	United States	BAC and subjective intoxication
Fairbairn (273)	2020	Experimental	Taste Test Laboratory-based questionnaires Observation	Young Adults	United States	BAC and subjective intoxication
Benitez (274)	2019	Experimental	Online Text Message	Students	United States	Number of drinks consumed
Koukounas (275)	2019	Experimental	Taste Test Laboratory-based questionnaires	General/Healthy Adult	Australia	Urge to drink
Tobias-Webb (276)	2019	Experimental	Taste Test Laboratory-based questionnaires	Male Students	United States	Units

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Bacon (136)	2018	Experimental	Taste Test Laboratory-based questionnaires	Students	United States	Amount consumed in taste rating task (ml)
Collins (277)	2018	Experimental	Laboratory-based questionnaires Taste Test	Students	Canada	Amount consumed in taste rating task (ml)
Field (278)	2017	Experimental	Laboratory-based Questionnaires Taste Test	Risky Drinkers	England	Amount consumed in taste rating task (ml)
Gullo (279)	2017	Experimental	Laboratory-based Questionnaires Taste Test	Young Adults	Australia	Amount consumed in taste rating task (ml)
Zaso (280)	2017	Experimental	Laboratory-based Questionnaires Taste Test	Young adult heavy drinkers	United States	Number of standard drinks consumed
Jones (138)	2016	Experimental	Taste Test	Students	England	Amount consumed in taste rating task (ml)
McGrath (281)	2016	Experimental	Laboratory-based Questionnaires Taste Test	University Students and staff	England	Quantity of beer consumed
Robinson *(Study 1)* (134)	2016	Experimental	Laboratory-based Questionnaires Taste Test	Students	England	Amount consumed in taste rating task (ml)
Robinson *(Study 2)* (134)	2016	Experimental	Laboratory-based Questionnaires Taste Test	Students	England	Amount consumed in taste rating task (ml)
Bacon (282)	2015	Experimental	Laboratory-based Questionnaires Taste Test Physiological Measures	Students	United States	Amount consumed in taste rating task (ml)
Dinc (283)	2015	Experimental	Laboratory-based Questionnaires Taste Test	Students	England	Amount consumed in taste rating task (ml)

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Beech (284)	2014	Experimental	Observation Taste Test Physiological Measures	General/Healthy Adult	United States	BrAC reading (Alco-Sensor IV)
Otten (285)	2014	Experimental	Observation Taste Test	Students	The Netherlands	Amount consumed in taste rating task (ml)
Thomas (112)	2014	Experimental	Laboratory-based Questionnaires Observation Physiological Measures Taste Test	General/Healthy Adult	United States	Quantity of alcohol consumed
Jones (286)	2013	Experimental	Laboratory-based Questionnaires Taste Test	Risky Drinkers	England	Amount consumed in taste rating task (ml)
Kuendig (287)	2013	Experimental	Taste Test	Young Adults	Switzerland	Pure ethanol consumed (g)
Engels (133)	2012	Experimental	Laboratory-based Questionnaires Observation Taste Test	Young Adults	The Netherlands	Quantity of drinks consumed
Kuntsche (288)	2012	Experimental	Online Taste Test	Young Adults	Switzerland	Amount consumed in taste rating task (ml)
Larsen *(Study 1)* (289)	2012	Experimental	Laboratory-based Questionnaires Observation Taste Test	Students	The Netherlands	Observed quantity of alcohol consumed
Larsen *(Study 2)* (289)	2012	Experimental	Laboratory-based Questionnaires Observation Taste Test	Students	The Netherlands	Observed quantity of alcohol consumed
Larsen *(Study 3)* (289)	2012	Experimental	Laboratory-based Questionnaires Observation	Students	The Netherlands	Observed quantity of alcohol consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
			Taste Test			
Wardell (290)	2012	Experimental	Laboratory-based Questionnaires Taste Test	Students	United States	Quantity of beer consumed Peak BAC
Kuendig (291)	2011	Experimental	Taste Test	Students	Switzerland	Pure ethanol consumed (g)
Larsen (292)	2010	Experimental	Taste Test Physiological Measures Laboratory-based Questionnaires Observation	Young Adults	The Netherlands	Quantity of alcoholic drinks consumed in a taste test (ml)
Larsen (135)	2009	Experimental	Taste Test Laboratory-based Questionnaires Observation	Young Adults	The Netherlands	Amount consumed in taste rating task (ml)
Corbin (293)	2008	Experimental	Laboratory-based Questionnaires Observation Taste Test Physiological Measures	Students	United States	Drinks consumed in taste test BAC (breathalyser)
MacKillop (294)	2006	Experimental	Laboratory-based Questionnaires Taste Test	Student risky drinkers	United States	Amount consumed in taste rating task (ml)
Nesic (139)	2006	Experimental	Laboratory-based Questionnaires Physiological Measures Taste Test	Risky Drinkers	England	Quantity of alcohol consumed Number of alcoholic units
Palfai (295)	2006	Experimental	Taste Test Observation Laboratory-based Questionnaires	Young adult heavy drinkers	United States	Amount consumed in taste rating task (ml)

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Colby (296)	2004	Experimental	Taste Test Laboratory-based Questionnaires Physiological Measures	Young smokers and risky drinkers	United States	Amount consumed in taste rating task (ml)
Caudill (103)	2001	Experimental	Taste Test Observation	Risky Drinkers	United States	BAC reading Amount consumed in taste rating task (ml)
Palfai (297)	2001	Experimental	Taste Test Observation Laboratory-based Questionnaires	Young adult heavy drinkers	United States	Amount consumed in taste rating task (ml)
Palfai (298)	2000	Experimental	Taste Test Laboratory-based Questionnaires	Smoking risky drinkers	United States	Amount consumed in taste rating task (ml)
Wolfe (299)	2000	Experimental	Laboratory-based Questionnaires Taste-Test	Students	United States	Amount consumed in taste rating task (ml)
Kidorf (300)	1999	Experimental	Laboratory-based Questionnaires Taste Test	Students	United States	Amount consumed in taste rating task (ml)
Samoluk (301)	1996	Experimental	Laboratory-based Questionnaires Taste Test	General/Healthy Adult	Canada	Number of drinks consumed BAL (Alco-Sensor III breathalyser)
Collins *(Study 1)* (302)	1985	Experimental	Laboratory-based Questionnaires Observation Taste Test	Male students who are risky drinkers	United States	Number of 330ml beer cans served Amount consumed (ml)
Collins *(Study 2)* (302)	1985	Experimental	Laboratory-based Questionnaires Observation Taste Test	Male students who are risky drinkers	United States	Number of 330ml beer cans served Amount consumed (ml)

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Babor *(Study 1)* (303)	1980	Experimental	Observation	General/Healthy Adult	United States	Number of drinks purchased in a bar
Caudill (304)	1975	Experimental	Face To Face Interview Observation Physiological Measures Taste Test	Male students who are risky drinkers	United States	BAL reading (breathalyser) Alcohol consumption (ml)
Higgins (305)	1975	Experimental	Taste Test Laboratory-based Questionnaires	Male students who are risky drinkers	United States	Amount consumed in taste rating task (ml)
Field						
Yao (306)	2018	Field	Physiological Measures Face To Face Interview	Drivers who experienced crashes	United States	BAC reading (breathalyser)
Croff (89)	2017	Field	Face To Face Interview	Students	United States	Number of drinks consumed BrAC (CMI Intoxilizer-400)
Giraldo (307)	2017	Field	Unknown	General/Healthy Adult	United States	BAC reading (breathalyser)
Giraldo (308)	2017	Field	Face To Face Interview Physiological Measures	General/Healthy Adult	United States	BAC reading (breathalyser)
Clapp (20)	2014	F ield	Paper and Pen Survey Observation	Students	United States	BrAC reading (breathalyser)
Ostergaard (309)	2014	Field	Face To Face Interview	Young Adults	United Kingdom	Number of standard drinks consumed
Ragsdale (310)	2012	Field	Face To Face Interview	Female students	United States	Number of drinks consumed
Thombs (311)	2009	Field	Face To Face Interview Physiological Measures	Students	United States	Number of drinks consumed BrAC (Alco-Sensor IV)
Clapp (25)	2008	Field	Face To Face Interview Observation	Students	United States	BrAC reading (breathalyser)

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
			Physiological Measures			
Knibbe (101)	1993	Field	Observation	Young Adults	The Netherlands	Drinking rate of one standard drink
van de Goor (166)	1990	Field	Observation	Young Adults	The Netherlands	Time taken to consumed one alcoholic drink
Babor *(Study 2)* (303)	1980	Field	Observation	General/Healthy Adult	United States	Number of drinks consumed
Recall of Specific Past Event/s						
Tanudjaja (312)	2020	Recall of Specific Past Event/s	Online	Students	Australia	Number of drinks and binge-drinking status
Curtis (313)	2019	Recall of Specific Past Event/s	Online	General/Healthy Adult	Australia	Alcohol consumed: Yes or No
Parry (314)	2019	Recall of Specific Past Event/s	Face to Face interview	General/Healthy Adult	South Africa	Type and size of primary alcohol
Wegner (315)	2019	Recall of Specific Past Event/s	Online	Male Students	United States	Number of drinks consumed
Madden (94)	2019	Recall of Specific Past Event/s	Online	Students	United States	Peak eBAC (Matthews and Miller formula, (246));
Fairlie (316)	2018	Recall of Specific Past Event/s	Online	Young Adults	United States	Number of drinks consumed
Dietze (93)	2017	Recall of Specific Past Event/s	Computer Assisted Phone call	Young adult heavy drinkers	Australia	Number of standard drinks consumed
Fillo (317)	2017	Recall of Specific Past Event/s	Online	Students	United States	Number of drinks consumed (DDQ; Collins, Parks and Marlatt, 1985)
Ford (318)	2017	Recall of Specific Past Event/s	Online	Female students	United States	Number of drinks consumed
Geisner (319)	2017	Recall of Specific Past Event/s	Online Email	Students	United States	Number of standard drinks consumed on 21st Birthday

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Lam (320)	2017	Recall of Specific Past Event/s	Online Face To Face Interview	Young adult heavy drinkers	Australia	Number of standard drinks consumed
Brown (321)	2016	Recall of Specific Past Event/s	Online	Young Women	United States	Number of drinks consumed
Diep (322)	2016	Recall of Specific Past Event/s	Paper and Pen Survey Classroom Questionnaire	Students	Vietnam	Number of standard drinks consumed
Miller (323)	2016	Recall of Specific Past Event/s	Online	Mandated college students	United States	Number of standard drinks consumed eBAC (Matthew and Miller formula (246))
Ogeil (324)	2016	Recall of Specific Past Event/s	Face To Face Interview Handheld Computer Paper and Pen Survey	Young adult heavy drinkers	Australia	Number of standard drinks consumed
Rodriguez (325)	2016	Recall of Specific Past Event/s	Online	Students	United States	Number of drinks consumed eBAC
Torronen (113)	2016	Recall of Specific Past Event/s	Unknown	General/Healthy Adult	Finland	Units of alcohol consumed eBAC (Widmark formula, (326))
Vallance (327)	2016	Recall of Specific Past Event/s	Face To Face Interview	Drug using population	Canada	Number of standard drinks consumed
Yurasek (328)	2016	Recall of Specific Past Event/s	Unknown	Mandated college students	United States	Number of drinks consumed eBAC (Matthews and Miller formula, (246))
Khurana (329)	2015	Recall of Specific Past Event/s	Online	Students	United States	Number of drinks consumed
Marzell (330)	2015	Recall of Specific Past Event/s	Unknown	Students	United States	Did students feel intoxicated

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Ahmed (236)	2014	Recall of Specific Past Event/s	Unknown	Students	United States	Modified Daily drinking questionnaire (Collins, Parks, Marlatt, (302))
Andreuccetti (331)	2014	Recall of Specific Past Event/s	Face To Face Interview	Alcohol-related A&E injured patients vs non-alcohol related controls	Latin American and Caribbean	Quantity of alcohol drunk (ml)
Callinan (332)	2014	Recall of Specific Past Event/s	Telephone	General/Healthy Adult	Australia	Number of standard drinks consumed
Cotti (70)	2014	Recall of Specific Past Event/s	Telephone	Risky Drinkers	United States	Quantity of alcohol drunk
Howells (333)	2014	Recall of Specific Past Event/s	Online	Female students	United States	Subjective ratings of intoxication
Kenney (334)	2014	Recall of Specific Past Event/s	Online	Students	United States	Number of drinks consumed (DDQ; Collins, Parks and Marlatt (302))
Lam (335)	2014	Recall of Specific Past Event/s	Online Face To Face Interview Paper and Pen Survey	Young Adults	Australia	Number of standard drinks consumed
McKetin (85)	2014	Recall of Specific Past Event/s	Online	Young Adults	Australia	Number of standard drinks
McKetin (336)	2014	Recall of Specific Past Event/s	Online	Young Adults	Australia	Quantity of alcohol consumed
Neighbors (109)	2014	Recall of Specific Past Event/s	Online	Students	United States	Number of drinks consumed Estimated BAC (Widmark equation, (326))
Hummer (337)	2013	Recall of Specific Past Event/s	Online	Student risky drinkers	United States	BAL (check how) Average drinks consumed Time spent drinking

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Kiene (338)	2013	Recall of Specific Past Event/s	Household Surveys Face To Face Interview	General/Healthy Adult	sub-Saharan Africa	Subjective reports of respondent or partner intoxication
Zamboanga (339)	2013	Recall of Specific Past Event/s	Online	Students	United States	Number of drinks consumed by location
Cherpitel (340)	2012	Recall of Specific Past Event/s	Face To Face Interview Laboratory-based Questionnaires	A&E patients	Canada	Number of drinks consumed
Brister (107)	2011	Recall of Specific Past Event/s	Laboratory-based Questionnaires	Students	United States	Number of drinks consumed eBAC estimated from questionnaire
Foster (341)	2011	Recall of Specific Past Event/s	Online	Students	United States	Consumption of 750ml of spirits
Cousins (342)	2010	Recall of Specific Past Event/s	Telephone	Young Adults	Ireland	Number of standard drinks consumed
Lewis (343)	2010	Recall of Specific Past Event/s	Online	Students	United States	Number of drinks consumed
Wei (344)	2010	Recall of Specific Past Event/s	Online	Students	United States	Number of standard drinks consumed eBAC (Matthews and Miller formula, (246))
McLean (345)	2009	Recall of Specific Past Event/s	Paper and Pen Survey	Alcohol-related A&E injured patients vs non-alcohol related controls	New Zealand	Number of standard drinks consumed
Mihic (346)	2009	Recall of Specific Past Event/s	Unknown	Students	Canada	Number of standard drinks consumed
LaBrie (347)	2008	Recall of Specific Past Event/s	Online	Students	United States	Number of drinks consumed BAL (Calculated using National Highway Traffic

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
						Safety Administration Formula)
Wells (348)	2008	Recall of Specific Past Event/s	Online	Students	Canada	Number of standard drinks consumed
Borsari (349)	2007	Recall of Specific Past Event/s	Paper and Pen Survey Face To Face Interview	Mandated college students	United States	BrAT reading (Breath Alcohol Kit)
Brown (350)	2007	Recall of Specific Past Event/s	Face To Face Interview Paper and Pen Survey	Students	United States	Number of drinks consumed
Collins (79)	2007	Recall of Specific Past Event/s	Face To Face Interview Laboratory-based Questionnaires	Young women who were involved in an aggressive incident in a bar	United States	Number of drinks consumed
Naimi (351)	2007	Recall of Specific Past Event/s	Telephone	Risky Drinkers	United States	Number of drinks consumed
Paschall MJ (352)	2007	Recall of Specific Past Event/s	Online Paper and Pen Survey	Students	United States	Number of drinks consumed
Clapp (71)	2006	Recall of Specific Past Event/s	Telephone	Students	United States	Number of drinks consumed
Watt (353)	2004	Recall of Specific Past Event/s	Face To Face Interview Physiological Measures	Alcohol-related A&E injured patients vs population controls	Australia	Number of drinks consumed BAC (Draeger Alcotest 7410)
Clapp *(Study 1)* (354)	2003	Recall of Specific Past Event/s	Telephone	Students	United States	Number of standard drinks consumed
Clapp *(Study 2)* (354)	2003	Recall of Specific Past Event/s	Telephone	Students	United States	Number of drinks consumed Subjective intoxication rating

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Leonard (355)	2003	Recall of Specific Past Event/s	Telephone Laboratory-based Questionnaires Face To Face Interview	Young men who were involved in an aggressive incident in a bar	United States	How many drinks consumed Subjective intoxication rating
Træen (356)	2003	Recall of Specific Past Event/s	Face To Face Interview Telephone Postal	General/Healthy Adult	European countries	Quantity of alcohol consumed Subjective ratings of intoxication
Abbey (357)	2001	Recall of Specific Past Event/s	Laboratory-based Questionnaires Paper and Pen Survey	Male Students	United States	Number of drinks consumed prior to consensual sexual intercourse
Clapp (358)	2001	Recall of Specific Past Event/s	Telephone	Students	United States	Number of drinks consumed
Clapp (118)	2000	Recall of Specific Past Event/s	Telephone	Students	United States	Number of drinks consumed
Cherpitel (359)	1999	Recall of Specific Past Event/s	Face To Face Interview	A&E patients	Canada	Number of drinks consumed
Gruenewald (82)	1999	Recall of Specific Past Event/s	Physiological Measures Administrative Records (Medical)	Drivers who experienced crashes	Australia	Bar sales of pure ethanol (g) BAC reading (breathalyser)
Jih (360)	1995	Recall of Specific Past Event/s	Paper and Pen Survey	Students	United States	Number of drinks consumed
Lang (74)	1995	Recall of Specific Past Event/s	Household Surveys Face To Face Interview	General/Healthy Adult	Australia	Number of drinks consumed
Aberg (361)	1993	Recall of Specific Past Event/s	Postal Paper and Pen Survey	Adult male	Sweden	Perceived intoxication
Stockwell (362)	1993	Recall of Specific Past Event/s	Household Surveys Face to Face Interview	General/Healthy Adult	Australia	Heavy alcohol consumption? (Yes/No)

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Temple (363)	1993	Recall of Specific Past Event/s	Household Surveys Face to Face Interview	General/Healthy Adult	United States	Quantity of alcohol consumed
Temple (364)	1992	Recall of Specific Past Event/s	Face To Face Interview	General/Healthy Adult	United States	Quantity of alcohol consumed
Kraft (365)	1991	Recall of Specific Past Event/s	Paper and Pen Survey Postal	Young Adults	Norway	If alcohol was consumed prior to intercourse (Yes/No)
Harford (100)	1983	Recall of Specific Past Event/s	Household Surveys	General/Healthy Adult	United States	Number of standard drinks consumed
Portal/Intercept						
Fung (366)	2021	Portal	Handheld Computer Physiological Measures	General/Healthy Adult	Brazil	Number of drinks consumed EBAC/BAC
Bourdeau (154)	2017	Portal	Handheld Computer Smartphone Application	General/Healthy Adult	United States	BAC reading (Intoxilizer 400PA)
Durbeej (367)	2017	Portal	Face To Face Interview Physiological Measures	General/Healthy Adult	Sweden	BAC reading Number of drinks consumed
Wagner (368)	2017	Portal	Face To Face Interview Handheld Computer Physiological Measures	People who drove to the nightclub	Brazil	BrAC (Draeger Alcotest 7410)
Miller (369)	2015	Portal	Face To Face Interview Administrative Records (Medical)	Alcohol-related A&E injured patients	Australia	Number of standard drinks consumed
Pennay (168)	2015	Portal	Face To Face Interview Smartphone Application Physiological Measures	General/Healthy Adult	Australia	Number of drinks consumed BAC
Santos (98)	2015	Portal	Face To Face Interview Handheld Computer Physiological Measures	General/Healthy Adult	Brazil	Number of standard drinks consumed BrAC (Draguer Alcotest 7410 breathalyser)
Santos (370)	2015	Portal	Face To Face Interview Handheld Computer	General/Healthy Adult	Brazil	Number of standard drinks consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
			Physiological Measures			BrAC by Draguer Alcotest 7410 breathalyser
Wells (172)	2015	Portal	Face To Face Interview Physiological Measures Online	Young Adults	Canada	Number of standard drinks consumed BrAC (Intoxlyzer-CMI)
Dumas (371)	2014	Portal	Face To Face Interview	Young Adults	Canada	BAC reading Number of drinks consumed
Graham (81)	2014	Portal	Face To Face Interview Physiological Measures Online	Young Women	Canada	Number of standard drinks consumed
Lubman (169)	2014	Portal	Face To Face Interview Smartphone Application	Young Adults	Australia	Number of drinks consumed BAC (Calculated?)
McClatchley (372)	2014	Portal	Face To Face Interview	General/Healthy Adult	England	Units of alcohol consumed
Quigg Z (73)	2013	Portal	Face To Face Interview Physiological Measures	Students	United Kingdom	Number of drinks consumed BAC (Lion 500 alcometer)
Dodd (373)	2012	Portal	Face To Face Interview	General/Healthy Adult	United States	Number of drinks consumed BrAC reading (Alco-Sensor IV)
Reed (171)	2011	Portal	Face To Face Interview Paper and Pen Survey Physiological Measures	General/Healthy Adult	United States	Number of drinks consumed BrAC
Rossheim (374)	2011	Portal	Face To Face Interview Physiological Measures	General/Healthy Adult	United States	Number of drinks consumed BrAC (handheld device)

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Thombs (375)	2011	Portal	Face To Face Interview Physiological Measures	General/Healthy Adult	United States	Number of drinks consumed BrAC (Alco-Sensor IV)
Thombs (376)	2011	Portal	Face To Face Interview Physiological Measures	Students	United States	Number of drinks consumed BrAC (Alco-Sensor IV)
Thombs (377)	2009	Portal	Face To Face Interview Physiological Measures	Students	United States	Number of drinks consumed BrAC (Alco-Sensor IV)
Thombs (378)	2009	Portal	Face To Face Interview Physiological Measures	Students	United States	Number of drinks consumed BrAC (Alco-Sensor IV)
Thombs (175)	2008	Portal	Observation Face to Face Interview	Students	United States	Number of drinks consumed BrAC (Alco-Sensor IV)
Watt (379)	2006	Portal	Face To Face Interview Physiological Measures	Alcohol-related A&E injured patients vs non-alcohol related controls	Australia	Number of drinks consumed BAC (Draeger Alcotest 7410)
Routine						
Griffin (380)	2017	Routine	Administrative Records (Medical)	General/Healthy Adult	Ireland	BAL (breathalyser) Number of standard drinks
Retrospective Diary						
Linden-Carmichael (381)	2021	Retrospective Diary	Online Email	Young Adult Heavy Drinkers	United States	Number of standard drinks consumed
Mackinnon (382)	2019	Retrospective Diary	Online	Young Adults	Canada	Number of standard drinks consumed
Mallard (383)	2019	Retrospective Diary	Online	Young Adults	United States	Number of drinks consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Sheehan (384)	2019	Retrospective Diary	Online	Students	Unites States	Number of drinks consumed
Turner (385)	2019	Retrospective Diary	Online	Male Students	United States	Number of drinks consumed
Greene (386)	2018	Retrospective Diary	Online	Students	United States	Number of alcoholic drinks consumed Binge drinking status
Lau-Barraco (235)	2018	Retrospective Diary	Online	Young Adults	United States	Number of standard drinks consumed
Linden-Carmichael (230)	2018	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed
Riley (387)	2018	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed
Laws (148)	2017	Retrospective Diary	Smartphone Application	General/Healthy Adult	United States	Number of drinks consumed
Martel (388)	2017	Retrospective Diary	Online Physiological Measures	Female students	United States	Number of units in past 24 hours
Peltz (389)	2017	Retrospective Diary	Email Online	Young Adults	United States	Number of standard drinks consumed
Russell (390)	2017	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed
Stevens (391)	2017	Retrospective Diary	Online	Young adult heavy drinkers	United States	Number of drinks consumed
Shorey (127)	2016	Retrospective Diary	Online	Female students	United States	Number of standard drinks consumed
Wymond (392)	2016	Retrospective Diary	Online	General/Healthy Adult	Australia	Number of standard drinks consumed
Fairlie (249)	2015	Retrospective Diary	Online	Students	United States	Number of alcoholic drinks consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
						eBAC (Matthews and Miller formula, (246))
Howard (393)	2015	Retrospective Diary	Online Email	Students	United States	Number of standard drinks consumed
Huh (394)	2015	Retrospective Diary	Handheld Computer	Female students	United States	Number of standard drinks consumed
Kerr (395)	2015	Retrospective Diary	Online Email	Students	United States	Number of drinks consumed daily
Liang (396)	2015	Retrospective Diary	Online Face To Face Interview	General/Healthy Adult	United States	Pure alcohol consumed (g)
O'Hara (397)	2015	Retrospective Diary	Online	African American Students	United States	Number of standard drinks consumed
Sacco (231)	2015	Retrospective Diary	Face to Face Interview Telephone	Older Adults	United States	Number of standard drinks consumed
Boynton (398)	2014	Retrospective Diary	Online	General/Healthy Adult	United States	Number of standard drinks consumed
O'Hara (399)	2014	Retrospective Diary	Online	African American Students	United States	Number of standard drinks consumed
O'Hara (62)	2014	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed
Shorey (400)	2014	Retrospective Diary	Online	Female students	United States	Number of standard drinks consumed
Fazzino (401)	2013	Retrospective Diary	Telephone Interactive Voice Response	Risky Drinkers	United States	Number of standard drinks consumed
Cullum (402)	2012	Retrospective Diary	Online	Students	United States	Number of drinks consumed
O'Grady *(Study 1)* (237)	2012	Retrospective Diary	Handheld Computer	General/Healthy Adult	United States	Number of drinks consumed
O'Grady *(Study 2)* (237)	2012	Retrospective Diary	Online	General/Healthy Adult	United States	Number of drinks consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Parks (403)	2012	Retrospective Diary	Telephone Interactive Voice Response	Young Women	United States	Number of drinks consumed
Quinn (222)	2012	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed eBAC (Matthews and Miller, 1979)
Aldridge-Gerry (404)	2011	Retrospective Diary	Online	Students	United States	Number of standard drinks
O'Grady (121)	2011	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed
O'Grady (405)	2011	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed
Parks (406)	2011	Retrospective Diary	Telephone Interactive Voice Response Face To Face Interview	Young Women	United States	Number of drinks consumed Subjective ratings of intoxication
Quinn (407)	2011	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed and eBAC (Matthews and Miller formula (246))
Armeli (68)	2010	Retrospective Diary	Online	Students	United States	Number of Standard drinks
Butler (238)	2010	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed
Cullum (408)	2010	Retrospective Diary	Online Email	Students	United States	Number of standard drinks consumed
Fromme (409)	2010	Retrospective Diary	Online	Students	United States	Number of drinks consumed
Kuntsche (410)	2010	Retrospective Diary	Text-Message Online	Young Adults	Switzerland	Number of standard drinks consumed
Dehart T (411)	2009	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Grant (61)	2009	Retrospective Diary	Online	Students	Canada	Number of evening drinks consumed
DeHart (412)	2008	Retrospective Diary	Handheld Computer Paper and Pen Survey Postal	Risky Drinkers	United States	Number of standard drinks consumed
Grzywacz (413)	2008	Retrospective Diary	Telephone	General/Healthy Adult	United States	Number of binge drinking episodes
Leigh (414)	2008	Retrospective Diary	Paper and Pen Survey Telephone	Students	United States	Number of drinks consumed
Jones (415)	2007	Retrospective Diary	Paper and Pen Survey	General/Healthy Adult	England	Units of alcohol consumed
Schroder (223)	2007	Retrospective Diary	Telephone Interactive Voice Response	General/Healthy Adult	United States	Number of standard drinks consumed
Helzer (416)	2006	Retrospective Diary	Telephone Interactive Voice Response Face To Face Interview	At risk male drinkers	United States	Number of drinks consumed
Armeli (417)	2005	Retrospective Diary	Online	Students	United States	Number of Standard drinks
Mohr (418)	2005	Retrospective Diary	Online	Students	United States	Number of drinks consumed
Neal (419)	2005	Retrospective Diary	Paper and Pen Survey	Students	United States	Number of standard drinks consumed
De Castro (420)	2004	Retrospective Diary	Paper and Pen Survey	General/Healthy Adult	United States	Quantity of alcohol drunk consumed
Park (421)	2004	Retrospective Diary	Online	Students	United States	Number of standard drinks consumed
Perrine (422)	2004	Retrospective Diary	Interactive Voice Response Face to Face Interview	General/Healthy Adult	United States	Number of standard drinks consumed
Todd *(Study 1)* (257)	2003	Retrospective Diary	Paper and Pen Survey Postal	General/Healthy Adult	United States	Number of standard drinks consumed
Armeli (423)	2000	Retrospective Diary	Paper and Pen Survey	General/Healthy Adult	United States	Number of Standard drinks

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Carney (424)	2000	Retrospective Diary	Postal Paper and Pen Survey	General/Healthy Adult	United States	Number of standard drinks consumed
Parks (80)	2000	Retrospective Diary	Face To Face Interview Paper and Pen Survey Postal	Adult Female	United States	Number of drinks consumed Subjective ratings of intoxication
Jula (425)	1999	Retrospective Diary	Paper and Pen Survey	General/Healthy Adult	Finland	Number of drinks consumed
Steptoe (426)	1999	Retrospective Diary	Paper and Pen Survey	General/Healthy Adult	England	Units of alcohol consumed
Cherpitel (427)	1998	Retrospective Diary	Face To Face Interview Handheld Computer	Experienced a skiing injury vs controls	United States	Quantity of alcohol consumed
Walmsley (428)	1998	Retrospective Diary	Face To Face Interview Physiological Measures	Older Adults	Britain	Number of alcoholic drinks consumed
Searles (429)	1995	Retrospective Diary	Telephone Interactive Voice Response	Adult male	United States	Number of drinks consumed
O'Callaghan (430)	1992	Retrospective Diary	Unknown	Students	Australia	Number of drinks consumed
De Castro (431)	1990	Retrospective Diary	Paper and Pen Survey	General/Healthy Adult	United States	Quantity of alcohol drunk consumed
Griffin (432)	1987	Retrospective Diary	Paper and Pen Survey Physiological Measures	Female Marijuana users	United States	Quantity of alcohol consumed
Diary and EMA						
Stevens (433)	2021	EMA Diary	Online Smartphone Application	Students	United States	Type and size of alcohol
Stevens (434)	2021	Diary EMA	Online	General/Healthy Adult	United States	Type and size of alcohol
Diary and Experimental						

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Acuff (435)	2021	Diary Experimental	Online	General/Healthy Adult	United States	Number of standard drinks consumed
Diary and Recall of Specific Event						
Williams (436)	2011	Recall of Specific Past Event/s Diary	Face To Face Interview Administrative Records (Medical)	A&E patients	Australia	Number of drinks consumed
Diary and Retrospective Diary						
Riordan (437)	2015	Retrospective Diary Diary	Face to Face Interview Paper and Pen Survey Text-Message	Students	New Zealand	Number of standard drinks consumed
McCabe (438)	2013	Retrospective Diary Diary	Online	Students	United States	Number of standard drinks per day
Kiene (439)	2009	Retrospective Diary Diary	Online	Students	United States	Number of standard drinks consumed
Diary and Routine						
Foster (440)	2015	Diary Routine	Administrative Records (Medical)	Young Men	Switzerland	Number of standard drinks consumed
Wood (120)	2007	Diary Routine	Online Paper and Pen Survey	Students	United States	Number of standard drinks consumed
Gmel (441)	2005	Diary Routine	Telephone Paper and Pen Survey	General/Healthy Adult	Switzerland	Number of drinks consumed Pure ethanol consumed (g)
Makela (442)	2005	Diary Routine	Face To Face Interview	General/Healthy Adult	Finland	Number of drinks consumed
EMA and Experimental						
Devenney (443)	2019	Ecological Momentary Assessment Experimental	Physiological Measures Smartphone Application	General/Healthy Adult	Northern Ireland	Number of drinks consumed

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Fairbairn (153)	2018	Ecological Momentary Assessment Experimental	Physiological Measures Smartphone Application Laboratory-based Questionnaires	Risky Drinkers	United States	Number of standard drinks Transdermal alcohol concentration
EMA and Retrospective Diary						
Norman (444)	2020	Retrospective Diary Ecological Momentary Assessment	Physiological Measures Smartphone Application Face to face interview	General/Healthy Adult	Australia	Number of drinking and TAS
Strahler (445)	2020	Retrospective Diary Ecological Momentary Assessment	Handheld Computer	General/Healthy Adult	Germany	Number of drinks consumed
Fairbairn (446)	2019	Retrospective Diary Ecological Momentary Assessment	Physiological Measures Smartphone Application	Risky drinkers	United States	Number of drinks and TAS
Wray (447)	2019	Retrospective Diary Ecological Momentary Assessment	Smartphone Application	Men who have Sex with Men	United States	Number of standard drinks consumed
Joyce (448)	2017	Retrospective Diary Ecological Momentary Assessment	Smartphone Application Online	Adult Female	Canada	Number of drinks consumed
Smit (67)	2015	Ecological Momentary Assessment Retrospective Diary	Online Email	Young Adults	The Netherlands	Number of drinks consumed
Mohr (449)	2001	Ecological Momentary Assessment Retrospective Diary	Handheld Computer Paper and Pen Survey	Risky Drinkers	United States	Number of drinks consumed
Experimental and Field						
Guéguen (76)	2008	Experimental Field	Observation	Adult male	France	Number of drinks ordered
Guéguen (78)	2004	Experimental Field	Observation	General/Healthy Adult	France	Number of drinks ordered

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
Wigmore (450)	1991	Experimental Field	Laboratory-based Questionnaires Observation Taste Test Physiological Measures	Male students who are risky drinkers	Canada	Quantity of beer consumed
Strickler (141)	1979	Experimental Field	Taste Test Observation	Male students who are risky drinkers	United States	Quantity of alcohol consumed and sip rate
Experimental and Recall of Specific Event						
Wetherill (451)	2009	Recall of Specific Past Event/s Experimental	Laboratory-based Questionnaires Paper and Pen Survey	Students	United States	Number of drinks consumed eBAC (Matthews and Miller formula, (246))
Experimental and Retrospective Diary						
Hamilton (452)	2017	Experimental Retrospective Diary	Laboratory-based Questionnaires Email	Students	United States	Number of standard drinks consumed
Field and Portal						
Devilly (Study 2) (453)	2019	Field Portal	Observation Physiological Measures	General/Healthy Adult	Australia	Number of drinks consumed and EBAC/BAC
Devily (Study 3) (453)	2019	Field Portal	Observation Physiological Measures	General/Healthy Adult	Australia	Number of drinks consumed and EBAC/BAC
Bourdeau (454)	2015	Field Portal	Face To Face Interview Handheld Computer Physiological Measures	General/Healthy Adult	United States	BAC reading (Intoxilizer 400PA)
Barry (176)	2014	Field Portal	Face To Face Interview Physiological Measures	General/Healthy Adult	United States	BrAC reading (Alco-Sensor IV)
Byrnes (455)	2014	Field Portal	Observation Physiological Measures	General/Healthy Adult	United States	BAC reading: (Intoxilizer 400PA)
Carlini (77)	2014	Field Portal	Observation Face to Face Interview	General/Healthy Adult	Brazil	BAC reading

Author	(Year)	Method(s)	Mode(s)	Population	Country	Event-level Alcohol consumption measures
			Physiological Measures			(Drager Alcohol test 7410)
Barry (174)	2013	Field Portal	Face To Face Interview Physiological Measures	Students	United States	BrAC reading (Alco-Sensor IV)
Bellis MA (456)	2010	Field Portal	Face To Face Interview Physiological Measures	General/Healthy Adult	England	Amount consumed in taste rating task (ml)
Clapp (75)	2009	Field Portal	Observation Face To Face Interview Physiological Measures	General/Healthy Adult	United States	BrAC reading (CMI Intoxlyzer SD-400)
Field and Recall of Specific Event						
Leavens (457)	2019	Recall of Specific Past Event/s Field	Online Face to Face Interview Over the telephone Physiological Measures	General/Healthy Adult	United States	Number of drinks consumed EBAC/BAC
Clapp (90)	2008	Recall of Specific Past Event/s Field	Online	Students	United States	Quantity of alcohol consumed
Field and Retrospective Diary						
Ostergaard (458)	2014	Field Retrospective Diary	Face To Face Interview Paper and Pen Survey Online Text-Message	Young Adults	England and Denmark	Number of standard drinks consumed

6. Identifying the key contextual characteristics of heavy drinking occasions: A qualitative content analysis of online alcohol support discussion forums

This chapter presents research currently under review at Drug and Alcohol Review. As this chapter is intended as a standalone publication, this chapter may repeat information included in previous chapters. The previous chapter (chapter five) evaluated the methods used to measure drinking contexts. This chapter builds on that by examining which contextual factors should be measured within a drinking survey. Thus, chapter five reviewed the data collection techniques used to measure characteristics in both lighter and heavier drinking occasion, whereas this chapter exclusively focuses on identifying the key contextual characteristics of HDOs. Given that HDOs and the increased consumption of alcohol are linked to a range of negative consequences, it was felt that exclusively focusing on HDOs within this chapter was appropriate.

The work presented in this chapter identifies the most mentioned contextual characteristics of heavy drinking occasion as discussed within user-initiated posts to online alcohol support discussion forums. In identifying the most mentioned characteristics of drinking occasions, the work in this chapter will help inform the selection of characteristics to be measured in later chapters of the thesis (chapter 7 and 8), and more widely what should be measured in event-level quantitative research.

6.1 Submitted paper

Running head: Characteristics of heavy drinking occasions

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OS, MO, MF & JHo conceived the study design. OS identified relevant posts and extracted the data posts to NVivo for data analysis. OS analysed the posts with JHu providing cross coding assistance. OS prepared the manuscript with significant contribution from all other authors.

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Abstract

Background and Aims: Event-level research designs are increasingly important within alcohol epidemiology and prevention research. However, there is little methodological guidance to inform choice of event-level concepts or measures, and little consistency on choices across studies. This paper aims to inform future methodological decisions by using online ethnography to identify the contextual characteristics of heavy drinking occasions that appear salient within user-initiated posts on online alcohol discussion forums.

Methods: Posts made to three alcohol support discussion forums on predominantly UK-centric websites were analysed (Reddit, Mumsnet and Soberistas). A sample of 1200 relevant posts, made between January 2015 and March 2020, discussing heavy drinking occasions were selected across forums. Posts were identified as relevant if individuals discussed occasions where they drank heavily, and posts included detail on the context of the occasion. Posts were transferred to NVivo12 for qualitative content analysis.

Results: Five interrelated groups of contextual characteristics were identified as salient within heavy drinking occasions: timing of the occasion (when, mentioned in 33.8% of posts), drink type (what, 19.6%), reason for drinking (why, 16.4%), drinking companions (who, 16.2%), and drinking location (where, 14.0%). Consuming wine, drinking within an evening, and at the weekend were the most salient characteristics of heavy drinking occasions. Drinking to cope with boredom was commonly mentioned, despite not being included in previous research. More than one contextual characteristic was mentioned in the majority of posts (n=921, 76.8%). Characteristics were often interlinked within a single occasion, demonstrating the complex nature of drinking occasions and the importance of measuring multiple characteristics and their interrelations within event-level alcohol research.

Conclusions: Studies examining heavy drinking occasions should measure multiple contextual characteristics including occasion timing, drink choice, purpose, companions, and location, and consider how characteristics interact to influence drinking. Measures of drinking motivation should also incorporate concepts related to boredom.

Six-Ten Key words: Alcohol consumption, Alcohol discussion forums, Content analysis, Drinking contexts, Heavy drinking occasions, Qualitative.

Introduction

Globally, excessive alcohol consumption results in approximately 3 million deaths per year and is a causal factor for over 200 diseases and injury conditions (5). Given the wide range of negative consequences associated with excessive consumption (4,5,459), it is imperative that we understand more about the occasions in which heavy drinking occurs. One approach to this is to study the contextual characteristics of heavy drinking occasions (HDOs), which can be summarised as *where, when, what, with whom,* and *why* an individual drinks (22). An improved understanding of the key characteristics of HDOs has the potential to assist in the development of epidemiological studies by informing variable selection and could also inform targeted health promotion messages and other public health interventions (12).

Previous research examining the characteristics of HDOs has found them to be diverse and differ by sociodemographic factors (11). Quantitative studies examining how occasion characteristics influence alcohol consumption have found a varied set of characteristics associated with heavy drinking, for example drinking in multiple locations across an occasion (18), with mixed gender groups (19), and in a private home with a close friend (211). Whilst a wide range of contextual characteristics are measured within the event-level literature, recent reviews of quantitative studies have established that few studies measure a comprehensive set of characteristics (22,29). Additionally, the characteristics measured are inconsistent across studies. In mapping the characteristics measured, Stevely et al. (22) found the existing literature focused disproportionately on a minority of contextual characteristics such as time of day, day of the week, and individual's mood. Furthermore, few papers were found to use theory to inform their selection of characteristics (22). Recent conceptual work on drinking occasions has emphasised the value of a practice-based theoretical lens that considers a wide range of contextual characteristics and their intersections (11,12). Whilst this work suggests a theoretical basis for including particular types of characteristics, it is less able to classify

characteristics into types or evidence their importance and interrelations. Given these limitations, studies to date may overlook important aspects of HDOs, which are important for policy and research.

Qualitative methods that generate new data, such as focus groups or one-to-one interviews, have also been used to gain a deeper understanding of how specific contextual characteristics are associated with HDOs (15,16,460). Whilst such methods are useful in explaining how event-level characteristics can contribute to HDOs, they have limitations which may impact upon the types of characteristics elicited from interviews. This includes social desirability bias, whereby respondents may give researchers an answer they believe to be more socially acceptable than truly representative of their behaviour or experiences (461), thus potentially compromising the validity of the findings.

One novel approach for identifying characteristics which may be underreported in qualitative studies and important for quantitative research is online ethnography, a method involving the usually covert observation of individuals' conversations and activity within an online setting (462). Previous online ethnographic research on alcohol-related topics has examined the general content of interactions on alcohol-related forums (463), in addition to investigating how such forums can provide a support network for those experiencing addiction (464,465). Social media platforms are increasingly used as tools for online ethnographic research, as they are a useful way to unobtrusively examine the naturalistic sharing of attitudes and behaviours across a wide range of topics (466). As many forums allow users to post anonymously, participants may be more honest about potentially sensitive subjects, including HDOs, than in an in-person setting. Additionally, examining existing posts on alcohol discussion forums can provide rich data at no material cost to the researcher or participant.

This project therefore aims to adopt elements of online ethnographic methods to identify and describe the most frequently mentioned contextual characteristics of heavy drinking occasions within user-initiated posts to three online discussion forums. It also aims to explore how these characteristics are linked within occasions.

Method

Online discussion forum selection

Given that the aim of this study was to identify the most commonly mentioned contextual characteristics within discussions of HDOs, all the forums selected were alcohol support forums, where individuals were more likely to post about their HDOs than in more general alcohol forums. Following scoping searches, three websites were identified as suitable for analysis: Mumsnet, Reddit and Soberistas. All three are widely used within the UK, have dedicated alcohol consumption forums, large numbers of users, and similar formats, in that each discussion thread starts off with an initial post that members of the online community can respond to. Subsequent posts or 'replies' to the original then vary in content with new topics of conversation or sub-threads introduced. Within each website the following discussion forums were chosen due to their large userbase and consent from forum administrators: Mumsnet forum 'Alcohol support', Reddit's sub-discussion group (otherwise termed sub-reddit) 'r/Stopdrinking', and all discussion forums on Soberistas given that the entire website is dedicated to the reduction or cessation of alcohol consumption.

Data retrieval

Posts from 2015 until March 2020 were reviewed for inclusion, as January 2015 was the earliest post on all three forums (See Figure 1). All forums comprised of multiple conversations (threads), which were formed from an initial post from a forum user to which other users could reply. To be eligible for inclusion posts had to discuss a heavy drinking occasion, determined

by reference to drinking over 4 drinks or 6 UK units or being drunk, and include detail on at least one contextual characteristic of the occasion (e.g. location, company). Sampling of posts was stratified across the four time periods within the year to account for seasonal variation in drinking(467–469). Each forum was screened from the earliest post within this time period until 100 eligible posts were identified from each discussion forum, with posts distributed across the three-month period. The eligible posts were then manually imported into NVivo12, allowing for 300 in total at each sampling time period, with 1200 posts in total.

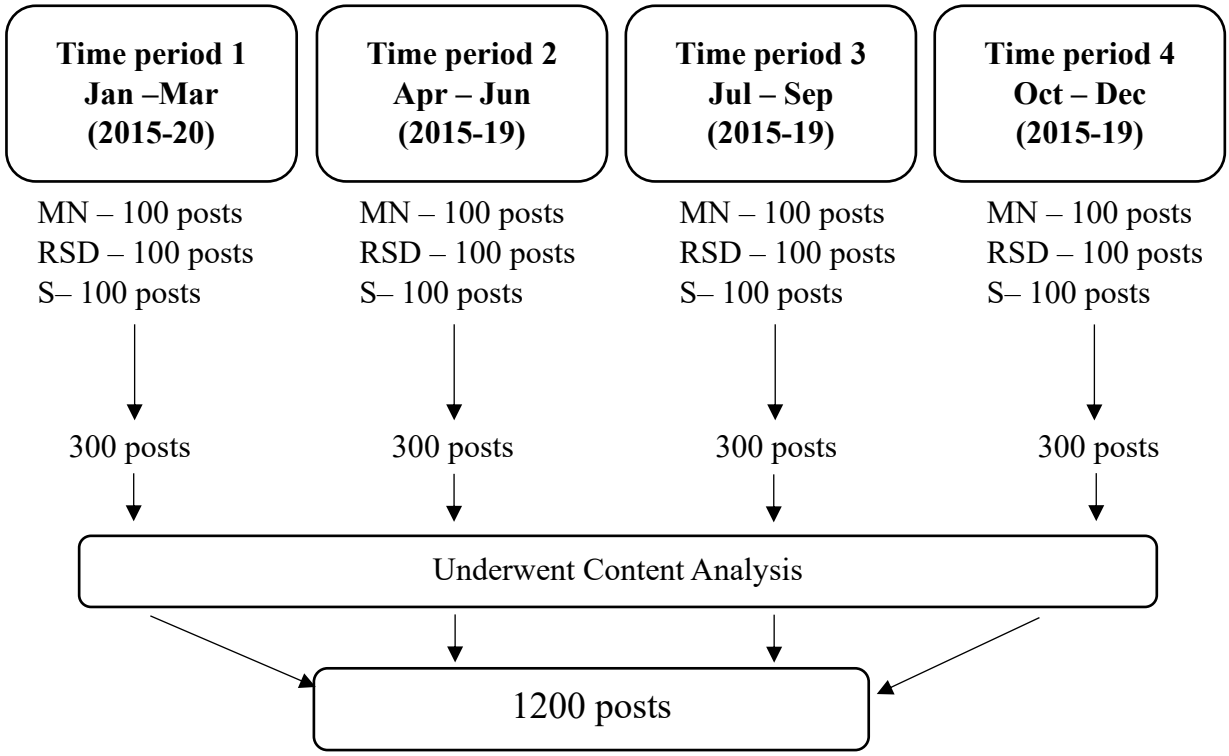


Figure 1: Process undertaken for data retrieval and analysis of posts from the three discussion forums.

Ethical considerations

This study was granted ethical approval by the University of Sheffield's ethics committee. All websites were contacted and consented to the use of their data in line with published guidance(466,470). To ensure that individuals posting could not be identified through online search engines, all quotes included within the results section have undergone slight

paraphrasing. To ensure full anonymity, the username associated with each post was removed prior to transferring the posts into NVivo12 and then replaced with an ID number.

Data analysis

When posts were imported into NVivo12, they underwent qualitative content analysis, an analysis method whereby text is assessed to quantify and analyse the presence of certain words, themes or concepts within qualitative data (471). For the current study all analyses were considered exploratory, with coding done both inductively and deductively. Within stage one of the analysis, the primary author inductively coded 300 posts (100 from each discussion forum) to identify sets of contextual characteristics which were mentioned within posts discussing heavy alcohol consumption. At this stage, codes were discussed with other authors and the rest of the data was coded largely deductively using the following categories: physical timing of the occasion (when), drink type (what), drinking companions *(who)*, reason for drinking (why), and drinking location *(where)*, with the only inductive coding from this stage being the creation of new sub-categories of codes where appropriate. An additional author (JHu) analysed a sub-set of posts to ensure inter-coder reliability. Any discrepancies were discussed between authors until coders reached a percentage of agreement of at least 80% with Cohen's kappa above 0.60, indicating moderate agreement (472,473).

Results

The content analysis identified five groups of contextual characteristics within discussions of HDOs: social and physical timing of the occasion (*when*), drink type (*what*), drinking companions *(who),* reason for drinking (*why*), and drinking location *(where)* (Table 1). Timing of the occasion and drink type were mentioned the most frequently within individual posts. Most posts contained references to more than one contextual characteristic in a single occasion (*n*=921, 76.8%), indicating that for many participants contextual characteristics of heavy drinking occasions were often interlinked. The interlinking of characteristics within HDOs was further explored in a network diagram (Figure 2), which identified the number of connections between contextual characteristics within posts. Drinking wine and drinking in the evening were the characteristics most commonly mentioned within the same post. In identifying other common links, individuals also frequently mentioned drinking wine and drinking within their own home, drinking within the evening and at the weekend, and drinking wine at the weekend within their posts. The five groups of contextual characteristics are discussed below and, as the characteristics are often interlinked, the relationships between characteristics are also considered.

Table 1: Characteristics of HDOs identified and the proportion of posts mentioning each characteristic.

Characteristics	**N**	**%**	**Sub characteristics**	**N**	**%**	**Mumsnet**		**Reddit**		**Soberistas**	
						N	**%**	**N**	**%**	***N***	***%***
When	882	*33.8*	*Evening drinking*	236	*25.9*	102	*43.2*	45	*19.1*	*89*	*37.7*
			Weekend	197	*21.6*	80	*40.6*	59	*29.9*	*58*	*29.4*
			Special occasion	128	*14.1*	38	*29.7*	46	*35.9*	*44*	*34.4*
			Alongside cooking and eating	118	*13.0*	65	*55.1*	21	*17.8*	*32*	*27.1*
			Alongside other activities	78	*8.6*	25	*32.1*	29	*37.2*	*24*	*30.8*
			After work	55	*6.0*	21	*38.2*	21	*38.2*	*13*	*23.6*
			Daytime	37	*4.1*	7	*18.9*	18	*48.6*	*12*	*32.4*
			Weather	31	*3.4*	12	*38.7*	10	*32.2*	*9*	*29.0*
			General holidays	30	*3.3*	9	*30.0*	9	*30.0*	12	*40.0*
What	532	*19.6*	*Wine*	259	*50.8*	105	*40.5*	41	*15.8*	*113*	*43.6*
			Beer	81	*15.9*	19	*23.5*	46	*56.8*	*16*	*19.8*
			Mixing of drinks within the same occasion	74	*14.5*	30	*40.5*	22	*29.7*	*22*	*29.7*
			Spirits	46	*9.0*	20	*43.5*	16	*34.8*	*10*	*21.7*
			Sparkling wine	21	*4.1*	8	*38.1*	1	*4.8*	*12*	*57.1*
			Drinking paraphernalia (e.g. glassware)	17	*3.3*	6	*35.3*	4	*23.5*	7	*41.2*
			Cocktails	9	*1.8*	2	*22.2*	5	*55.6*	2	*22.2*
			Cider	3	*0.6*	1	*33.3*	1	*33.3*	1	*33.3*
Who	427	*16.4*	*Friends*	164	*38.4*	51	*31.1*	36	*22.0*	77	*47.0*
			Romantic partner	129	*30.2*	65	*50.4*	39	*30.2*	25	*19.4*
			Family	57	*13.3*	17	*29.8*	21	*36.8*	19	*33.3*
			Alone	56	*13.1*	19	*33.9*	15	*26.8*	22	*39.3*
			Work Colleagues	16	*3.7*	1	*6.3*	8	*50.0*	7	*43.8*
			Neighbours	5	*1.2*	5	*100*	0	*0*	0	*0*
Why	423	*16.2*	*Cope with negative mood*	81	*19.1*	29	*35.8*	19	*23.5*	33	*40.7*
			Alleviate stress	77	*18.2*	25	*32.5*	27	*35.1*	25	*32.5*
			Out of boredom	52	*12.3*	13	*25.0*	19	*36.5*	20	*38.5*
			Relax	51	*12.1*	19	*37.3*	22	*43.1*	10	*19.6*
			Out of habit	38	*9.0*	14	*36.8*	18	*47.4*	6	*15.8*

			Socialise	30	*7.1*	9	*30.0*	8	*26.7*	13	*43.3*
			As a reward	28	*6.6*	7	*25.0*	12	*42.9*	9	*32.1*
			Celebrate	24	*5.7*	10	*41.7*	4	*16.7*	10	*41.7*
			Cope with childcare	21	*5.0*	13	*61.9*	3	*14.3*	5	*23.8*
			Feel tipsy	12	*2.8*	3	*25.0*	5	*41.7*	4	*33.3*
			Have fun	9	*2.1*	3	*33.3*	2	*22.2*	4	*44.4*
Where	365	*14.0*	*Own home*	150	*44.8*	49	*32.7*	60	*40.0*	41	*27.3*
			Drinking 'out'	66	*19.7*	30	*45.5*	16	*24.2*	20	*30.3*
			Pub	28	*8.4*	6	*21.4*	5	*17.9*	17	*60.7*
			Multiple locations	24	*7.2*	8	*33.3*	9	*37.5*	7	*29.2*
			Restaurant	24	*7.2*	11	*45.8*	5	*20.8*	8	*33.3*
			Parties	22	*6.6*	5	*22.7*	6	*27.3*	11	*50.0*
			Others' home	18	*5.4*	4	*22.2*	8	*44.4*	6	*33.3*
			Nightclubs	3	*0.8*	0	*0*	0	*0*	3	*100*

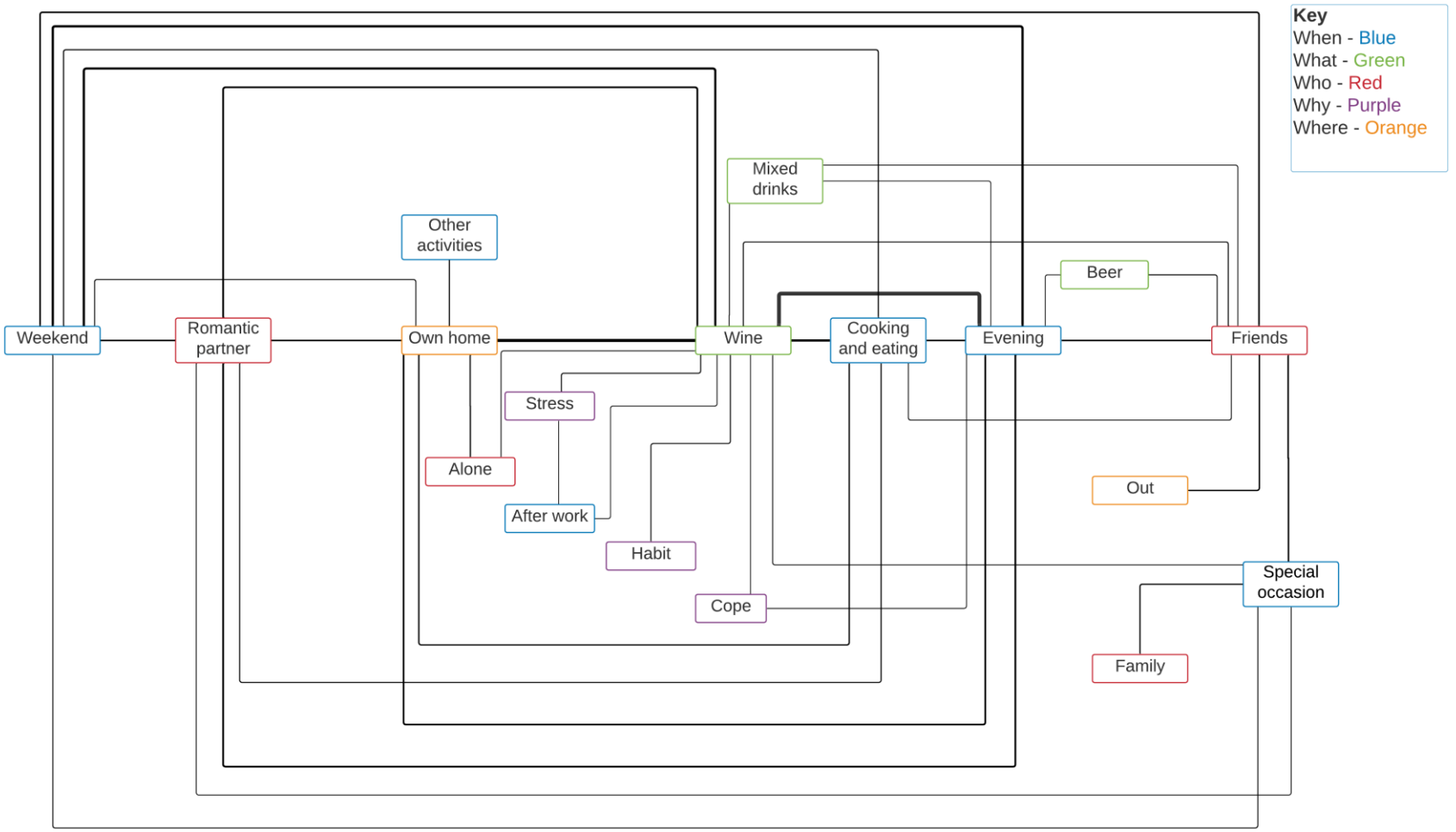


Figure 2: *Network diagram displaying the links within posts between two contextual characteristics when links were mentioned in 20 or more posts*[1]*. The thicker the line between characteristics, the more posts the link was mentioned in.*

[1]*For full list of connections between two contextual characteristics within posts see Supplementary 1.*

When

Timing of the drinking occasion was identified as the most salient characteristic and was mentioned in 33.8% of posts. Mentions reflected on both the physical timing of the occasion (e.g. time on a clock) and its social timing (e.g. special occasion). Individuals often described drinking in the evening and at the weekend, with many individuals reflecting that at the weekend they would drink more and begin occasions earlier than a weekday evening:

"Most evenings I settle down with a glass or two of wine and most weekends see me drinking a few bottles of wine." (S1_39).

"I hadn't really noticed that I wait until 5pm on weekdays but on weekends I usually start drinking a lot earlier....I would start at lunch time!" (MN3_11).

Heavy drinking within an evening was identified in posts as being symbolic of the end of the working day or week and the beginning of their own time. For many individuals, drinking within an evening had become a habitual behaviour that originated as an outlet for the day's stress, and a social time and space to connect and bond with partners:

"I know I want to drink. I know my triggers are wanting to destress and put an end to the day and a start to the evening." (MN1_27). "I have a couple of glasses of wine .. mostly more ... to chill of an evening .. it's become bad habit more than anything .. I don't crave it ... I don't feel the need for it ... it's just something I have done for far too long." (S2_23).

Details of other activities that accompanied drinking were commonplace. For many individuals, drinking was often paired with preparing and consuming foods. For occasions such as 'Sunday lunch', many individuals associated these meals with 'wine' or 'prosecco', with these occasions often viewed as a special event. Drinking often commenced whilst preparing the food, and then continued throughout the evening and into other activities such as watching the television:

"I really struggle as my husband never wants to give up. He does a lot of the cooking and likes a g&t [gin and tonic] or two while cooking and then wine. So I have it too. Major FOMO [fear of missing out]. He is happy to stop drinking after dinner but I like to take a glass through to have while watching tv." (MN1_100).

More generally, drinking was frequently associated with, and seen as integral or expected, at special occasions such as parties or weddings:

"So, Saturday. We went to a family member's 40th birthday party and I caved in and drank. Everyone was drinking. Not one person was chilling with a coke or water. The voice told me "just drink on special occasions, you've got this." (R1_24).

What

As reflected in Table 1, wine was the most salient drink type within accounts of HDOs. Within posts, wine was mentioned in a range of different drinking contexts, with individuals expressing that drinking wine was a way to *"wind down at the end of the day" (MN1_34),* to socialise with others by *"splitting a bottle"(S3_86),* and to provide an accompaniment to meals as it "*tastes great and pairs beautifully with food" (R3_63).*

The cultural phenomenon coined 'Wine O'clock' was frequently mentioned within posts, with individuals often discussing the social acceptability and normality of drinking wine at a specific time. Drinking at 'Wine O'clock' was often discussed by those who identified themselves as mothers or women:

"*I wasn't a daily drinker until I was a mommy with [young children]. My husband and I used to joke that I was a better mommy after my evening glass of wine. But then it became 2 then 3 then... I saw/heard so many messages about wine and the mommy culture. I even had a therapist say a glass of wine after a stressful day wasn't such a bad thing." (R2_97).*

The type of alcohol consumed for many was dependent on their drinking location: *"wine in public and whiskey at home" (S1_56).* Champagne and prosecco were often associated with celebratory occasions, with mixing of drinks also commonplace at parties: *"Yesterday I went on my work Christmas lunch, I drank my body size several times over in beer, prosecco and tequila" (MN4_69).*

Who

Friends (38.4%) and romantic partners (30.2%) were the most frequently mentioned companions on HDOs. Drinking with friends was often associated with drinking to socialise, with the primary purpose of many social events being to engage in heavy drinking:

"all of my friends are heavy drinkers and alcohol is always involved when socializing with them" (R4_34).

As many individuals drank with other heavy drinkers, they described a norm to drink heavily together, with individuals often encouraging each other to drink more: *"I'll have one if you are having one" (S4_93)"*

Many occasions when individuals drank with a romantic partner occurred during dinner, where drinking with a meal had become habitual. Often an individual's partner affected their consumption, with individuals expressing they would mirror their partners abstinence, light or heavy drinking: *"not sure yet if I am going to drink tonight. My partner isn't drinking and I want to get out of the habit of drinking alone" (MN1_27),* whereas if their partner was drinking heavily they would also drink more:

"We never have dinner without a bottle of wine and at weekends a lot more, my husband is forever topping up my glass and if he has just poured it then I drink it"(MN2_51).

Only a small number of posts discussed drinking alone, indicating that for most, heavy drinking formed part of a social occasion. Alternatively, individuals may be unlikely to mention drinking

alone unless it was important or salient to them. In posts that did mention solitary drinking, individuals identified that being alone represented a trigger for them and that drinking when alone was often a coping mechanism for loneliness:

"I use alcohol as a coping mechanism for depression, boredom and loneliness. When I do go out drinking with friends and be social, I don't really say I have a drinking problem. It's when I spend weeks at home drinking alone" (R1_67).

Why

A range of reasons for drinking heavily within occasions was present in individuals' posts as shown in Table 1. Within all accounts, drinking to cope with negative mood was the most salient characteristic, with individuals often reflecting that drinking was a way for them to escape their lives, "*I know I drink to help me 'cope' but really it is just a way of 'getting me out of reality' and numbing my feelings." (S4_6).*

Drinking to cope with boredom was also commonly expressed by individuals. For some, it was often associated with being alone *"I live on my own, and haven't got a family, and whilst I'm not unhappy, I think I get bored and have nobody to tut over my drinking" (S1_6),* whereas other individuals often discussed drinking heavily to cope with the mundaneness of everyday life:

"Before having children I was never a big drinker however it all started about 6 years ago as a coping mechanism to get through evenings; the bedtime routine, my unhappy marriage and boredom really."(MN1_18).

For many individuals, drinking heavily was a way to alleviate stress often associated with their jobs and families. These same individuals were also likely to view drinking as a reward, feeling as if they deserved to drink if they had coped well with challenging situations:

"I have a lovely life, family and friends. Yes I do have a lot of stress on occasions. I always tell myself I deserve wine!! If I've had a bad day I deserve it to make myself feel better, and if I've had good day, I use it to celebrate it!!" (S2_41).

Drinking to socialise and have fun were also discussed as reasons for heavily drinking. These occasions often involved individuals drinking heavily with others, with some individuals experiencing pressure from others to keep drinking *"I would stop drinking and my wife would say, "oh, come on! just have one, it's more fun if we drink together." (R2_39).*

For others, HDOs were opportunities to bond over a shared experience and provided an opportunity for individuals to connect within the drinking group. Often drinking heavily was celebrated, with the consequences of drinking excessively (e.g. hangovers) seen as a 'badge of honour':

"I'm becoming more aware of the fact that every get together is always centred around alcohol, and lots of it. Then the amount drunk by all is celebrated the next day as if it's an achievement." (MN4_68).

Where

Individuals reported HDOs in a wide range of settings, but most commonly within their own homes. For many, the location of their drinking was due to convenience or cost and reflected other responsibilities, such as parental commitments. It also became habitual and occurred almost mindlessly when engaging in other activities such as watching live sports or boxsets:

"We only ever used to drink when out. But now we rarely go out as it's so bloody expensive and we struggle for babysitters. So we drink at home. And because you are home every night a couple of drinks becomes the new normal. And everyone else is doing it so why not!" (MN1_27).

"We've gotten into the bad habit of drinking the entire time we're sitting there. This usually means 1-2 bottles of wine or wine plus some bourbon. We end up going to bed drunk and waking up the next day feeling like crap." (R4_96).

In comparing how their drinking occasions differed between locations, individuals reflected that when drinking outside of their own home, these occasions tended to escalate more and result in a higher rate of alcohol-related harms such as 'blacking out', being sick, or becoming involved in fights:

"I hardly drink at home and can have the odd night out where I have a couple and have a really good night. Then all of a sudden I'll have a night out and get absolutely hammered and wake up full of worry about what's happened and who I might have upset. I've sometimes kissed other people while I've been drunk and can get argumentative." (MN3_06).

For some individuals though, drinking outside their home was associated with a lighter drinking occasion than those drinking at home due to having to drive to their drinking location:

"I was in the same position as you, I always drive when I go out so never have more than 2 drinks over an evening, but I was drinking wine alone when not out (probably three bottles a week)" (MN3_18).

Discussion

The present study aimed to identify the most salient contextual characteristics of HDOs, as discussed within posts on three alcohol support discussion forums. Through content analysis, five inter-related contextual characteristics were identified, with timing of an occasion (*when)* and drink type (*what*) the most frequently mentioned. Most posts included more than one contextual characteristic, for example, drinking wine in the evening and drinking wine with a romantic partner, demonstrating the complexity of HDOs and highlighting the importance of measuring a range of characteristics and their interrelations within event-level alcohol research.

The contextual characteristics identified within this study largely map onto those currently measured within the existing quantitative event-level literature as a whole; however, individual studies do not consistently measure all relevant characteristics (22,29). Similarly to Stanesby et al. (29), we found that daily stressors such as work and other responsibilities were frequently mentioned in discussions of HDOs. The influences of drinking companions on consumption were regularly discussed within individuals' posts, particularly when drinking with a romantic partner or a group of friends. Individuals often reported feeling pressured to consume more alcohol when drinking within a heavy drinking group, something which has been evidenced extensively within the traditional qualitative literature examining peer group relations (17,474). In comparison to previous literature, some characteristics which have been previously identified as salient within HDOs were not present in our study, such as the use of illicit drugs (22). A potential explanation for this could be that the demographic within this study did not engage in drug use. Alternatively, given that all forums focused on aiming to reduce heavy drinking they felt discussing their drug use would not be accepted within these communities. Within our study, HDOs often occurred in the contexts of other activities such as watching the television or consuming food. Within these occasions, consuming alcohol was not always integral to the occasion, but for many individuals they had linked the activities, for example,

always drinking wine when watching television, or having a drink whilst cooking. As alcohol was not always a central or essential feature within these occasions, our findings have important implications for future research when considering how we measure drinking occasions, as individuals may not consider these activities as a "drinking occasion" in the same way as they may view going to the pub with friends or going to a wedding as a drinking occasion and therefore, these occasions may be underreported in surveys.

Whilst the findings of our study are largely consistent with the existing literature, new characteristics have been identified through our analysis which are important for future research. One characteristic identified in our work which is not measured extensively within the existing literature is drinking to cope with boredom. In a study investigating reasons for high intensity drinking across young adulthood, Patrick et al. (475) found a positive association between boredom and high intensity drinking, with this association increasing with age. Within our analysis, drinking to cope with boredom was present in a variety of occasions, with alcohol being consumed to detract from the 'mundaneness of everyday life' and often linked to drinking out of habit or from negative mood. Currently the Drinking Motivation Questionnaire-Revised (44) does not measure boredom as a motivation for consuming alcohol. Given the frequency of this characteristic within posts and within other research, future research would benefit from actively measuring and exploring the role of boredom further, either by adding this dimension into the DMQ-R or creating new measures to accurately capture this concept.

Within the existing literature the timing of a drinking occasion has been studied extensively, with research finding that individuals tend to drink more on an evening or weekend(18,396,476). However, aside from a small number of studies using traditional qualitative methodologies (16,477), limited research has explicitly considered the role that drinking symbolises within an individual's life, specifically in relation to temporality. For many in our study, and within the previous qualitative literature (16,477), drinking often

symbolised an opportunity for individuals to unwind from the day's activities, and signified the start of leisure time and freedom from responsibilities. For many this was linked with their identity of being a parent, with individuals reflecting on how their drinking occasions had changed since becoming a caregiver. Drinking at a specific time, i.e., 'Wine O'clock', was frequently identified by individuals as a time within the early evening, typically between 5pm and 7pm, where it became socially acceptable to begin drinking. To understand more about how drinking occasions are constructed, future research should aim to examine the relationships between objective time and the meanings associated with drinking, potentially by adopting a practice theoretical approach (12). Furthermore, our findings show that many of the characteristics mentioned co-occurred, for example drinking wine in the home and in the eventing were often mentioned together. This has methodological implications and highlights the need for researchers to think carefully about how different characteristics interrelate to each other within an occasion. As such, it may be appropriate to adopt methods such as directed acyclic graphs (DAGs)(478) to facilitate thinking about causal pathways between variables, and cluster analyses to elucidate inter-related factors rather than looking at individual contextual factors in isolation.

To our knowledge, this study is the first to use online discussion forum posts to identify heavy drinking occasion characteristics. By utilising online ethnography we have been able to capture naturalistic interactions which demonstrate how individuals experience HDOs. Whilst the findings from this study are useful in informing which contextual characteristics are most salient within HDOs, it is important to consider the study population from which the posts were taken. A limitation of this study is that no individual characteristics such as age, sex, socioeconomic status, or alcohol consumption levels could be collected from individuals posting to the forums due to the online anonymous nature of the study. Additionally, for some websites, particularly Mumsnet, the sample may have been biased, in that all individuals were

likely to be mothers of young children, and this may affect both the types of HDOs they engage in, and the characteristics mentioned most frequently within posts (479). Finally, although we chose online forums deliberately to encompass different demographic groups, all the discussion forums used within this study were alcohol support forums, and therefore the types of occasions and characteristics captured within this study might be biased towards perceiving excessive alcohol consumption negatively. As such, this research may not encompass all relevant contextual characteristics of HDOs.

Conclusion

Five inter-related groups of contextual characteristics were found through content analysis of alcohol discussion forum posts: drinking occasion purpose *(why)*, location *(where)*, companions *(who)*, timing *(when)*, and drink choice *(what)*. Through content analysis this study identified further characteristics which have previously been understudied within event-level alcohol research, such as drinking to cope with boredom and the temporality of drinking occasions. These findings can inform judgements and best practice recommendations on the contextual characteristics that should be measured within future drinking occasion surveys and may offer avenues for targeted interventions or inform policy. Furthermore, this study highlights the co-occurrence and interrelation of multiple contextual characteristics within individual drinking occasions. We outline the need to think carefully about how characteristics may interact in occasion-based research rather than looking at individual characteristics in isolation.

6.2 Supplementary Material

Table S1: Full list of connections between two contextual characteristics within posts

Contextual characteristics	Evening	Weekend	Special occasion	Cooking and eating	Other activities	After work	Daytime	Weather
Evening		60	10	33	15	8	9	7
Weekend			25	30	11	7	15	7
Special occasion				11	6	1	7	2
Cooking and eating					13	7	7	5
Other activities						2	2	3
After work								
Daytime								6

Contextual characteristics	Holidays	Wine	Beer	Mixed drinks	Spirits	Sparkling wine	Drinking paraphernalia	Cocktails
Evening	17	116	20	20	12	4	6	
Weekend	8	56	16	19	10	6	2	1
Special occasion	3	23	6	13	11	18	2	2
Cooking and eating	1	53	8	11	10	5	2	2
Other activities	3	17	8	4	3	1		2
After work		21	10	4	1			1
Daytime	6	14	8	2	3	2	1	
Weather	2	19	10	2	1	1	1	
Holidays		15	6	2	2	1		
Wine			15	22	12	6	11	1
Beer				19	8		1	4
Mixed drinks					15	4	2	3
Spirits						5	3	1
Sparkling wine							1	1
Drinking paraphernalia								

Contextual characteristics	Cider	Friends	Romantic partner	Family	Alone	Work colleagues	Neighbours	Cope with negative mood
Evening		34	46	5	14	1	1	21
Weekend	2	40	37	13	8	1	1	15
Special occasion		37	21	32			1	3
Cooking and eating	1	24	27	8			2	1
Other activities		18	12	2	13		1	1
After work		6	3	1	4	1		
Daytime		10	5	2	1	3		
Weather		3	6	1				
Holidays		14	4	5	1			
Wine	1	26	46	16	22	4	1	25
Beer	1	25	6	8	4	3		6
Mixed drinks		23	15	7	5		2	4
Spirits		12	9	3	1		2	3
Sparkling wine		5	2	7	3	1	1	
Drinking paraphernalia			5	1	1		1	3
Cocktails		5		1	1			
Cider				1				
Friends			18	9		2		7
Romantic partner				7	1		5	12
Family					1	1	1	2
Alone						1		6
Work colleagues								
Neighbours								

Contextual characteristics	Alleviate stress	Boredom	Relax	Out of habit	Socialise	Reward	Celebrate	Cope with childcare
Evening	13	14	17	18	6	3	1	8
Weekend	5	9	9	11	9	2	5	2
Special occasion	4	1	2		2		7	4
Cooking and eating	8		7	2	3	7	2	1
Other activities	4	3	6	2	2	2	1	
After work	22	3	9	6		4	5	3
Daytime					1		3	1
Weather			1	2		2	3	
Holidays	1			1				
Wine	26	9	15	25	1	14	5	9
Beer	9	4	3	3		1	4	5
Mixed drinks	3	1	1	2	4	2	1	3
Spirits	4	1		1	1			
Sparkling wine		1						
Drinking paraphernalia		1						
Cocktails		1						
Cider		1						
Friends	5	4	3	3			4	2
Romantic partner	4		16		5	3	3	
Family	4		1	1	1		6	4
Alone	6	10	3	3				1
Work colleagues					2			
Neighbours							1	
Cope with negative mood	6	1	3		4	1	1	3
Alleviate stress		4	1	2	1	5	3	5
Boredom				7	1		2	
Relax				2	6	4		4
Out of habit						1		
Socialise								
Reward							5	
Celebrate								

Contextual characteristics	Feel tipsy	Have fun	Own home	Drinking 'out'	Pub
Evening	4	3	45	15	6
Weekend	2	4	25	19	3
Special occasion	2		6	13	4
Cooking and eating	1	1	34	2	
Other activities			30	2	2
After work			12		1
Daytime	1		8	5	2
Weather		1	10	1	
Holidays				2	
Wine	3	3	87	13	3
Beer	4	2	16	12	13
Mixed drinks	1		18	5	7
Spirits			15	1	2
Sparkling wine			8	3	
Drinking paraphernalia			4	1	
Cocktails			1		
Cider					
Friends	1		18	35	16
Romantic partner			33	9	4
Family			14	4	3
Alone			42		1
Work colleagues			1	5	4
Neighbours			2		
Cope with negative mood			13	5	
Alleviate stress		1	18	4	1
Boredom		1	14	3	3
Relax			8		
Out of habit	2		9		2
Socialise			2	5	1
Reward			7		
Celebrate			3		2
Cope with childcare			7	1	
Feel tipsy			2		
Have fun			3		
Own home				8	4
Drinking 'out'					1

Contextual characteristics	Multiple locations	Restaurant	Parties	Others' home	Nightclubs
Evening	10	5	2	5	2
Weekend	2	5	2	3	
Special occasion	7	2	4	2	
Cooking and eating	4	10	1	10	
Other activities	1	3	1		
After work				1	
Daytime	3	3		1	
Weather	1	1		2	
Holidays		1			
Wine	7	7	5	4	
Beer	7	6	5		
Mixed drinks	13	5	2	1	
Spirits	10	4	3	1	
Sparkling wine	2	1		1	
Drinking paraphernalia	2	1	2	2	
Cocktails	1		1		
Cider					
Friends	7	12	14	12	3
Romantic partner	8	11	4	1	
Family	2	2	2	8	
Alone					
Work colleagues			2		
Neighbours	2	1			
Cope with negative mood			2		1
Alleviate stress	1	2	2	2	
Boredom					
Relax		2			
Out of habit					
Socialise	1		4		
Reward		1			
Celebrate	1		2	1	
Cope with childcare					
Feel tipsy					
Have fun					
Own home	10	5	1	2	
Drinking 'out'	2	1			
Pub	8	2	1	1	
Multiple locations		6	1	2	
Restaurant					
Parties				4	
Others' home					

7. Developing and testing an event-level survey of drinking occasion measures

This chapter presents the third study of this PhD. The work outlined describes the process of development and testing of an online survey which measures the contextual characteristics of a drinking occasion. It uses the findings from chapters three, four, five, and chapter six of this thesis to inform the design and content of the survey which measures drinking occasion characteristics. Findings from chapter three helped to inform how a drinking occasion could be conceptualised. Findings from chapter four (literature review of data collection techniques) and chapter five informed the data collection technique chosen for this survey. In informing which contextual characteristics should be measured within the survey, chapter six identified the contextual characteristics which should be measured within HDOs, whilst the literature reviewed in chapter four (literature review of the contextual characteristics) identified which contextual characteristics should be measured in all drinking occasions. The resulting survey will then be used to collect data on drinking occasions in the final empirical chapter of this thesis (chapter eight).

Prior to the work presented in this chapter, reflecting on the findings from the systematic review in chapter five, it was decided that a retrospective survey on drinking occasions was the most appropriate data collection technique given that studies using this method had good compliance rates and tended to impose less participant burden when compared with other techniques. As such, this chapter focused on identifying existing questions and developing new questions for contextual characteristics which could be feasibly measured within a retrospective survey

Whilst using a retrospective survey has many benefits, we acknowledge selecting this method means there are some contextual characteristics which cannot be feasibly measured with this

technique. The limitations of a retrospective survey in general, and the survey developed here in particular, are discussed at the end of this chapter and within the discussion of the thesis.

7.1 Background

The contextual characteristics of a drinking occasion, otherwise known as *where, when, what, with whom, and why* an individual drinks, have been well established within the event-level literature to influence consumption and alcohol-related harm outcomes (22,29,47). Previous research examining how context influences consumption has identified a range of characteristics associated with heavy drinking occasions, for example drinking in multiple locations (93), in mixed gender groups (19), and in response to low mood (62,418).

Although a number of studies have identified individual contextual characteristics associated with increased consumption, a recent mapping review conducted by Stevely et al. (22) found that few papers were guided by theory, with some characteristics such as time and day of the week measured more frequently throughout the literature. Furthermore, in their systematic review on the contexts of heavy drinking occasions, Stanesby et al. (29) identified that few studies measured an appropriately wide range of contextual characteristics. Taken together, both reviews demonstrate that the current practice of measuring the context of drinking occasions is not conducted in a comprehensive manner within individual studies or in a consistent manner across studies. Further evidence of this lack of consistency can be seen in how specific characteristics are operationalised. As established in chapter 4.1 of this thesis, contextual characteristics such as location can be defined in a variety of ways. For example Kypri et al. (117) asked students to select which of four locations they had consumed alcohol at within the past seven days: (1) pub, bar, or nightclub, (2) student flat or house, (3) hall of residence, or (4) other locations. This contrasts with Mustonen et al. (69), in which location was asked as a binary variable, with participants able to select having their last drinking occasion in either: (1) a home environment or (2) a licensed premises. This lack of consistency

in measuring characteristics limits the comparability of findings across studies. Additionally, the lack of comprehensiveness in measuring characteristics within studies limits the value of the event-level literature more broadly. Given that multiple factors shape and distinguish different 'types' of occasions (11), by looking only at this narrow subset of commonly measured characteristics and often evaluating these characteristics in isolation, avenues of research and intervention opportunities are potentially missed.

Additionally, Stevely et al.'s mapping review found that within the papers included there is a lack of existing validated event-level measures. A systematic review identifying validated alcohol-related harm measures at the event-level conducted by Brooks et al.(214) produced similar findings. This lack of validated event-level measures is concerning, given that previous research has suggested failing to use validated scales may limit the comparability and the validity of findings (116). Given the evidence linking context to consumption and harm outcomes (47), it is important that valid event-level measures are designed which comprehensively and consistently measure the most important contextual characteristics of drinking occasions.

There are therefore several key issues that a new survey of contextual characteristics should address. Firstly, surveys should ensure that an appropriately wide range of contextual characteristics are measured, with their inclusion justified by theoretical rationale. Secondly, the way in which characteristics are defined should be consistent across studies to allow for cross-study comparison. Finally, where possible, surveys should aim to use validated event-level measures. The next stage is to consider how to approach the development of a new survey to ensure that these key issues are addressed.

From the findings of the systematic review presented in chapter five, it is evident that within event-level alcohol research the data collection methods used are heterogeneous, with no

overall gold-standard approach identified. Additionally, in collecting data on drinking occasions researchers should ensure that the data collection techniques chosen are suitable for the question of study. As identified in chapter five, when designing future data collection techniques, researchers should test that the mode of administration does not impose a high participant burden, which has previously been associated with low participation rates (115,184). In developing validated event-level measures to be used within drinking occasion surveys, it is important that the questions chosen are both appropriate in content and acceptable to users, including ensuring that questions are easily understood by participants. Findings from chapter six of this PhD identified the most salient characteristics of a heavy drinking occasion discussed in user-initiated posts on discussion forums, and in combination with key findings from the literature a set of questions were developed within this chapter.

To ensure that feasible and valid questionnaires and surveys are developed, it is imperative that the measures undergo a development and pilot testing phase. Survey development experts Dillman, Smyth, and Christian (480) recommend that prior to a survey being administered to a wider population it should undergo a rigorous pretesting process, the first stage of which is to obtain expert feedback on the survey. Gaining expert feedback on survey materials is commonly done within survey and intervention research to ensure all relevant topics are covered (481,482). In addition to gaining academic expert opinion on survey materials, within recent years there has been a wider push to incorporate public and patient (PPI) groups within research (483), with previous research documenting how actively involving individuals with lived experience in the research process is beneficial in creating meaningful research (484,485).

To ensure surveys are valid, in that the survey is comprehended by participants in the way it is intended, cognitive interviewing is recommended as a tool for testing and improving upon questionnaire design (480,486,487). Cognitive interviewing is a method of systematically collecting valid and reliable evidence of response processes for questionnaire items (487,488).

Cognitive interviews use a range of techniques which allow respondents to verbalise their response processes when completing questionnaire items. One such method is the 'think-aloud' protocol (489), whereby individuals verbalise their thoughts through concurrent verbalisation while completing the task. 'Think-aloud' studies have successfully been used to assess the validity and usability of surveys and interventions (486,490,491) with Crane et al.(490) using this technique to evaluate individual's first-time experiences of using the Drink Less mobile application. Whilst some authors have expressed concern over the potential reactivity of 'think-aloud' studies, in that speaking aloud may influence an individual's performance (486,492), a meta-analysis by Fox, Ericsson, and Best (493) found no evidence of reactivity when comparing the task performance of those speaking aloud to those who did not provide verbalisations.

Research Aim

The current study aimed to develop and test a survey measuring the contextual characteristics of a drinking occasion for use within the final study of this PhD.

Research Questions

1. What contextual characteristics should be included within a drinking occasion survey?

2. How should these contextual characteristics be measured within a drinking occasion survey?

3. Which contextual characteristics are feasible to measure within a drinking occasion survey and is Qualtrics a suitable platform to administer the survey on?

Research Objectives

1. To identify existing measures or develop new questions which are suitable to measure the contextual characteristics of drinking occasions within an online survey.

2. To assess whether the questions used to measure the contextual characteristics of a drinking occasion are feasible by:
    a. Sending the survey to international experts in event-level analysis of alcohol consumption and getting feedback on the contextual characteristics measured.
    b. Conducting a PPI group with members of an established alcohol research advisory group to determine whether the questions are comprehensible.
    c. Conducting cognitive interviews as participants complete the Qualtrics questionnaire to assess whether the questions used to measure the contextual characteristics of a drinking occasion have face validity and to identify any technical challenges to using the Qualtrics online survey platform, the preferred option, in the collection of event-level data.

Ethical Considerations:

The individuals attending the PPI meeting attended in an advisory capacity, with the contributions from attendees directly informing and influencing the research project. As none of the discussions within this focus group would be published, the University of Sheffield did not require ethical approval. Ethical approval for the cognitive interviews was provided by the School for Health and Related Research's ethics committee (Ref:034892).

7.2 Methodology

7.2.1 Stage One: Identification of key types of occasion characteristic

To ensure the comprehensiveness of the drinking occasion survey, development work began by compiling categories of drinking occasion characteristics which could be measured within the survey. When selecting which characteristics could be measured, we identified characteristics under the following categories: *where, when, what, with whom, and why*.

Several sources were used to compile this list of characteristics. Firstly, we considered which contextual characteristics were measured within the existing literature. In their mapping review of 278 papers, Stevely et al. (22) identified a wide range of characteristics currently measured in the event-level literature. Amongst these, day of the week, affect or mood, and venue type were the most frequently measured, with others such as number of venues less frequently measured across studies.

In identifying these contextual characteristics, the authors of the review noted that few papers used a theoretical rational to justify measuring specific characteristics (22). Given this evidenced lack of theoretical rationale, we felt it was important that the measures within this survey were informed by theory. To address this, we attempted to map contextual characteristics to the theories identified in chapter 3.1, the results of which are presented in Table 1. As shown in Table 1, some theories have elements which map more explicitly onto drinking occasion characteristics, for example motivational models tended to map solely onto reasons why individuals might drink, whilst Theories of Practice, as conceptualised by Shove et al. (48), tended to map more broadly across characteristics. By examining how theories map onto the elements of contextual characteristics, it is apparent that no single theory fully incorporates all aspects of drinking occasions. However, it is important to note that the mapping exercise was to aid the selection of characteristics based on theory, rather than to place a theoretical frame on the research. As such, when selecting which characteristics to measure within this drinking occasion survey, we used a range of theories to inform our decision-making.

Table 1: Identifying which contextual characteristics have a theoretical basis						
	Social Practice Theory *Shove et al.* (48)	**Social Practice Theory Principles of Temporality** *Southerton* (51)	**Socio-ecological model of Alcohol Use** *Grunewald et al.* (57)	**Social Learning Theory** *Bandura & Walters* (58)	**Motivational Models**	**Social Norms Theory**
Where			**Location** Activity spaces Type of drinking location (e.g. car, restaurants)			
When		**Tempo** Pace of drinking **Duration** Length of the drinking occasion **Sequence** What happens around the drinking occasion? E.g. before and after **Periodicity** Interval of drinking occasion. **Synchronisation** What else occurs within the occasion apart from drinking?	**Situation** Legal and social constraints Social availability of alcohol Childcare responsibilities			
Why	**Meanings** Why people drink What the occasion means to participants Drinking attitudes			**Cognitive** Attitudes to drinking	**Conformity** Drinking to fit in and avoid social rejection **Coping** To lessen negative emotions **Enhancement** Drinking to enhance positive mood or well being **Social** Drinking to obtain social rewards	**Personal beliefs** Attitudes to drinking
What	**Materials** Alcoholic beverages Glassware					
Who			**Social** Number of people in the occasion Demographic composition and characteristics of social network Drinking patterns of others	**Environmental** Social norms Influence on others (ability to change own environment)		
Other	**Competencies** Knowing how others drink Knowledge of how to behave in a situation					**Beliefs about others** What is typical What is appropriate

Finally, we included the findings from the content analysis in chapter six in addition to those identified both within the existing literature and through theory, the results of which can be seen in the list of characteristics presented in Table 2. Once the list of characteristics was developed, this list was sent initially to seven experts in analysis of event-level alcohol consumption at the University of Sheffield for comments on the comprehensiveness of the characteristics included, and to ensure face validity of the concepts chosen. Researchers were asked to comment on the comprehensiveness of the concepts, including if they felt that there were concepts which were missing or should be included. Of the seven researchers the concepts were sent to, three were able to provide feedback within the required timeframe. In the feedback received from three researchers, the concepts measuring the 'what' and 'who' characteristics were considered comprehensive. However, additional characteristics to be considered within the survey were identified by these researchers, with the new concepts to be considered presented in *italicised* text within Table 2.

Table 2: Drinking occasion characteristics identified through literature searches and empirical findings in chapter 6.		
Characteristics	**Contextual characteristics identified through theoretical frameworks**	**Other characteristics identified**
Where	• Type of drinking location e.g. Pub, restaurant, own home, other home • Number of drinking locations • *The features of the drinking venue e.g. is it loud, dirty, crowded, isolated? Are there cheap drinks or discounts?* • Rural vs. Urban setting • Outlet density Relative location: In regards to where you live/ other venues and off-licenses	Travel to/from locations

When (timing)	• What happens around a drinking occasion, i.e. before and after?
	• *Sequencing within the occasion – e.g. capturing things like change of venue.*
	• Day of the week
	  ○ Weekend vs weekday
	• Time of day
	  ○ Mealtimes
	• Duration of the occasion
	• Time of first drink
	• Pace of drinking
	• Pre-drinking
		• Holidays
		• Timing of the drinking around other responsibilities e.g. childcare, work etc.
		Phase of your life e.g. parent, carer etc.

Why	• Drinking to cope • Drinking to fit in • Drinking for positive mood • Drinking to obtain social rewards • Drinking attitudes • Drinking intentions • Purpose for the occasion • Purpose for *drinking* in the occasion. • *Competencies e.g. managing intoxication*	• Drinking to reward yourself • Drinking due to boredom • Drinking out of habit • Drinking due to stress

What	• Drink type ○ Including non-alcoholic drinks • Drink size • Glassware	

When (activities)	• Accompanying activities to a drinking occasion (i.e. watching TV, eating a meal, drinking games). *Round buying, toasting, downing drinks*
	• Food available/ *drank with a meal*
	• *Music and dancing*
		• Drinking at a special occasion e.g. wedding or birthday
		  ○ Feast vs fast day
		  ○ *Sports*
		• Weather
		• *Video-calling as an accompanying activity*
		• *Price of the drinks*

Who	• How many drinking partners? • Relationships to individuals within the occasions, e.g. friends, family, colleagues. • What others in the occasion are drinking? • Demographic composition of the group? E.g. gender, age • Beliefs about how much others in the group are drinking. • Social support dynamics	• Are children present?

7.2.2 Stage Two: Questionnaire Development – Development of specific questions and external review

The drinking occasion survey was designed to have three sections. The first section of the survey was designed to ask about health-related characteristics such as smoker status, diet status, and AUDIT score; the second section was designed to collect information about drinking occasions occurring in the past seven days; and the final section was designed to collect data on demographic information such as age and gender. Given that the main purpose of the thesis was to develop and test a survey measuring the contextual characteristics of drinking occasions, this chapter will mainly be focused on describing the process of how drinking occasion questions within section 2 were developed for inclusion within the survey. The questions included within the context-specific drinking occasion survey were devised based on the concepts in Table 1 and 2 within this chapter. For more information on which health-related characteristics and demographic information were collected within this survey, please see the measures described in appendix A of this chapter.

Creation of the context-specific survey questions

As outlined throughout this thesis, the development of the context-specific drinking occasion survey described in this chapter underwent many iterations in the process of development, refinement, and testing. Within Appendix B of this chapter, Table B1 displays the questions used within the context-specific survey at points throughout its development, namely (i) the questions after initial development; (ii) the questions after external review and PPI feedback; and (iii) the question wording after undergoing cognitive testing.

Defining a drinking occasion within the initial context-specific survey

When initially designing the context-specific survey, we had planned to ask participants to identify their own drinking occasions by providing the following instruction to participants within the survey:

"Over the next few pages we are going to ask you to recall the occasions in which you have drunk alcohol over the past 7 days.

We would like you to think of a drinking occasion as a period of time where you had no more than 2 hours between your drinks.

For example, if you had several drinks between 1pm and 6pm, as long as there was not a 2 hour gap between any of these drinks, this would be classified as one drinking occasion.

However, if you had two drinks between 1pm and 2pm and then did not drink alcohol again until 4pm, you should class this as two separate drinking occasions.

If you moved from one pub to another or from your home to a pub, this should still be classed as one drinking occasion unless there was a two hour gap between drinks."

A drinking occasion, defined as a period of time with no longer than a 2-hour gap between drinks, has been previously applied within the literature to conceptualise a drinking occasion (11,37). Given this, we felt that asking participants to classify their drinking using this definition would contribute to the literature on how to conceptualise drinking occasions.

Measures of drinking location (where)

After reviewing the concepts identified in the literature and within chapter six of this thesis, we felt measuring the following aspects of drinking location were suited for use in a context specific survey.

The first aspect measured was the type of drinking location within an occasion. This concept was deemed an important contextual characteristic to measure given that much of the previous literature focuses on both trade and venue type in explaining consumption (11,22,70), and by measuring drinking location findings our survey could be used to inform policy development. After reviewing measures of location type in the literature, we created a question similar to existing measures of location type used by previous studies (22,494) which allowed us to collect detailed information beyond knowing whether drinking happened in the on- or off-trade.

The second aspect measured within an occasion was the mode of transport to get to a drinking location. After reviewing the literature, we adapted questions on mode of transport used in the International Alcohol Control Study (IAC) and the wider literature for use in the context-specific drinking occasion survey (494).

Measures of drinking timing (when)

Given the importance both through theory and research of measuring the timing of drinking occasions (22), we created questions which measured the day of the week the occasion occurred on, if participants were on holiday during the past seven days, the time the drinking occasion started at, and the duration of the occasion. In initially creating these questions on drinking start time and duration (as outlined in Appendix B – Table B1), we decided to create categorical response options to allow individuals to select answers from a pre-defined list, as we believed it would be easier for participants to select a time and duration from a list of pre-determined answers. We also initially planned to work out end of occasion from looking at the duration.

Measures of drinking motivation (why)

In reviewing the concepts identified within chapter six of this thesis and the wider literature, we initially decided to measure three concepts of drinking: purpose, reason, and intention.

When reviewing the literature, it became apparent that many studies measured the purpose of the drinking occasion (i.e. the reason for attending an occasion) as the same as the reason why individuals may drink in an occasion (i.e. the reason for drinking within an occasion). In attempting to explore if any differences lay in individual's conceptualisation of these two concepts, we decided to create two questions, with the first asking "what was the purpose for the occasion?" and the second asking "why did you drink within the occasion?". In terms of creating response options for these questions, after reviewing the use of validated event-level measures used to capture drinking motivations, it was noted in chapter five that there were a limited number of studies using validated scales at the event-level to measure drinking motives.

When looking further at how these scales had been adapted for use in event-level research, most of the literature using these scales administered them on a daily basis rather than a location-specific or occasion-specific basis (495). As we had planned to measure drinking occasion motives on an occasion-specific basis, with individuals theoretically able to report on up to 7 occasions a week, we felt the use of any existing validated questionnaires on drinking motives, for example the DMQ-R-SF, when adapted for the event-level (111,495) would enact a high participant burden. Additionally, as noted in chapter six, at the time of creating the context-specific drinking occasion survey, drinking to cope with boredom and drinking due to habit or routine were not currently measured in any validated drinking occasion motive questionnaires or measures. As multiple assessments in the survey would have lengthened time and no validated measures or drinking motivations included items to assess drinking due to boredom and drinking out of habit, we decided to create response options where we asked participants to endorse motivation concepts (e.g. "Drank to alleviate a negative mood") rather than select items on a scale.

In measuring an individual's drinking intentions at the event-level, for every reported drinking occasion we planned to ask individuals how intoxicated or drunk they intended to get within this occasion. Individuals were also asked how intoxicated or drunk they actually got in order to assess for the role of intentions on event-level alcohol consumption.

Measures of drink type (what)

For each occasion we had planned to ask participants to report the types of alcoholic and non-alcoholic drinks they had consumed during each occasion and the number of serving sizes they had consumed of each drink type. In identifying the types of drinks we should capture within the survey, after reviewing the academic literature and national surveys measuring alcohol consumption including the Alcohol Toolkit Survey (496), The Health Survey for England (497), and the International Alcohol Control Study (494), we created a list of alcoholic and

non-alcoholic drinks which are outlined in Table 2 in Appendix B of this chapter. Given the recent market growth and research interest in low- and no-alcohol drinks (498), we made the decision to include these drink types as a separate category to non-alcoholic drinks.

Measures of accompanying activities (when)

In line with the findings of chapter six and after reviewing the findings within the wider published literature, we compiled a list of activities which individuals may engage in during a drinking occasion alongside drinking. In developing this list, we had planned for each activity type to be asked regardless of drinking location, as we believed this would allow us to learn more about what occurs in each location aside from drinking.

Measures of drinking companions (who)

When creating the initial survey, to create questions to measure drinking companions, we reviewed how questions had been operationalised in the wider event-level literature (11,22). To measure how individuals within the occasion may influence event-level alcohol consumption, we planned to ask individuals to report any children and other adults in the occasion regardless of whether they were drinking an alcoholic drink (See Appendix B – Table B1 for question wording). Following this, we planned to ask additional questions on the number of adults the respondent was with, the gender composition of individuals within the drinking occasion, the number of adults drinking an alcoholic drink within the occasion, and a question measuring how individuals felt their drinking compared to others in the occasion. Given the policy implications of children consuming alcohol, we adapted questions from the International Alcohol Control Study (494) to measure the amount and type of alcoholic drink children between the ages of 13-17 consumed (if any) within each occasion where children were present.

Other contextual measures not measured at an occasion level

To measure alcohol-related harms experienced each day we used items from the Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ) (499).

7.2.3 Stage Three: Testing the feasibility of the drinking occasion survey

3a. Feedback from external experts

As advised by Dillman et al. (480), once the first version the survey was drafted based on the measures covered in this section, we circulated the draft to academic researchers who were eminent in the field of drinking occasion research. We asked for feedback in relation to the following areas: the importance of the questions included, if any questions were unnecessary or missing from the survey, and comments on the question wording. Six academics were contacted and agreed to provide feedback, the summary of which is outlined below.

In relation to how drinking occasions were initially conceptualised, most experts liked the 2-hour definition, given that this was adopted from the paper by Mustonen et al. (37). However, some experts felt days of the week could be used instead of the 2-hour definition, as they felt this would be easier for participants to comprehend. In getting participants to apply a 2-hour definition to their drinking, experts were concerned that participants may not be able to recall the characteristics of their occasions reliably or accurately. Furthermore, given that drinking was not being recalled based on a location-specific basis (e.g. within the home), experts felt that we would have a lack of knowledge in how much participants drank in each location and trade type (e.g. on- and off-trade), which ultimately may have limited the cross-study comparability of quantitative findings from the context-specific drinking occasion survey.

In entering the occasions participants had over the previous week, one expert felt that the survey could present participants with a virtual calendar timeline which could assist them in recalling their occasions. Whilst this would be useful from a visual perspective, the amount of pre-testing work which would be required for this was considered outside the scope of this thesis.

As outlined in the previous section of this chapter, the start and end time of the occasion was initially designed to be categorical with a label applied to each time period, e.g. lunchtime. Across expert feedback there was a consensus that participants should be able to select the start and end times based on a 24-hour clock, as this would allow for more precision in estimating the occasion duration. Additionally, experts were opposed to the concept of applying a 'label' such as lunchtime as this would not fit everybody's routine and may lead to participants selecting based on a 'label' rather than a time. One expert suggested using a visual timeline to allow participants to enter occasion.

When looking at the reasons for drinking within each occasion one expert provided a copy of an early version of the 20-item Drinking Motivations Questionnaire for Adults which is currently undergoing validation. Whilst this measure was applicable to adults the measure was not an event-level one, so the decision was made not to include this. However, based on expert feedback we added in a question which aimed at capturing habitualised and routinised drinking.

Finally, in providing feedback on the other activities which may occur within the drinking occasion, experts suggested the addition of cooking and eating a meal as two separate response options, given that these activities may occur in different contexts, e.g. cooking a meal at home vs eating a meal in a restaurant. Initially using cannabis was included within a category called 'using illicit drugs'. Experts recommended two key changes here. Firstly, experts recommended changing the category to 'using recreational drugs', given that this label may be less judgemental. Secondly, experts felt that cannabis use may be more widely prevalent than other drugs, and therefore recommended that 'using cannabis' and 'using other recreational drugs' became separate response options.

3b Advisory Public and Patient Involvement (PPI) group

In developing the drinking occasion survey, we felt it was important to incorporate an element of public and patient involvement (PPI) into the process by involving individuals with lived

experience of alcohol use in assessing the suitability and appropriateness of questions. Previous research has documented how actively involving individuals with lived experience in the research process is beneficial in creating meaningful research (484,485). Members of the Sheffield Addiction Recovery Research Panel (ShARRP), an established PPI group formed of individuals who have had personal experience of dependent or problematic drug and alcohol use as well as carers, partners, or relatives, were approached and asked for feedback on whether the questions chosen were suitable in content and were comprehensible to a lay audience. Two PPI meetings took place during the development of this survey, with one session occurring in September 2020 to provide feedback on the survey and a second session occurring with the same individuals in November 2020 to review changes made to the survey based on their feedback. During these focus groups, attendees were presented with an initial draft of the questions and asked for their feedback. Specifically, attendees were asked to comment on how easy the questions were to understand and whether they felt the questions were appropriate (e.g. not unnecessarily intrusive) to be asked within a survey on drinking occasions. Feedback from this session contributed to the development of questions for inclusion within the final survey.

From these meetings there were two main points of feedback. Firstly, the PPI group recommended we change the definition of a drinking occasion to reduce cognitive burden for participants. In the initial meeting with the PPI group, drinking occasions were defined as a period of time where participants had "*no more than 2 hours between drinks"* which is similar to the approach taken to defining drinking occasions within academic literature (11,37). To help contextualise this definition, there was further instruction provided in the survey:

"*For example, if you drank between 1pm and 6pm and had drinks without a 2 hour gap this would be classified as one drinking occasion. However, if you had drank between 1pm and*

2pm and then again from 4pm till 6pm these drinking events would be classified as two separate drinking occasions."

Within the first PPI meeting, attendees expressed that this definition was hard to comprehend, with the primary reason being the definition provided was too wordy and required them to re-read the question multiple times to understand what was being asked of them. From this feedback and in line with the expert feedback above, we made the decision to adapt the way we operationalised our definition of drinking occasions. Instead of asking them to categorise their own drinking occasions by using the "*no more than 2 hours between drinks*" rule, we decided to ask participants to firstly select the days on which they had consumed alcohol on over the past 7 days, and to then select up to three locations where they had drunk alcohol each day. In doing this, we felt it would impose less participant burden as it would require less cognitive effort to recall the days on which they drank and then the locations, rather than asking respondents to remember time between drinks. However, it allowed us to still impose our definition of a drinking occasion on the data as we could separate distinct occasions based on their being less than 2 hours between drinking in different locations. When presenting this new version of the survey to members of the PPI group in November 2020, attendees felt the question wording was much clearer.

Secondly, the PPI group felt the difference between the '*purpose for drinking occasion'* and '*purpose for drinking'* questions was not explicitly clear. Following this feedback, we decided to add additional text to these questions and change the formatting of the question to include bold and underlining of text to make this distinction clearer. The new questions were presented to the PPI group in November 2020, with the attendees feeling that the questions were more distinct from each other.

3c: User-testing of the Qualtrics Survey: 'Think Aloud' study

The following section describes the final stage in developing and testing the context-specific survey. Cognitive interviews using the 'think-aloud' technique were conducted to assess whether the questions used to measure the contextual characteristics of a drinking occasion had face validity and to identify any technical challenges to using Qualtrics as a survey platform.

Considerations and Adaptations due to COVID-19 Pandemic

Development of general topics to be included in the drinking occasion survey commenced in February 2020. In March 2020 the spread of COVID-19 resulted in the UK entering a national lockdown on 26th March 2020, where individuals were instructed to stay in their homes. Following this initial national lockdown, a cycle of national lockdowns and local restrictions were put in place to curb the spread of the pandemic (181). As a result of the lockdowns, all on-trade establishments such as pubs, bars and restaurants stopped trading with immediate effect. During the first and subsequent lockdowns and related restrictions the contexts and ways in which people drank differed from pre-pandemic levels; namely that as drinking in on-trade locations was not possible, drinking within the home increased (500).

The research informing the survey development occurred prior to the COVID-19 pandemic and given that at the time of developing this survey there was limited knowledge as to how long the pandemic would last for, the survey was developed for use in a non-pandemic environment as we wanted to capture how individuals within on- and off-trade establishments drink. Given that the PhD is time limited, and the research needed to be completed within a time frame to allow for the cross-sectional study to collect and analyse meaningful data on drinking occasions post-lockdown, we made the decision to proceed with the cognitive interviews remotely in December 2020, at a time when the UK was in a 'tier' system. Given that all participants would have worked at the University of Sheffield, and at this time Sheffield

was in ‘Tier 3’ (all pubs and restaurants were forced to close), we assumed participants were not able at this time to drink in on-trade establishments (501).

To test the understanding and appropriateness of questions specific to the on-trade, we asked half of respondents to think back to a time when they would drink in on-trade establishments. As a result, the quantitative data collected as part of this study may have additional biases related to the longer recall period given as some respondents were recalling data from months prior. Given the main purpose of this study was to establish the face validity of the questions and ensure that the format of the survey was user-friendly, we felt that continuing with the cognitive interviews at this time but making changes to the procedure was an appropriate alteration, given that the alternative was collecting no data about on on-trade drinking occasions.

Sampling and recruitment procedures

Sampling

In a review of sample sizes used for cognitive pre-testing, Conrad and Blair (502) found there to be little guidance on appropriate sample sizes within the existing literature. After attending a Social Research Cognitive Interview training seminar conducted by NatCen Social Research, it was advised that a minimum of six individuals should be recruited for each version of the survey, and that changes to the survey should be made once all cognitive interviews for that version have finished. To be eligible to take part in the cognitive interviews, participants had to be aged 18 and above, drink alcohol at least once a week, and be a non-academic member of staff at the University of Sheffield. A non-academic staff sample has previously been used in research developing and evaluating survey measures (490) and therefore can be considered suitable for use within the current study.

Recruitment

Participants were recruited through an email sent via a University of Sheffield staff volunteer mailing list. Within this email, potential participants were directed to email the principal investigator (PhD student) to check eligibility and to book a testing slot. We initially planned to recruit 6 non-academic members of staff, with this sample split between genders (3 males and 3 females). However, due to COVID-19 and the national tiered lockdown, we realised that having all participants completing the survey based on their past week's drinking would limit the usability testing, as these participants would only be recalling off-trade drinking occasions. Therefore, we decided to widen the sample to 10, with the sample split between those who recalled their previous week's drinking and those who recalled at a typical week pre-COVID, as this was more likely to include drinking in on-trade locations. Due to over-recruitment, we ended up with 11 participants (5 males, 6 females) taking part in a cognitive interview. Six participants recalled their drinking over the past seven days, whereas five participants recalled their drinking in a typical week pre-pandemic.

Procedure

Whilst the previous sections of this chapter have described the development process taken in identifying and developing questions for inclusion in the drinking occasion survey, it is important to also consider which mode of administration is most appropriate for this survey Given the context in which data collection occurred, any face-to-face data collection techniques would have been impractical given the COVID-19 pandemic restrictions (181). Additionally, given that the purpose of this thesis was to create a comprehensive drinking occasion survey we felt that EMA data collection measures would not allow for a survey of this length to be repeatedly tested. As noted in chapter five, most studies collecting data on event-level alcohol consumption used online modalities. Within the wider literature there has been an evidenced rise in self-completion web-based surveys in research (182,183). The use of online surveys in

research has clear advantages as data can be collected quickly, remotely, and at a relatively low cost and burden to participants (184).

In deciding which online platform should be used to host the survey, at the time of data collection Qualtrics was the only GDPR compliant survey platform recommended by the University of Sheffield's ethics committee and therefore identified as the most suitable platform (185). Qualtrics is an internet-based survey platform which offers a dynamic interface for survey design and includes features to help reduce participant burden such as the ability to include filter questions to route participants to only questions which apply to them (186). Qualtrics is also widely used as a survey platform to collect data within a range of government and academic research projects (186,187).

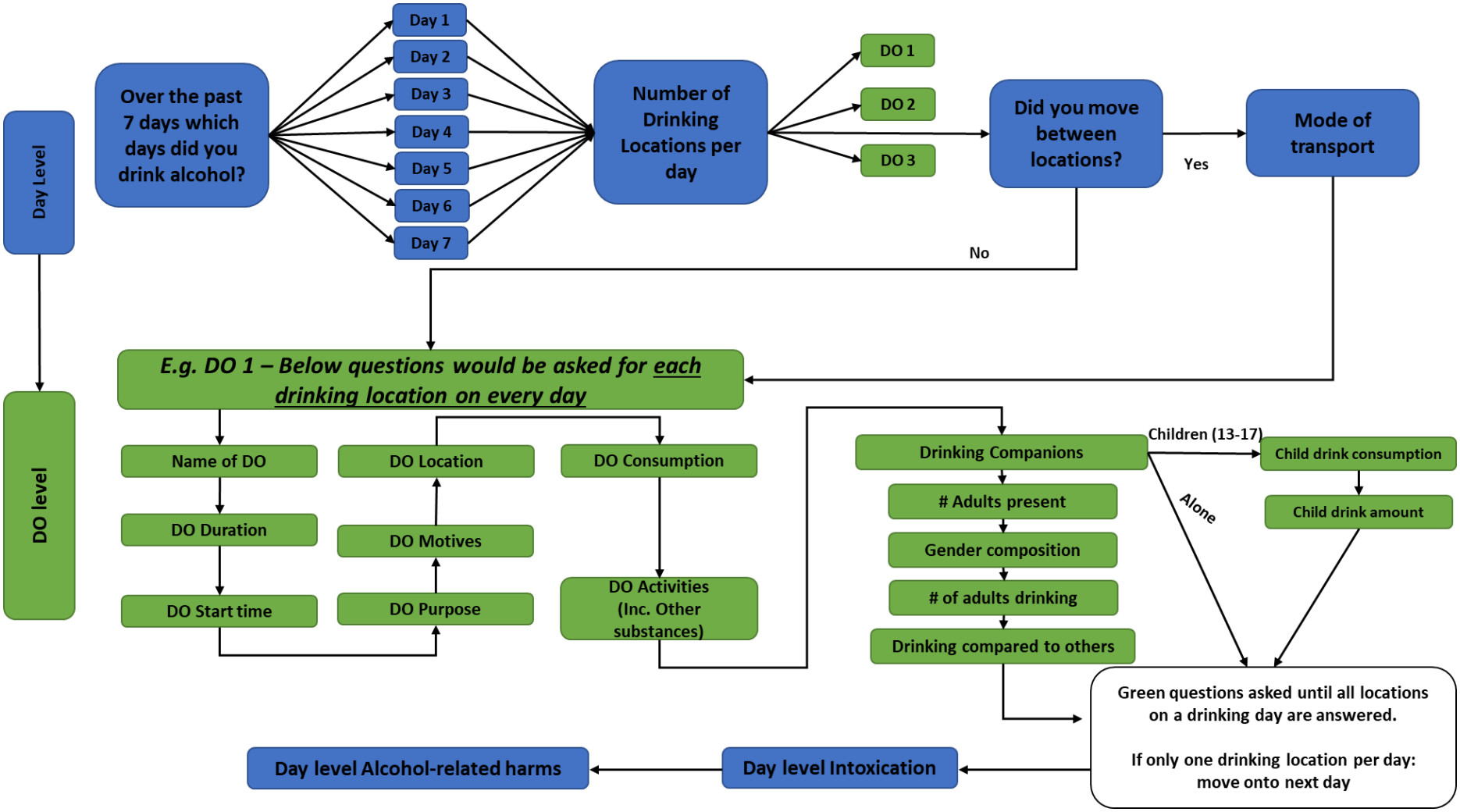
In building the survey, each set of day and location questions were built into separate survey blocks to allow participants to complete the survey in the most efficient manner. To ensure that participants provided adequate information to complete the survey, we added question validation to some questions to ensure that answers were given; for example, when asking participants to select which drink type they had consumed, participants had to select at least one type of drink (i.e. beer or cider) to continue with the survey. Participants completed the survey as illustrated in Figure 1, with questions in blue asked for each drinking day (e.g. Friday) and questions in green asked for each drinking location (e.g. Drinking at home).

Participants were asked to report their drinking occasions occurring within the past 7 days or pre-pandemic. Interested participants were contacted and invited for an online testing session at their convenience. After reading the information sheet and providing written consent, participants were told the purpose of the study was 'to assess their experiences of using the drinking occasion survey' and that they would be presented with instructions from the interviewer on how to complete the 'think-aloud' study. All cognitive testing interviews took

place online via Blackboard Collaborate, a platform which allows for video conferencing has screen sharing facilities for laptop devices. All respondents were allocated an interview time slot by the interviewer and were sent a secure link to the interview session in advance. All participants completed this survey using a tablet or laptop/computer device. We had initially planned to complete user-testing on mobile devices but given that mobile screen sharing at this time was unfeasible we decided not to proceed with this. Once participants started to complete the survey, they were asked to share the internet window which displayed the survey with the interviewer. Given that we planned to analyse the data they provided to assess the validity of the survey, participants were encouraged to complete the survey as honestly as possible. Participants were informed that their interviews would be screen recorded which would capture both their screen and video, and any answers they entered within the survey would be stored in an anonymised format.

Participants began the interviews by completing the 'think-aloud' portion of the study. In line with previous research suggesting participants should be given time to practice verbalising their thoughts (491), participants were asked to verbalise their thoughts in response to the following statement devised by Willis, Caspar and Lessler (503) "*Try to visualize the place where you live, and think about how many windows there are in that place. As you count up the windows, tell me what you are seeing and thinking about*." (p. 4). The interviewer provided the participant with an example of the think aloud technique to the above statement, and the participant was asked to practice prior to the survey starting. After completing this activity, participants were sent a link via the Blackboard chat to the survey hosted on Qualtrics. Once respondents provided consent to take part in the survey, indicated by selecting boxes on an online consent form, the interview began recording. Participants were reminded again to try and verbalise their thoughts aloud to the interviewer, with the interviewer noting any non-verbal behaviour relevant to the completion of the questionnaire, such as nodding or frowning.

After completing the ‘think-aloud’ portion of the study, which took approximately 45 minutes, a brief semi-structured individual interview lasting approximately 15 minutes was conducted with participants where they were asked questions in relation to their user experience, such as how they found the visuals of the survey. Once participants completed the semi-structured interview, they were fully debriefed and compensated with a £20 Amazon voucher for their participation, with this amount paid to participants in a similar study (490).



Key: DO: Drinking Occasion

Figure 1. Schematic diagram of survey flow on Qualtrics tested within cognitive interviews

Planned Analysis

Once participants had finished the interview, the video recording of both the 'think-aloud' study and the individual interview was transcribed by the primary researcher, before being transferred to NVivo12 for storage and analysis. All verbatim data underwent content analysis to identify key findings in relation to the user experience when completing the survey, and to assess whether the questions included had face validity. Findings from both the cognitive interviews and early stages of survey development outlined in this chapter were combined to produce a final version of questions which were used within the final study of the PhD.

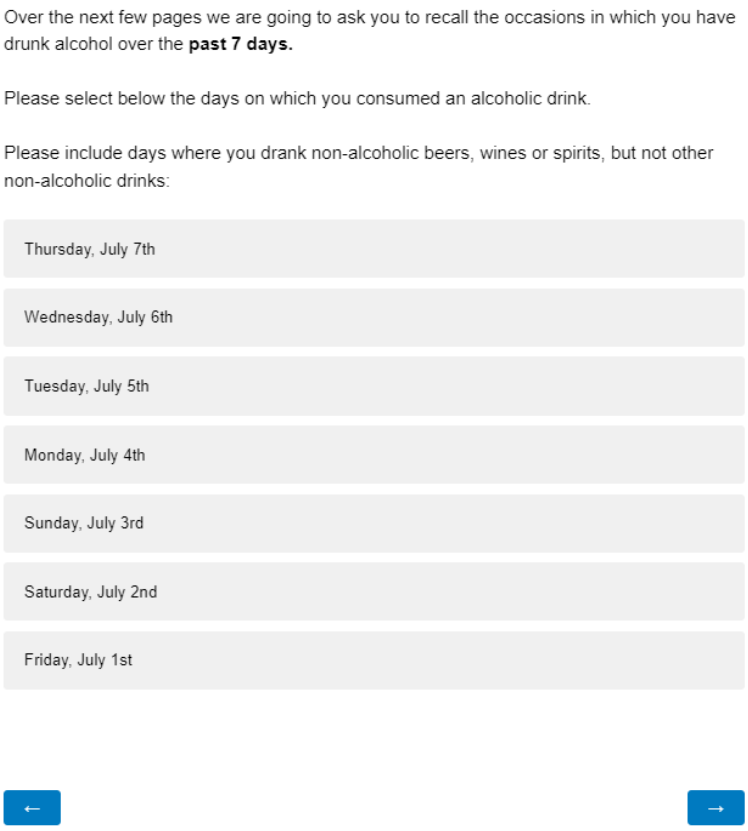
7.2.4 Findings from cognitive interviews

Across the 11 participants completing the cognitive interviews, participants on average reported drinking on 3 days (*SD* = 1.26) during the 7-day recall period. Most participants reported drinking at only one location per drinking day, with only 3 participants (27.3%) reporting drinking at more than one location per drinking day.

In general, when recalling answers to questions most participants tended to naturally mention contextual information about their drinking, for example participants would naturally mention who they were with and what they were doing at the time of drinking (e.g. catching up with friends) when recalling the days on which they drank.

Generally, participants encountered few problems with the survey and feedback mostly focused on identifying areas for improving wording clarity and user experiences of the survey. For each section of the survey we report specific findings for questions grouped by contextual characteristics before documenting the recommendations and changes made to the survey based on this feedback. To illustrate how the survey was displayed visually to respondents, screenshots of questions are provided throughout this section.

Survey instructions: selecting the days they drank on



Findings

In general, the wording of this question was well understood, as most participants were able to identify that they needed to select the days they had drank on over the past seven days. One participant found the information given within the question to be slightly '*wordy*' which resulted in them spending an increased amount of time reading the question. When identifying which days participants had drunk on, some participants worked from the earliest date backwards, while others worked from the furthest date to the earliest one. One participant read the survey instructions but proceeded to the next page of the survey without selecting any drinking days. When this happened, this participant was routed to the alcohol-related harms

questions at the end of the survey, which resulted in the participant re-entering the survey and lengthened the time spent completing the survey.

When selecting drinking days, most participants verbally considered the contexts in which they drank in anchoring their drinking days, for example one participant said they knew they had drank on a Thursday because this was the day they do a virtual pub quiz with their family. Three participants used their mobiles to locate their electronic calendar when reflecting on what they were doing over the past seven days. Other participants found selecting their drinking days very easy because of the 'rigidness' of their drinking, in that they drink on the same days every week.

In relation to the text '*please include all alcohol-free drinks including non-alcoholic beers'* some participants remarked that they do not drink these types of drinks anyway. This shows that this information is being read.

Changes made to the survey

To ensure participants were not able to proceed through the survey without selecting at least one drinking day, force validation was applied to this question within Qualtrics. Applying this change ensured that respondents who did not select any drinking day were not routed to the context-specific survey, but were routed to the end of the survey

Drinking location *(Where)*

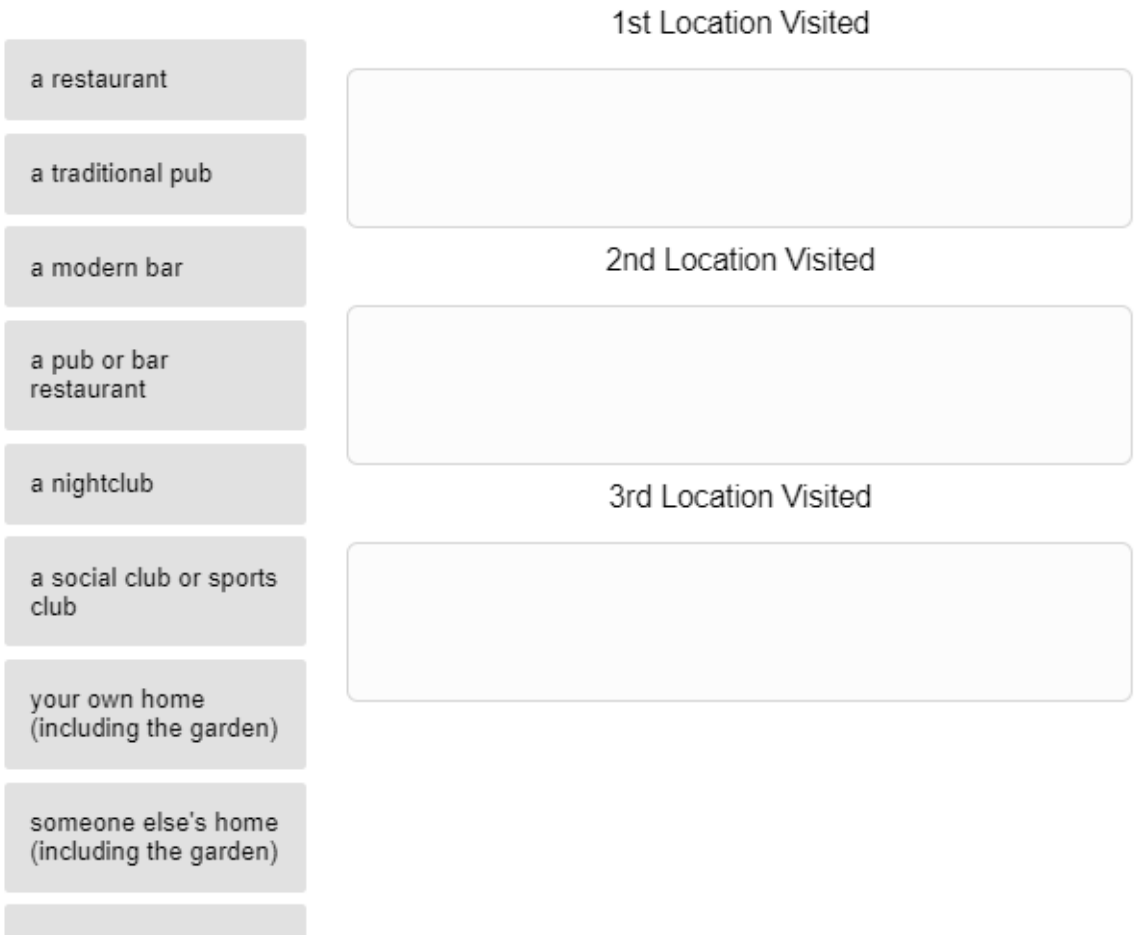
Locations findings

To help us understand more about your drinking occasions over the last week, we want to create a timeline of your drinking on each day.

Please select the types of locations you drank in on **Thursday, July 7th** and the order you visited them by selecting the location on the left of the page and dragging it to the appropriate box. For example, if you visited three traditional pubs before going to a restaurant, the 1st location you visited would be a traditional pub and the 2nd a restaurant.

If you visited the same location type twice, for example, you visited traditional pubs (1st), then a restaurant (2nd) and then visited a traditional pub afterwards (3rd), you should use the *'other'* option at the end of the list and write the location type (e.g. traditional pub) in the text box.

On **Thursday, July 7th,** which of the following locations did you consume alcohol within?



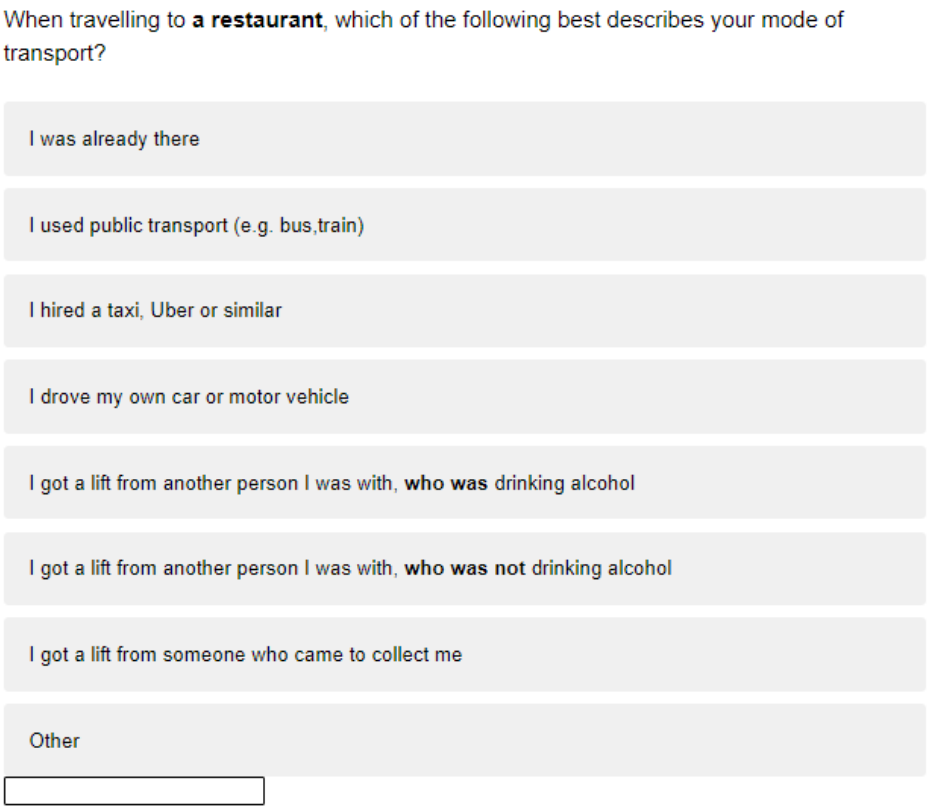
When accessing this page, some participants read the date embedded. Some participants found the description of locations a little wordy.

For some participants who selected ‘Other’ as the drinking location, whilst there was a text box to allow for free-text entry this text did not embed within future questions about this location. This resulted in the location ‘Other’ showing for participants in later questions, which was confusing.

For those who had multiple drinking days at the same location, i.e. home, participants found this easy to select and drag into the location boxes. A few participants reported difficulty in dragging the location boxes across to order them.

Within the participants who were instructed to recall their past week’s drinking, there was reflection on their pre-lockdown drinking habits and how these had changed since the tier system. A few participants felt that that their drinking locations had not changed much due to restrictions, as they had always drank at home predominantly. However, others reflected that lockdown had changed their drinking locations substantially, with one participant expressing that pre-lockdown they would have gone to a pub and had a more varied occasion, e.g. more locations in one drinking day. Another participant expressed that they had begun to drink in the park on a walk as this was legally allowed at this time.

Travel findings



All participants read the options fully. In recalling their mode of transport, as most of the participants were in Tier 3, these participants found it easy to select the option that they were '*already there'* at their drinking location.

Some participants who were recalling or reflecting on their drinking occasions pre-lockdown said that if they were drinking outside of the house they would typically not get a taxi but instead might use public transport or more typically walk. As participants were not able to select 'I walked' from the pre-determined answers, participants entered this as an 'other' response.

Changes made to the survey

Location

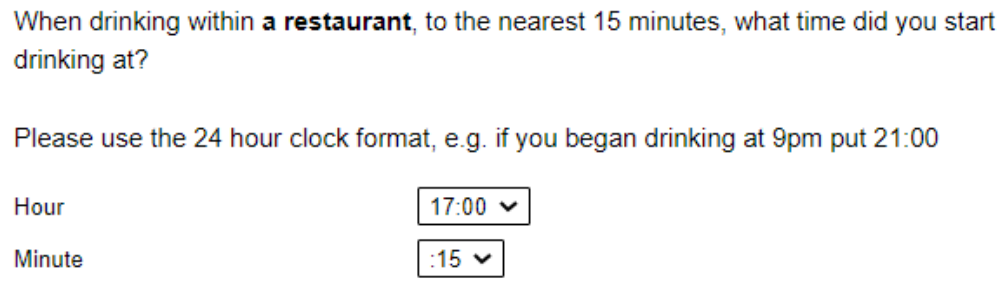
To ensure participants could accurately answer the survey based on their drinking location, when selecting 'other' as the location option, the survey programming was changed so that

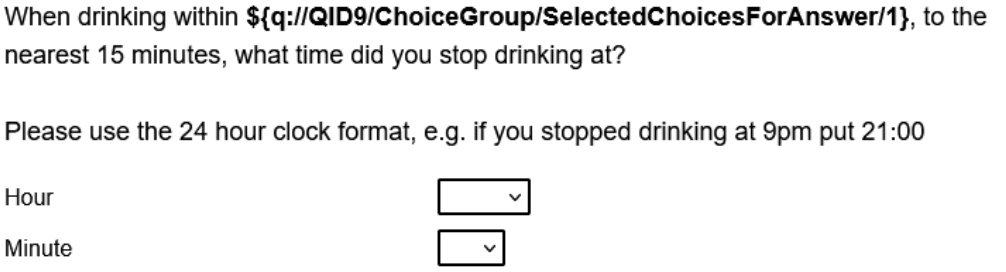
the free text written next to this location would flow through the survey and would be embedded in questions which ask location specific information.

Travel

Given the high frequency of participants selecting 'other' as a mode of transport and within free-text typing 'walked', we added *'I walked'* as a response option for the travel to location question.

Drinking timing (When)





Start and finish time findings

In general, participants selected the answer which they had verbalised as being their start and stop time correctly using the 24-hour clock format. Only one participant did not enter their time in a 24-hour format, i.e., entered 09:00 when they verbalised it was 9 o'clock in the evening.

One participant thought it was the start and finish time for the whole day, rather than being location specific.

Some participants reported some frustration at having to select the minute time separately if they began drinking at a time which ended in :00, e.g. 21:00. However, for most participants this was not a problem.

Again, most participants used contextual factors to determine their start and finish time, for example starting of the dinner, finishing of work or the starting of a television show. When finding their stop and start time on a walk where they drank beers, one participant used the application Strava to look at their logged start and finish time.

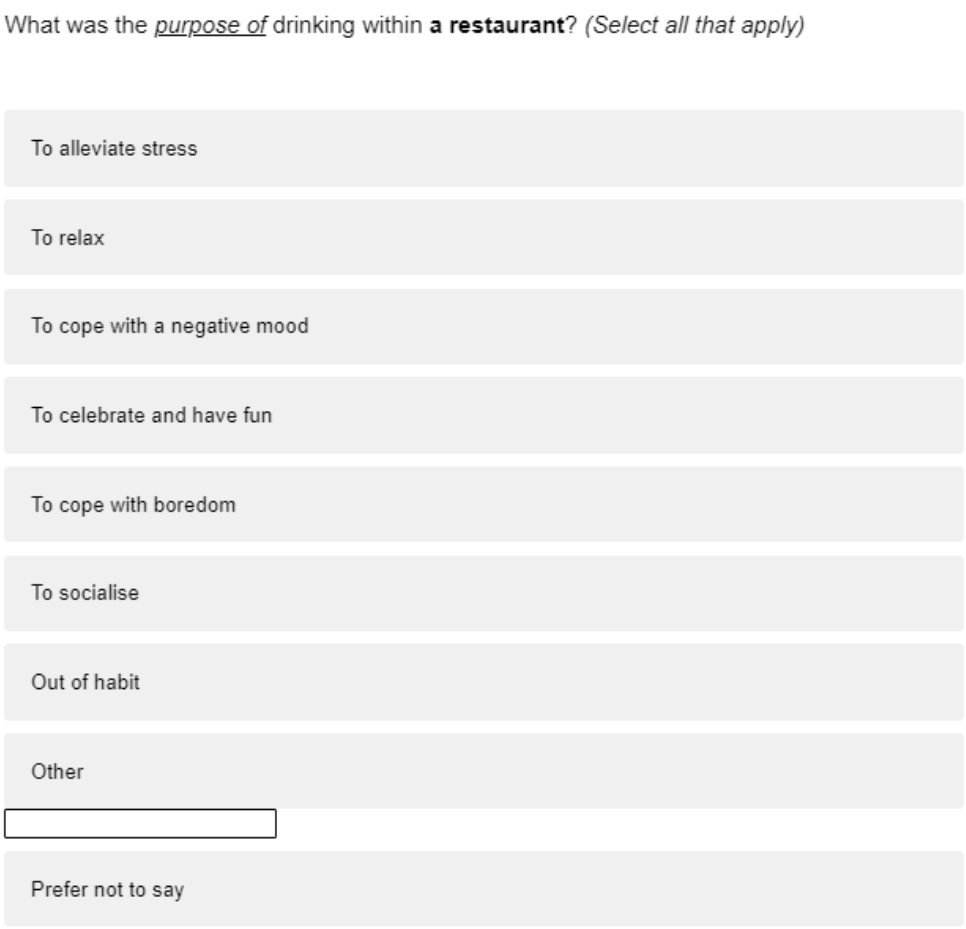
Changes made to the survey

Start and finish time

To ensure participants would report the start and finish time of their drinking at each location ***only*** rather than the entire drinking day, we made the decision to add the day of drinking into the question to make this more contextually salient: "*On Monday 14th December, when drinking in a restaurant...*"

Drinking motivations (Why):

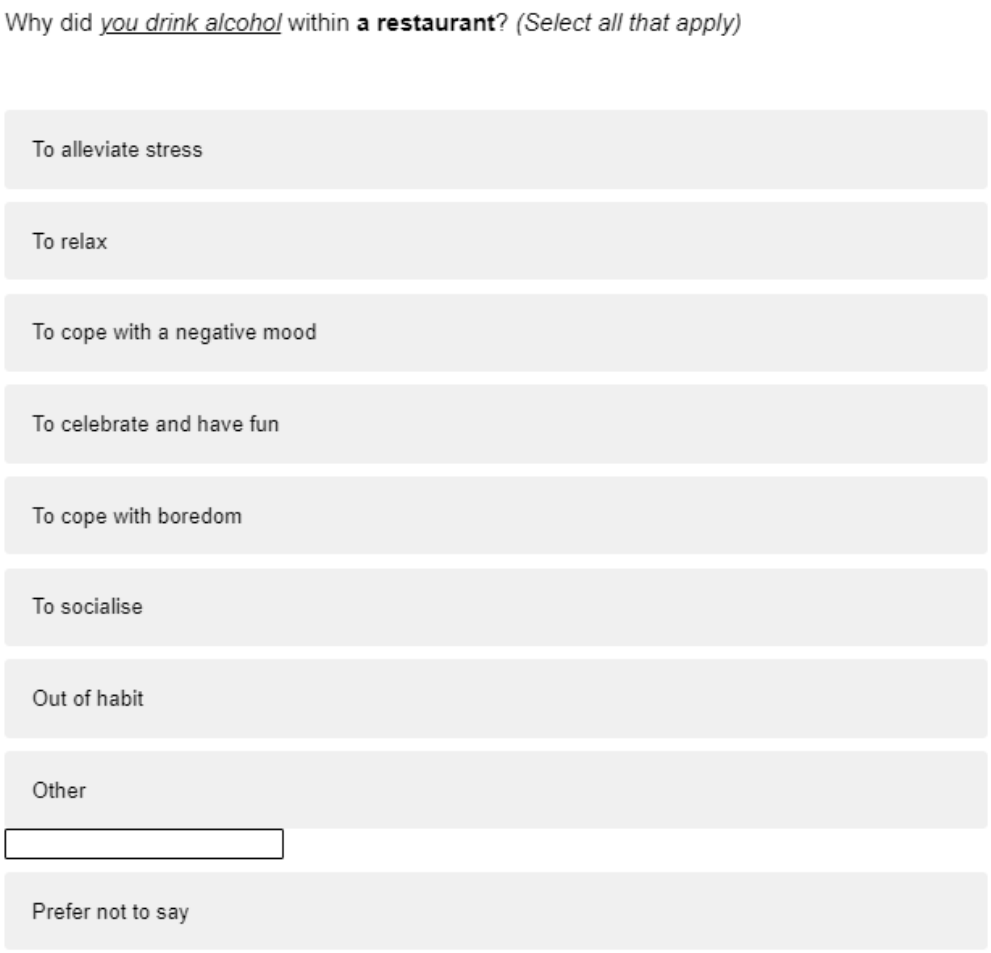
Purpose



Most participants found the question asking about drinking occasion purpose clear to understand. Most participants related the purpose for drinking to the specific drinking day and location, with only one participant speaking about their purpose for drinking occasions in general.

Participants were able to distinguish between the different motivations for drinking well, with all participants able to select a motivation for drinking purpose depending on the occasion, with the most common combinations of motivations being '*To relax*', *'Out of habit*' and *'To socialise*'. When thinking about their drinking motivations, most participants thought about the reason for drinking, with some participants saying they were '*At a work party'*.

Reason



When reaching the question asking for the *reason why* participants drank in the location, some participants expressed confusion. For some participants, they felt this question was a duplication of the previous question asking about the purpose for drinking, with some participants verbally expressing '*I thought I had answered this question already*', while other participants selected the back button to check whether this was an error. Even though these participants expressed confusion over this question, most participants did select additional reasons for why they drank when compared to the previous question asking about purpose for drinking. In probing after the cognitive interviews, the wording of this question was discussed with participants. When discussing with participants the differences between the reason for *attending* the occasion and the reason for *drinking* in the occasion, most participants reflected

that these were indeed different. For example, one participant said they would go to the pub with work colleagues to socialise but they would have a drink to relax after a stressful week. Most participants felt that this distinction should be clearer to aid their understanding, with other participants feeling that as most of their drinking occasions take place within the home, they felt the purpose for attending and reason for drinking was the same, whereas if they were to drink outside the home it would be different.

Changes made to the survey

Purpose and Reason questions:

Whilst some participants felt a clearer distinction could be made between the purpose and reasons questions, when examining the response options participants provided most respondents did select different response options for these two questions, and through their verbalisations did express different reasons for drinking within an occasion compared to attending a drinking location. Given this, we decided to leave both questions in the survey and to evaluate the utility of including both questions after collecting the cross-sectional quantitative data in chapter eight before providing recommendations on these questions.

Given that most participants thought about their drinking purpose by thinking about their activity e.g. 'I was at a party', we decided to add an additional question which was taken from the Finnish Drinking Habits Study (69) and adapted to a UK audience by removing the option of '*At the sauna'*:

New question:

Which of the following best describes your drinking occasion within **[Location]?** *(Select one)*

- Paying a visit (others visiting your home or you visiting someone else's home)
- Entertainment, game and hobby
- Festive occasion or party
- Meal
- No Special occasion
- Other *(Please specify)*

Drink type (What)

When drinking in **a restaurant,** please select which of the following drink types you drank:

- Beer or cider
- Wine
- Spirits, liquors or shots
- Cocktails or Alcopops
- No-alcohol and Low alcohol beer, cider and wine
- Non-alcoholic drinks

Most participants accurately selected the drink types which they had consumed within the drinking location. One participant selected 'cider' as being drunk, but when asked to report the serving size and amount of cider consumed within this location left it blank.

For some participants there was a programming error where if one of the day options was selected (current day-3), participants were shown the beer drink types even if they had not selected beer.

When drinking within **a restaurant,** please select which of the following types of **Beer or cider** you drank (*Select all that apply)*

- Normal strength beer/ lager/ stout (less than 6% by vol, e.g. Budweiser, Becks, Stella)
- Strong beer/ lager/ stout (e.g. Tenants Extra, Special Brew)
- Normal Strength Cider (less than 6% vol, e.g. Magners, Kopparberg)
- Strong Cider (e.g. Diamond White, Frost Jack, Pulse, K Cider)

Please select the serving size and amount of **beer or cider** you drank in **a restaurant**

If you only drank half a serving, e.g. half a pint, please enter 0.5:

	Normal Strength Beer	Strong beer	Normal strength cider	Strong Cider
Pint	☐	☐	☐	☐
Small can (up to 330ml)	☐	☐	☐	☐
Standard can (440ml)	☐	☐	☐	☐
Large can (500ml/ pint)	☐	☐	☐	☐
Small/ Continental bottle (up to 250ml)	☐	☐	☐	☐
Standard bottle (330-440ml)	☐	☐	☐	☐
500ml/ pint bottle	☐	☐	☐	☐
Jug/ pitcher (2L)	☐	☐	☐	☐

Most participants selected they had drunk either Wine and/or Beer and Cider. The only feedback on the subcategories was, in reading the strength of the strong beer, some participants verbalised that the 6% beer was '*very strong*'.

All participants were able to correctly enter the amount of alcoholic drinks they had verbalised drinking, with all participants able to find a serving size of each beverage that matched the way they wanted to answer. When drinking from a standardised size, e.g. pint of beer, participants reported feeling more confident in recalling this correctly. However, when participants were reporting their spirit and wine intake, some participants felt less certain on the exact serving size.

When reporting their wine consumption, most participants tended to report their consumption in relation to standard bottle sizes, for example 1 bottle or 0.5 bottles, with only one participant using the option of '*glasses (unspecified size)*'. For mixed drinks, for example gin and tonics, participants selected spirits as the drink type and then entered the measures as either single or double measures where applicable. This way of entering drinks converged with our expectations of how this question should be completed.

Changes made to the survey

Drink type:

Given that some participants felt uncertain about the size of their drink, particularly when reporting wine consumption, we felt that keeping 'glasses (unspecified size)' as an option would enable participants to still report that they had consumed wine, but without pressurizing participants to guess a serving size.

Whilst some participants felt that the strength of the strong beer was very strong, this was a standard definition of what strong beer and cider is classified as and was taken from The Health Survey for England (504). As a result, we left this definition of strong beer.

Activities accompanying drinking (When)

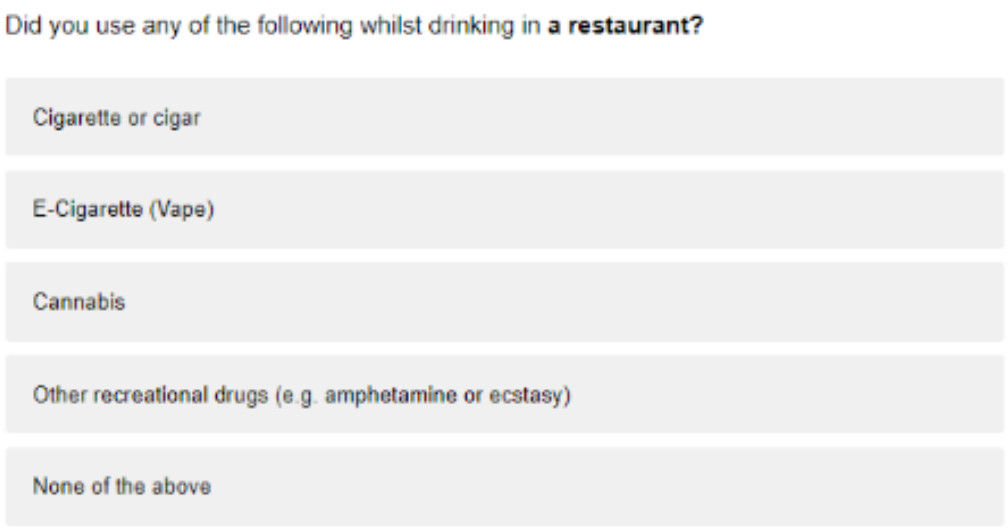
Activities

All participants were able to find response options which corresponded with the activities they were engaged in whilst drinking. When thinking of these activities, all participants thought back to the specific drinking location and day.

For respondents who expressed that they did other activities not on this list, they were able to select the '*other (please specify)'* option and type this activity in the free text box. For the three participants who added activities not on the list, these included '*karaoke*', '*walking and talking*', and '*gossiping*'. In probing after the completion of the survey, none of the participants reported any difficulty with using the free-text box and said they liked the option to add activities not already on the list.

Amongst the varied options selected by respondents, '*speaking with people over videoconferencing*' was selected frequently. Given the time in which these cognitive interviews occurred, it is likely that the high endorsement of this activity may be related to the lockdown and may not be as prevalent pre- and, with less certainty, post-pandemic.

Other substances



Most participants selected the *'None of the above'* response options. Some participants reported using cigarettes in their drinking occasions. No participants selected using illicit substances. A few participants who were non-smokers, generally those who had drank on multiple days within the past week, found having to select '*None of the above*' every time slightly frustrating, and felt there should be an option to select 'non-smoker' and not be shown this question again.

Changes made to the survey

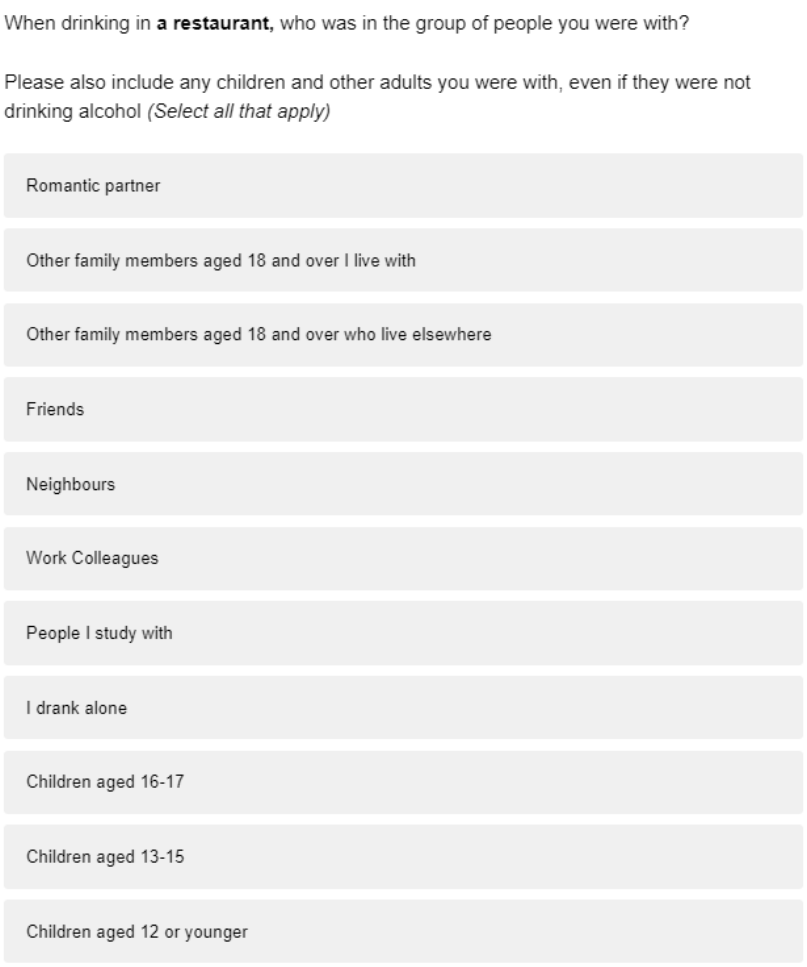
Activities accompanying drinking

Given that the list of activities already requires participants to scroll up and down their screen, to ensure participants were not overly burdened we made the decision to not include

any more activities to this list. Whilst some respondents did verbalise that they did partake in activities not on this list, all these participants selected the '*other*' response option and in the free-text box typed the activity that they engaged in.

Whilst some respondents were frustrated with having to select *'None of the above'* every time they answered this question, other respondents who selected '*None of the above*' for some locations, did then select *'Cigarettes'* for later locations. Given this, we have decided to leave this question in the survey and to ask it to all participants to ensure we capture all other substance use in occasions.

Drinking companions (Who)

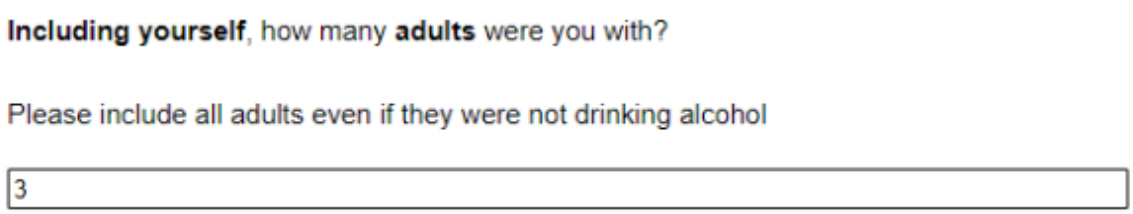


Who you were with

All participants were able to select a response option from this list, with most participants selecting that they drank with their *romantic partner*. When thinking about who they were within each drinking location, there was some debate within participants about how to conceptualise the other people in the occasion when using video conferencing. This was because the people who they were drinking with were not physically present, but they were there virtually. Amongst most participants, there was a tendency to classify any virtual others as being within the location, for example participants who were drinking at home with their romantic partner but were on a videocall with their friends, selected **both** romantic partner and friends as response options. However, for two participants who were recalling a week during the Tier 3 lockdowns, the use of videoconferencing whilst drinking caused participants to

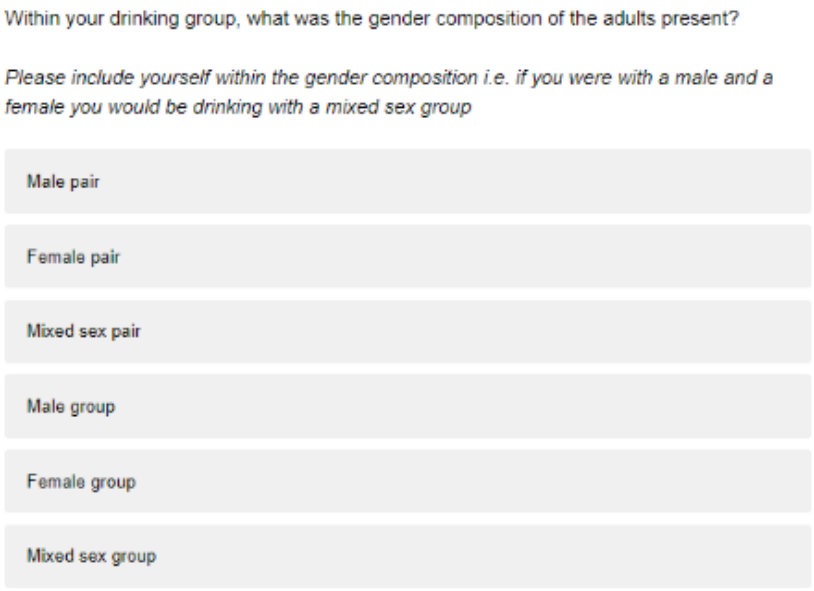
become confused at this question, with two participants selecting drinking with other people. e.g. friends and people they study with, in addition to selecting that they drank alone. This was particularly problematic for the survey as when participants select that they drank alone, they are not asked any other drinking companion questions to reduce their burden from being shown unnecessary questions. This problem was limited however to those who recalled their drinking during the previous week in Tier 3 lockdown rather than their pre-pandemic drinking. When comparing these two groups, none of the participants who recalled drinking pre-pandemic entered that they drank both alone and with other people.

How many adults



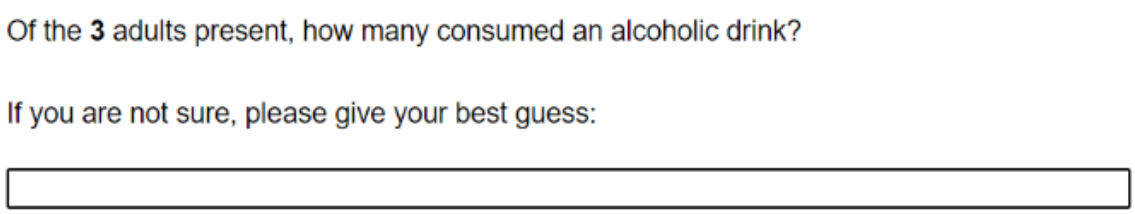
Most participants read the question and realised that they needed to include themselves in the total count, with these participants saying the instructions on this page were clear and easy to understand. Two participants initially did not count themselves, but when getting to the question asking how many consumed an alcoholic drink, returned to this question, and amended the number of adults in the occasion. All participants noticed that they needed to put the number of adults they were with, even if these adults were not drinking, and this was evident through their verbalisations when answering this question, for example '*There were three adults, even though my husband did not drink*'.

Drinking composition by gender



This question was well understood by participants with all participants able to select an answer from the response options presented to them. Where participants drank in a group of two adults, all these participants selected a drinking pair option, with participants drinking in groups of three and above selecting a drinking group option.

Number of adults drinking within the occasion



This question embedded the answer given to the question *'Including yourself, how many adults were you with'.* All respondents noticed the number within the question, with respondents feeling this was useful to remind them of the number of people they were with. Participants were able to type a number in the box, with all participants typing a number which was same as or lower than the number of people in the drinking location.

If drinking with others: how did your drinking compare?

All participants were able to select a response option from the list available to them. Some participants were shown this question when they were the only person drinking in the occasion, for example, their partner was with them within the home, but they did not drink. In these circumstances, these participants became a little confused at this question, with some verbalising that because their partner did not drink, they did not know whether to select *much more* or *a little more* as technically the other adults in the occasion did not drink.

Some participants also verbalised that they were not sure how to define their drinking in relation to others in the location when their drinking partners were consuming different types of alcohol, as some participants verbalised that they had drunk a higher quantity of beer in ml, but their partner had drunk wine which has a higher alcohol content. Ultimately, these participants made the judgement based on a mixture of alcohol content and amount consumed, with one participant expressing *'I drank a [pint] bottle of beer, whilst my partner had two [small] cans of Coors light, I probably didn't drink more in volume but in alcoholic content I drank more'*.

If children are present, how did they drink?

Within your group, did any children under the age of 16 drink any alcohol in this location?

- Yes
- No
- Prefer not to say

Which of the following drinks did they consume?

- Normal strength beer/ lager/ stout (less than 6% by vol, e.g. Budweiser, Becks, Stella)
- Strong beer/ lager/ stout (e.g. Tenants Extra, Special Brew)
- Normal strength cider (less than 6% vol, e.g. Magners, Kopparberg)
- Strong cider (e.g. Diamond White, Frosty Jack's, Pulse, K Cider)
- Wine (including sparkling and Champagne)
- Spirits (e.g. whisky, vodka, gin, cognac, brandy, rum, schnapps, tequila)
- Liqueurs (e.g. Baileys, Cointreau, Malibu, Pimms, Jagermeister)
- Shots (undiluted spirits/ liqueurs tipped back in one shot e.g. Aftershock)
- Sherry, port, fortified wine or martini (e.g. Vermouth, Buckfast, Madeira, Croft Original)
- Cocktails (drinks containing a mix of alcohol)
- Alcopops or pre-mixed drinks (e.g. WKD, Bacardi Breezer)
- Prefer not to say

How much did they drink?

- Just a sip
- Less than a normal serving size (e.g. half a glass or can)
- One normal serving size
- More than one serving size
- Prefer not to say

Only one participant reported a child less than 16 drinking within their drinking occasion, with all remaining participants reporting a child present in the drinking location answering '*No'.* When seeing this question, most participants said they would not let their child drink with them, as most participants verbalised that their children were under the age of 10. The one participant who answered '*Yes*' reported that the child had drunk one can of normal strength beer. In probing with this participant, when asked if they felt uncomfortable with any questions, the participant felt that this question made them feel slightly uncomfortable given that they felt it was wrong for a child to drink alcohol and they themselves did not let the child drink alcohol. When probing further, this participant felt that this question is important to ask, and that because you are not being asked to name the child or give your opinion on a child drinking it does not come across as a judgemental question.

Changes made to the survey

Drinking companions

Within the first question asking about who the respondent drank with, some participants became confused if they should class individuals who joined the occasion virtually, i.e., by videocall, as being in the location. When examining the differences between individuals' recalling a pre-pandemic week's drinking, none of these participants engaged in a videocall. Given that the survey was designed to be administered in a post-pandemic environment, we made the decision to not specify whether the drinking occasion companions should be virtually or physically present in the occasion, especially given that during the activity questions we asked respondents if they used videoconferencing during their drinking occasions.

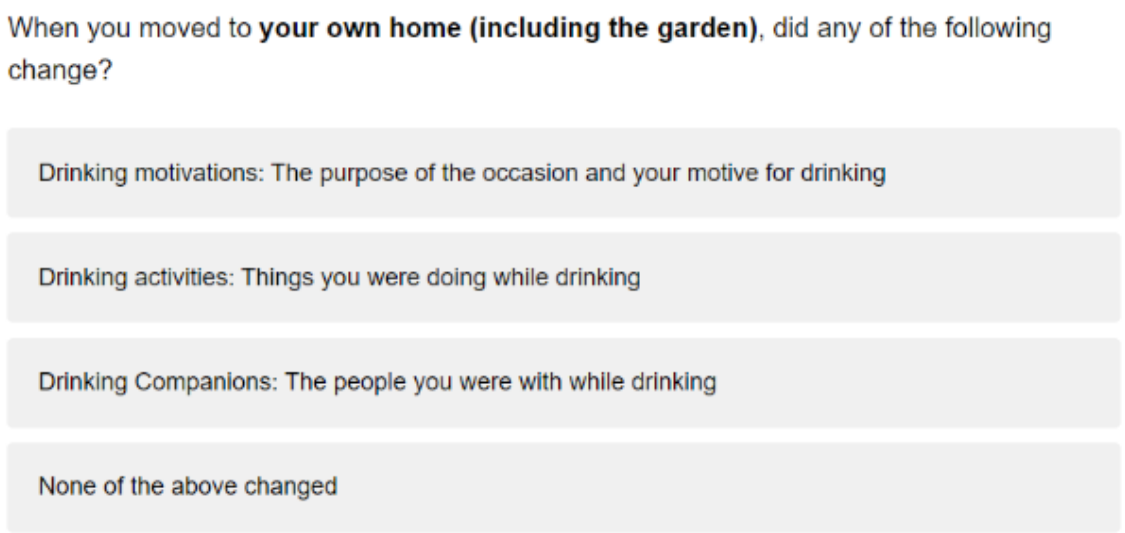
Drinking comparing to other adults in the location:

Some respondents were shown this question when they answered that they were with other people within the location, but they were the only individual who drank. Given that in these circumstances this question confused participants, we decided to change the survey logic so that participants would only be shown this question if the answer to the question asking about the number of adults who *drank* in the occasion was 2 or greater.

Child question:

Whilst only one participant was shown and answered the question specifically on a child under the age of 16 drinking in the occasion, we felt that given the importance of this topic to both policy and research this question should remain in the survey, especially given that the wording of the question was well received by the participant.

Change in drinking occasion motivations, activities, and companions



Findings

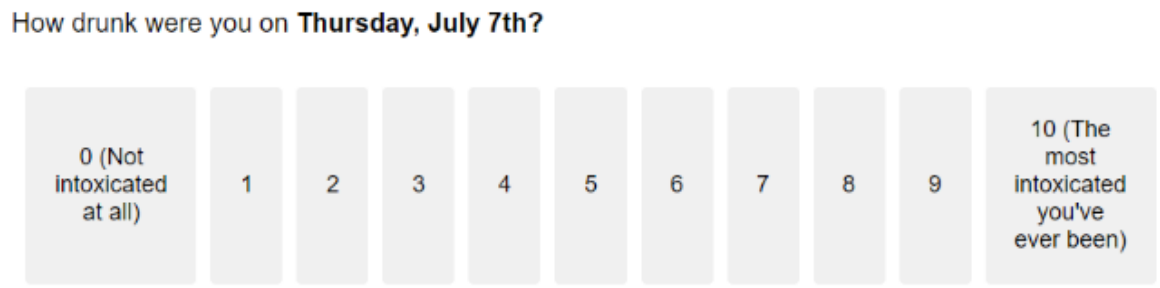
Three participants selected more than one location in a day and were subsequently asked this question. This question was included with the aim to reduce participant burden when drinking

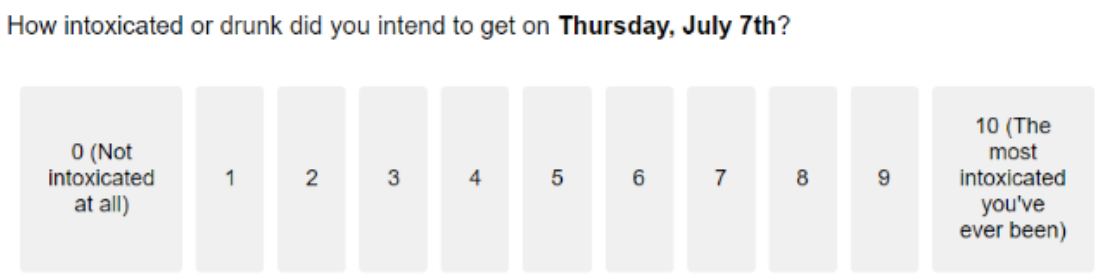
in multiple locations per drinking day, so that participants would only have to re-enter information which changed as they moved location, for example, if they people they were with stayed the same, they would not have to re-enter this information at their next drinking location on the same day. For all three participants who were shown this question, all understood what the question was asking of them, with these participants able to select only the options which had changed when moving location in line with their verbalisations during the cognitive interview.

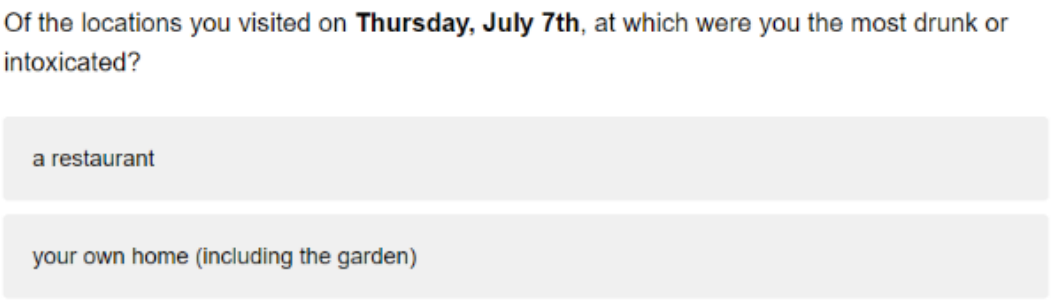
Changes made to the survey: Change in location questions

No changes were required to this question given that the question was understood by all respondents who accessed it.

Intoxication and harms







Intoxication question findings:

In terms of deciding if they felt drunk, some participants who rated themselves at the lower end of the scale referred to feeling a specific way, for example some participants recalled that they felt *'Nice and fuzzy but could still perform normal actions*'. A lot of participants seemed to relate their level of intoxication to whether they could operate machinery or drive a car, with those who expressed they couldn't tending to give a higher rating than those who said they could. Participants who gave a higher rating for how drunk they felt reported that they had experienced a hangover the next day after drinking.

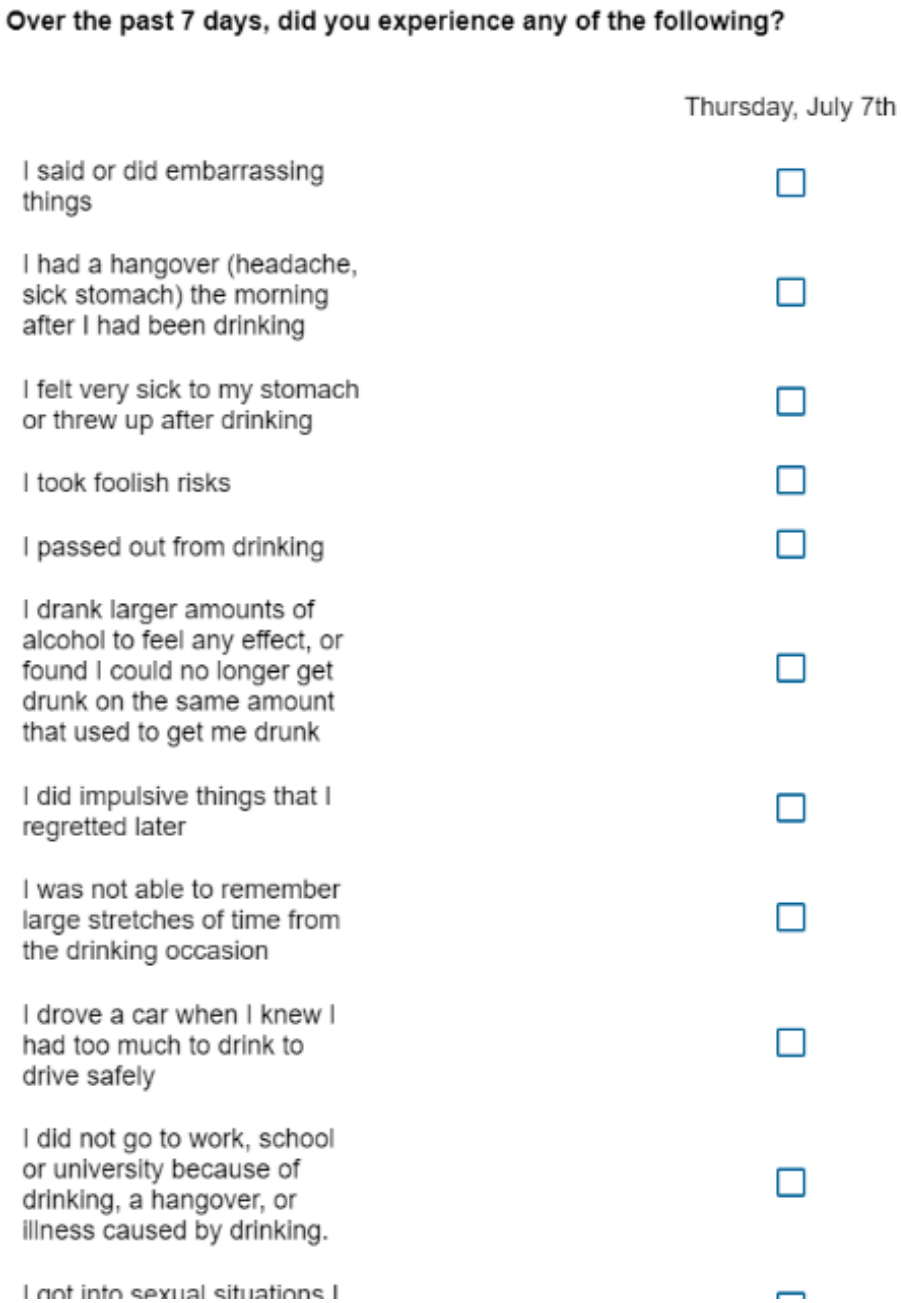
In responding to the question asking participants how *drunk they intended to get*, most participants tended to rate themselves at a similar level to how drunk they felt, with many participants reasoning that whilst they intended to drink alcohol, they did not intend to get drunk.

In understanding the scale, most participants when determining a score did make reference to the value labels added to 0 and 10 and did appear to take these into account when making their decision, for example one participant verbalised *'10 would be the most drunk I've ever been, so pass out drunk'*.

For the three participants who reported drinking at multiple locations on a drinking day, all participants reported feeling the most intoxicated or drunk at the final drinking location of the day. However, one of these participants did express that they had to think about this question

a bit before answering because they said their feeling of '*drunkenness*' comes in *'peaks and troughs'* throughout the night.

Harms findings:



Over the past 7 days, did you experience any of the following?

	Thursday, July 7th
I said or did embarrassing things	☐
I had a hangover (headache, sick stomach) the morning after I had been drinking	☐
I felt very sick to my stomach or threw up after drinking	☐
I took foolish risks	☐
I passed out from drinking	☐
I drank larger amounts of alcohol to feel any effect, or found I could no longer get drunk on the same amount that used to get me drunk	☐
I did impulsive things that I regretted later	☐
I was not able to remember large stretches of time from the drinking occasion	☐
I drove a car when I knew I had too much to drink to drive safely	☐
I did not go to work, school or university because of drinking, a hangover, or illness caused by drinking.	☐
I got into sexual situations I	☐

Most respondents completing the survey selected none of the harms on this list. In reading through the list, most participants did reflect on the harms listed and expressed that a few

years ago when they were younger, they would have selected more harms on this list, with one participant expressing that *'none of them applied to me, which feels quite nice*'.

Some participants when thinking about their answer verbalised that they felt tired, but when they were thinking about their answers, they did not select the option *'I had less energy or felt tired because of my drinking*' because they felt it was other factors which had caused the tiredness and not the drinking, for example because it was a late night.

For participants who did select experiencing harms, the most commonly selected options were *'I had a hangover'* and '*I had less energy or felt tired because of my drinking*'. None of these participants reported any discomfort at having to select any of the harms, with one participant feeling because of the anonymous nature of the survey they would feel more comfortable in being honest.

Changes made to the survey

No changes were required to this question given that the intoxication and harms questions were well understood by all respondents.

Whilst most respondents did not report experiencing any harms after drinking, most did reflect that when they were younger, or were living pre-covid, that they would have selected options on this list. Given this, we decided to leave the harms list unaltered given that the options were taken from a validated measure on alcohol-related harms.

Findings from the semi-structured interviews

After completing the survey, all participants were asked five questions on their experience of completing the survey. In general, all the participants felt the survey was very thorough, with

participants liking that the survey was separated by drinking locations so they could respond differently to each drinking event.

Feedback on whether there were questions participants did not understand

Aside from the *purpose* and *reason* questions discussed earlier in this chapter, in general participants felt the survey was very easy to understand, with the questions included clear and straightforward. Most participants felt that their drinking occasions tended to be very similar to each other, so completing the survey was quite simple. One participant felt at the beginning that the survey was asking about their drinking in general, but when they filled out the survey, they felt it was clear that the survey was asking about drinking within specific locations.

Feedback on whether any questions made participants feel uncomfortable

No participants reported that the survey made them feel uncomfortable. In reflecting on the harm questions, some participants said that whilst they did not feel uncomfortable answering these questions, if they were younger and had experienced more of the harms they may have felt a bit awkward about selecting some of the response options such as *I woke up in an unexpected place*. Some participants reflected on the impact of the interviewer whilst completing the survey, with these participants saying that if someone had experienced some harms they might not feel comfortable in selecting these options. When the participants understood that the survey when administered to a wider population would be a web-based survey which participants completed anonymously without an interviewer present, they felt this would be beneficial in collecting information on more sensitive subjects such as other substances taken.

Feedback on whether there were any response options missing

As discussed earlier in this chapter, most participants felt the option of walking to the drinking location was missing from the response options. In the list of locations, one participant felt that

the term '*gastropub'* could have been included but felt that this term would be hard to define and felt they could include this as an *'other'* location. In discussing the activities listed in the survey which could be done within each drinking location, all participants reported that they could find a response option, with those who completed the survey recalling their previous week's drinking in Tier 3 feeling as if pre-lockdown they could have selected applicable options from this list.

Feedback on the visual layout

Most participants felt that the survey was very clear, and the language used was easy to understand. In relation to navigating the survey, participants felt it was laid out well and easy to navigate with only one participant reporting that they felt the survey was a bit *'click heavy'* but acknowledged that this was in line with their experience of partaking in other web-based surveys. Other participants noticed the back buttons and felt these were useful for going back to amend any previous answers. In relation to questions using the drag and drop response format (i.e. drinking locations), some participants felt that having to scroll down the screen and then drag and drop the box into the correct order was a little challenging. However, all these participants reported that they managed to select the correct locations for their drinking days, with other participants liking that not every question was in a tick box format.

Feedback on whether the survey was easy to complete

All participants felt completing the survey was easy, with participants verbalising that the survey was quicker to complete than they had expected. One participant felt that recalling the information from a week ago was a little challenging, with their rationale being that during lockdown every day merged into one. One participant felt having a progress bar would be useful in informing them how much of the survey they had left. Based on the survey methodological literature, we felt that it would be technically challenging to include a progress

bar that would not be detrimental, as the survey had multiple loops and therefore progress through the survey could be misleading and ultimately lead to participants dropping out of the survey (505).

Changes made to the survey

No further changes aside those listed above were made to the survey after the semi-structured interviews.

7.3 Discussion

This chapter describes the development and testing processes undertaken within this thesis to create the drinking occasion survey.

Firstly, this chapter identified which contextual characteristics could be measured within a drinking occasion survey. These characteristics were identified by reviewing the drinking occasion characteristics currently measured within the existing literature in chapter four of the thesis, in combination with the new characteristics identified in chapter six through content analysis, such as drinking to cope with boredom. Given that limited research to date has explicitly included measures based on theoretical guidance (22), we mapped these contextual characteristics onto the theoretical frameworks used to understand drinking occasions, which were reviewed in chapter 3.1. Secondly, in deciding how the identified contextual characteristics should be measured within the drinking occasion survey, existing measures of the characteristics were identified and where measures were not available or suitable, new questions were developed to allow for these contextual characteristics to be measured. Finally, the developed drinking occasion survey underwent an extensive and rigorous pre-testing process consisting of expert-review; feedback from an advisory PPI group; and cognitive

interviews to assess how drinkers within the general population interpreted and understood the measures, and how easy they found Qualtrics as a platform to use.

By undertaking a diverse and comprehensive development and testing approach, both academic experts and members of the general public, including the advisory PPI group, were able to provide valuable feedback on the development of the context-specific survey. Both groups of stakeholders were valuable in influencing the design of the survey. Through involving academic experts, we were able to ensure the drinking occasion concepts and measures within the survey were appropriate within a research context, and by involving the PPI group we were able to assess whether the questions included were comprehensive and easy to understand. A good example of the value of external perspectives is modifications to our operationalisation of a drinking occasion. Originally, we had planned to have participants determine their own a drinking occasions based on the two hour rule but following feedback from experts and the PPI group we asked participants to respond to a location-specific survey and applied the two hour definition ourselves post data collection.

The cognitive interviews also yielded important methodological insights. Participants understood the questions included in the survey well, demonstrating that the survey had adequate face validity from a lay perspective. Through cognitive testing we were able to identify missed response options (e.g. walking to a drinking location) and technical issues within the survey, for example the '*other*' location following through to later questions, an issue which was rectified prior to survey being fielded in chapter eight.

Using a retrospective survey has many benefits; however, some contextual characteristics identified within theory and the literature as important could not be feasibly measured using this technique. For example, whilst measuring round-buying practices would be a theoretically useful characteristic to measure within drinking occasion research and allow us to capture the

influence of social dynamics in an occasion, it is a difficult characteristic to accurately recall and therefore measure within a drinking occasion survey and would be more suited to observational field-based research. Whilst using a survey does allow us to capture some social dynamics of an occasion, in that we measure the reason for the occasion and who the respondents' drinks with, we are only able to capture the occasion from the perspective of the respondent and not their drinking companions, for whom the occasion may have a different meaning.

Finally, within the systematic review presented in chapter five, we found few examples of studies using validated event-level measured to capture drinking motives, with these studies typically using measures adapted or modified versions of the Drinking Motives Questionnaire-revised (DMQ-R-SF) at the day-level (111,495) Whilst it would be of value to use a validated measure of drinking motives within the context-specific survey, creating and validating a measure through psychometric development fell outside of the scope of this thesis. Given the evidence suggesting that the characteristics of drinking occasions can explain more variance in consumption than individual levels (21,506), future research should aim to develop validated event-level measures of drinking motivations.

Strengths and limitations

Critiques of the existing occasion-level literature are that contextual characteristics are not comprehensively measured, with each study measuring a selected number of characteristics with limited rationale (22). As such this chapter took a diverse and comprehensive approach in developing this survey. In our comprehensive approach we attempted to collect detailed contextual information about participants' drinking occasions, with this information collected on a location-specific basis. Whilst the approach allowed for detailed information, the level of detail participants were asked to recall may have been burdensome, especially considering the

number of questions asked (507). It is important to note that within the cognitive interviews no participants explicitly reported experiencing any fatigue with the survey, with some participants commenting that the survey was quicker to complete than expected. However, it is important to note that due to the sampling approach taken within the cognitive interviews, to be eligible participants had to consume alcohol at least once a week rather than specifically be a heavy drinker. If we had explicitly recruited participants who were heavy drinkers, the survey may have taken longer to complete as they may have drank more drinks per occasion or had more occasions per week. Given the number of questions asked within this survey, and the guidance that web-based surveys should take no longer than 20 minutes to complete (508), the length of the context-specific survey should be reviewed following quantitative data collection described in chapter eight. If participant burden is indicated by high attrition rates or an average time of completion longer than 20 minutes, it may be appropriate to reduce the number of questions asked within future iterations of the survey, with one approach being to remove the measurement of contextual characteristics which are not frequently endorsed by participants.

In designing and testing the survey on Qualtrics, we had initially planned to test the survey on mobile phone devices in addition to laptops and computers, with recent evidence from panel studies finding that most respondents complete surveys on their smartphones (509). Within the survey development literature, it is recommended that researchers adopt a 'mobile-first' design process, in that surveys are designed for the smallest screen possible with the implication being that if a survey works on a small screen, it will work equally as well on a larger one (510). However, cognitive testing took place in a time where COVID-19 restrictions were active, with face-to-face meeting restricted (501). Given that cognitive interviews had to take place remotely, we decided that cognitively testing the context-specific survey on mobile devices would not be feasible, given that interviews took place over Blackboard Collaborate where sharing applications (such as web-browsers) was not supported at the time of this study.

Reflecting on this, we would recommend only fielding the context-specific survey of drinking occasions on devices which have a screen size similar to or larger than a laptop screen until user-testing had been conducted on mobile phone devices.

Finally, the approach taken was practically constrained given the time sensitive nature of a PhD and the impact of COVID-19, in that feedback was sought from key stakeholders such as drinking occasion experts and the PPI advisory group in a sequential approach. If this research did not have a strict time limit then adoption of a Delphi method, an iterative process whereby multiple rounds of feedback on a survey is provided by stakeholders (e.g. academic experts, PPI groups etc), would have been beneficial (511).

Using the survey in practice

The final survey developed within this chapter was used to collect cross-sectional data on drinking occasions within the final empirical chapter of this thesis. As described in the initial sections of this chapter, whilst this chapter largely described the development and testing process of the context-specific drinking occasion survey, the survey administered within chapter eight also included wider health-related questions (such as AUDIT score and smoker status) and demographic questions (such as age and gender) (see Figure 2). As previously stated, the measures used to capture wider health-related information and demographics did not undergo cognitive testing as these measures have been used extensively within previous research or have been previously validated (512). These questions did however undergo expert review during stage 3a of this chapter, with both health and demographic measures proposed for inclusion generally agreed upon.

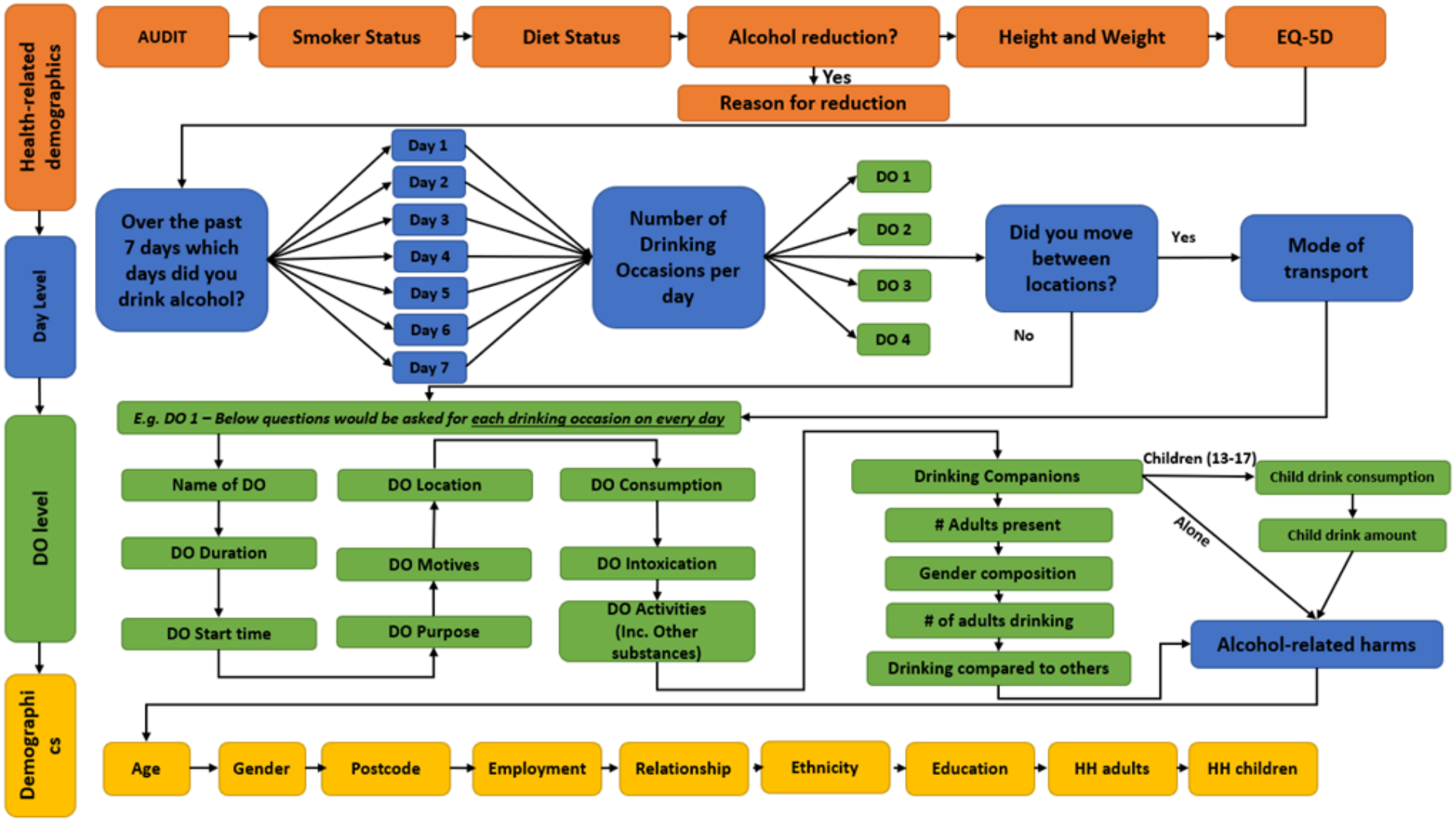


Figure 2. Schematic diagram of final survey flow within Qualtrics

7.4 Appendices of Chapter 7

Appendix A: Summary of individual-level measures identified and adapted within the context-specific drinking occasion survey used within section 1 and section 3 of the survey

Section 1: Health-related characteristics

Harmful and risky drinking patterns: We used the 10-item Alcohol Use Disorders Identification Test (AUDIT) (513) to measure individual's harmful and risky drinking patterns. In the use of AUDIT in the survey, no amendments were made to this tool given that it is a well validated tool which is used extensively within alcohol research to identify harmful and risky drinking patterns (512).

Smoking status*:* Current smoker status was measured by asking a question used in the Smoking Toolkit Survey (514). No amendments were made to this question within the context-specific survey.

Diet status: After reviewing the academic survey literature for measures of diet status, we developed a question for use in the context-specific drinking occasion survey. Individuals were asked **"Are you currently on a diet with the intention to lose weight?",** with the following response options provided: (1) I am currently on a diet with the intention to lose weight; (2) I am currently on a diet trying to maintain my weight; (3) I am currently on a diet trying to gain weight; (4) I am not on a diet; (5) Other and (6) Prefer not to say

Attempts at and reasons for reducing alcohol consumption: Individuals attempts and reasons for reducing alcohol consumption was measured using two questions, both taken from the Alcohol Toolkit Survey (496). The first question asked individuals if they were currently trying to reduce their alcohol consumption. If individuals selected '*yes'* at this question, they were filtered to a follow up question asking about the reasons for their most recent attempt to restrict

their alcohol consumption. In using this question in the context-specific survey we added two additional response options: (1) pregnancy or breastfeeding, (2) I had a bad experience with alcohol.

BMI: To measure Body Mass Index (BMI), individuals were asked two standardised questions used in the Health Survey for England 2018 about their height and weight (497).

Physical and mental wellbeing: To measure physical and mental wellbeing, individuals were asked questions from the EQ-5D-5L (515).

Section 3: Demographic information

Age: Individuals were asked to report their age in years. This is common practice within government and academic surveys.

Gender: Following guidance from the academic literature and government survey, individuals were asked: "*Do you identify as:"* with the following response options provided: (1) Male; (2) Female; (3) Other; (4) Prefer not to say.

Geographical region: Geographical region was measured by asking the partial postcode question used within the COVID-19 infections mobile application (516).

Employment status: Current employment status was measured by asking a question used in the Alcohol Control Study (494). No amendments were made to this question within the context-specific survey.

Relationship status: Current relationship status was measured by asking a question used in the Health Survey for England 2018 (497).

Ethnicity: Individual's ethnicity was measured using the harmonised standard used by the Government Statistical Service.

Qualifications: Individuals were asked to report the highest level of qualification they have. The levels of qualifications were adapted from the guidance provided on the Gov.uk website (517). Within the research, highest qualification achieved is indicative of socio-economic status which is linked with a higher risk of alcohol-attributable mortality (518).

Total number of adults in household: After reviewing the literature for measures of parental status we developed a question for use in the context-specific drinking occasion survey. Individuals were asked "What is the total number of adults aged 18 and above living in your household, including yourself", with individuals able to enter a number using free-text entry box.

Parental status: After reviewing the literature for measures of parental status we developed a question for use in the context-specific drinking occasion survey. Individuals were asked *"Are you a parent or guardian to any children aged 17 and under?"*, with the following response options provided (1) Yes; (2) No; and (3) Prefer not to say.

Children in household: After reviewing the literature for measures of parental status we developed a question for use in the context-specific drinking occasion survey. If participants indicated they were a parent or guardian to any children aged 17 or under, they were asked the total number of children living in the household and the age of these children.

Appendix B – Table B1: Table summarising the changes made to the context-specific drinking occasion survey during development[2] and testing

	Survey questions after initial development	**Survey questions after expert review and PPI feedback**	**Survey questions after cognitive testing**
Number of drinking occasions	We would like you to think of a drinking occasion as a period of time where you had no more than 2 hours between your drinks. For example, if you had several drinks between 1pm and 6pm, as long as there was not a 2 hour gap between any of these drinks, this would be classified as one drinking occasion. However, if you had two drinks between 1pm and 2pm and then did not drink alcohol again until 4pm, you should class this as two separate drinking occasions. If you moved from one pub to another or from your home to a pub, this should still be classed as one drinking occasion unless there was a two hour gap between drinks. Q1. How many drinking occasions have you had over the past seven days? • 1 • 2 • 3 • 4 • 5 • 6 • 7+	Question was removed from survey after expert review and PPI feedback.	Question not present.

[2] Prior to the survey being presented to experts, we had planned to ask participants to identify their own drinking occasions using the 2-hour definition applied within the academic literature. Following feedback from drinking occasion experts and a PPI group, we changed the way in which we asked participants to tell us about their drinking occasions, and instead asked participants to report information for each location they had consumed alcohol per drinking day.

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
When (social and physical timing)			
Information on deviation from normal routine	**Have you been on holiday in the past seven days? (E.g. did you take time off from your work, studies, or voluntary role?)** 1. Yes 2. No 3. Other **Where did your holiday take place?** 1. Within the UK 2. Outside the UK 3. Prefer not to say	**Have you been on holiday in the past seven days? (E.g. did you take time off from your work, studies, or voluntary role?)** 1. Yes 2. No 3. Other **Please select the days you were on holiday:** Response options of past 7 days provided **Where did your holiday take place?** 1. Within the UK 2. Outside the UK 3. Prefer not to say 4. I stayed at another international location	**Have you been on holiday in the past seven days? (E.g. did you take time off from your work, studies, or voluntary role?)** 1. Yes 2. No 3. Other **Please select the days you were on holiday:** Response options of past 7 days provided **Where did your holiday take place?** 1. Within the UK 2. Outside the UK 3. Prefer not to say

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Information on drinking day	**On what day did the drinking occasion occur?** 1. Monday 2. Tuesday 3. Wednesday 4. Thursday 5. Friday 6. Saturday 7. Sunday	Over the next few pages we are going to ask you to recall the occasions in which you have drunk over the **past seven days.** Please select below the days on which you consumed an alcoholic drink. Please include days where you drank non-alcoholic beers, wines or spirits, but not other non-alcoholic drinks. 1. ${date://CurrentDate/DM} 2. ${date://OtherDate/DM/-1%20day} 3. ${date://OtherDate/DM/-2%20day} 4. ${date://OtherDate/DM/-3%20day} 5. ${date://OtherDate/DM/-4%20day} 6. ${date://OtherDate/DM/-5%20day} 7. ${date://OtherDate/DM/-6%20day}	Question remained the same as after expert review and PPI feedback.
Start time	**At what time did the drinking occasion start?** 1. Between 6am and 12 noon 2. Between 12.00noon and 2pm (e.g. at lunchtime) 3. Between 2pm and 5pm (e.g. in the afternoon) 4. Between 5pm and 8pm) (e.g. at dinner time) 5. Between 8pm and 10pm 6. Between 10pm and 1am 7. Between 1am and 6am	When drinking within a (**location)**, to the nearest 15 minutes, what time did you start drinking at? Please use the 24 hour clock format, e.g. if you began drinking at 9pm put 21:00 Hour: Minute:	On **(date)**, when drinking within a (location), to the nearest 15 minutes, what time did you start drinking at? Please use the 24 hour clock format, e.g. if you began drinking at 9pm put 21:00 Hour: Minute:

	Survey questions after initial development	**Survey questions after expert review and PPI feedback**	**Survey questions after cognitive testing**
End time	Question not present in survey	When drinking within a (**location)**, to the nearest 15 minutes, what time did you stop drinking at? Please use the 24 hour clock format, e.g. if you stopped drinking at 9pm put 21:00 Hour: Minute:	On **(date)**, when drinking within a (location), to the nearest 15 minutes, what time did you start drinking at? Please use the 24 hour clock format, e.g. if you stopped drinking at 9pm put 21:00 Hour: Minute:
Duration	**How long did the drinking occasion last?** 1. Less than an hour 2. More than 1 hour but less than 2 3. More than 2 hours but less than 3 4. More than 3 hours but less than 4 5. More than 4 hours but less than 5 6. More than 5 hours but less than 6 7. More than 6 hours but less than 7 8. More than 7 hours but less than 8 9. More than 8 hours or more	Not explicitly asked in the survey but calculated in analysis using start and end time.	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Other activities in the occasion	**Within this drinking occasion, did you engage in any of the following?** 1. Consuming food 2. Cooking a meal 3. Speaking with people over videoconferencing (e.g. Zoom, Skype etc) 4. Watching TV or video on any device (including DVDs, Blu-Ray or streaming services) 5. Household chores (for example the ironing, cleaning) 6. Playing a computer or console game (e.g. PlayStation, Xbox) 7. Playing a non-computer game (e.g. card, board game) 8. Playing a sport 9. Listening to an audio device (e.g. radio or streaming service) 10. Watching a live event (e.g. music, sport) 11. Dancing 12. Pub quiz 13. Separate out computer and non-computer game 14. Drinking games 15. Smoking 16. Reading 17. Working 18. Other (free text response)	**Within this drinking occasion, did you engage in any of the following?** 1. Consuming food as a meal 2. Consuming food as a snack 3. Cooking or baking food 4. Speaking with people over videoconferencing (Zoom, Skype etc) 5. Watching TV or video on any device (including DVDs, Blu-Ray or streaming services) 6. Spending time on social media (e.g. Facebook, Instagram, TikTok) 7. Completing household chores (for example, ironing, cleaning) 8. Playing a computer or console game (e.g. PlayStation, Xbox) 9. Playing a non-computer game (e.g. card, board game) 10. Playing pool, darts or similar bar-room game 11. Listening to an audio device (e.g. radio or streaming service) 12. Watching a live event (e.g. music, sport) 13. Dancing 14. Doing a pub quiz 15. Playing drinking games 16. Reading 17. Working 18. Other (free text response)	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Use of substances within the occasion	**Within this occasion did you use any of the following:** 1. Cigarette 2. E-Cigarette (Vape) Illicit drugs (e.g. amphetamine, cannabis or ecstasy)	Did you use any of the following whilst drinking in a (**location)**? 1. Cigarette or cigar 2. E-Cigarette (Vape) 3. Cannabis 4. Other recreational drugs (amphetamine or ecstasy) 5. None of the above (exclusive code)	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Where (drinking location)			
Location type	**In which of the following places did you drink during this occasion?** ***(please select all that apply)*** 1. Restaurant (licensed establishment primarily serving food and drink) 2. Traditional pub (on-trade establishment primarily serving drink only) 3. Modern bar (on-trade establishment primarily serving drink only) 4. Other pub or bar (on-trade establishment primarily serving drink only) 5. Pub-restaurant 6. Nightclub 7. Social club or sports club 8. Your own home (including the garden) 9. Someone else's home (including the garden) 10. Outdoors away from home 11. Other (free text) 12. Prefer not to say	To help us understand more about your drinking occasions over the last week, we want to create a timeline of your drinking on each day. Please select the types of locations you drank in on (**date)** and the order you visited them by selecting the location of the left of the page and dragging it to the appropriate box. For example, if you visited three traditional pubs before going to a restaurant, the 1st location you visited would be a traditional pub and the 2nd a restaurant. If you visited the same location type twice, for example, you visited traditional pubs (1st), then a restaurant (2nd), then a traditional pub afterwards (3rd), you should use the '*other*' option at the end of the list and write the location type (e.g. traditional pub) in the text box. On (**date),** which of the following locations did you consume alcohol within? 1. Restaurant (licensed establishment primarily serving food and drink) 2. Traditional pub (on-trade establishment primarily serving drink only) 3. Modern bar (on-trade establishment primarily serving drink only) 4. Other pub or bar (on-trade establishment primarily serving drink only) 5. Pub-restaurant 6. Nightclub 7. Social club or sports club 8. Your own home (including the garden) 9. Someone else's home (including the garden) 10. Outdoors away from home Other (free text)	

	Survey questions after initial development	**Survey questions after expert review and PPI feedback**	**Survey questions after cognitive testing**
Mode of transport	**When moving between drinking locations, which of the following best describes your mode of transport? (Please select all that apply)** 1. I cycled 2. I used public transport (e.g. bus, train) 3. I hired a taxi (including Uber and similar services) 4. I drove my own car or motor vehicle 5. I got a lift from another person I was drinking with 6. I got a lift from another person not attending the drinking occasion 7. Other	When travelling to a (**location),** which of the following best describes your mode of transport? 1. I was already there 2. I used public transport 3. I hired a taxi, Uber or similar 4. I drove my own car or motor vehicle 5. I got a lift from another person I was with, **who was** drinking alcohol 6. I got a lift from another person I was with, **who was not** drinking alcohol 7. I got a lift from someone who came to collect me 8. Other (*free text)*	When travelling to a (**location),** which of the following best describes your mode of transport? 1. I was already there 2. I used public transport (e.g. bus, train) 3. I hired a taxi, Uber or similar 4. I drove my own car or motor vehicle 5. I got a lift from another person I was with, who was drinking alcohol 6. I got a lift from another person I was with, who was not drinking alcohol 7. I got a lift from someone who came to collect me 8. I walked 9. Other (*free text)*

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Why (drinking motivations)			
Purpose for the drinking occasion	What was the purpose for the occasion? *(Select all that apply)* 1. To alleviate stress 2. To relax 3. To cope with negative mood 4. To celebrate and have fun 5. To cope with boredom 6. To socialise 7. No specific purpose 8. Other (free text response) 9. Prefer not to say	What was the <u>*purpose of*</u> drinking within **(location)**? *(Select all that apply)* 1. To alleviate stress 2. To relax 3. To cope with a negative mood 4. To celebrate and have fun 5. To cope with boredom 6. To socialise 7. Out of habit 8. Other 9. Prefer not to say	
Reason for drinking in the occasion	Why did you drink within the drinking occasion? *(Select all that apply)* 1. To alleviate stress 2. To relax 3. To cope with a negative mood 4. To celebrate and have fun 5. To cope with boredom 6. To socialise 7. To reward myself 8. Others were drinking within the occasion 9. Other (free text response) 10. Prefer not to say	Why did <u>*you drink alcohol*</u> within (**location)?** *(Select all that apply)* 1. To alleviate stress 2. To relax 3. To cope with a negative mood 4. To celebrate and have fun 5. To cope with boredom 6. To socialise 7. Out of habit 8. Other 9. Prefer not to say	

	Survey questions after initial development	**Survey questions after expert review and PPI feedback**	**Survey questions after cognitive testing**
Occasion description	*Not present*	*Not present*	Which of the following best describes your drinking occasion within **(location)** *(Select one)* 1. Paying a visit (others visiting your home or you visiting someone else's home) 2. Entertainment, game and hobby 3. Festive occasion or party 4. Meal 5. No special occasion 6. Other (please specify)
Occasion-level drinking intentions	**How intoxicated or drunk did you during this drinking occasion?** *Likert scale: 0 (not intoxicated) to 10 (very intoxicated)* **How intoxicated or drunk did you intend to get in this occasion before you started drinking?** *Likert scale: 0 (not intoxicated) to 10 (very intoxicated)*	How drunk were you on **(specific drinking day)?** *Likert scale 0 (not intoxicated at all) to 10 (most intoxicated you've ever been)* How intoxicated or drunk did you intend to get on **(specific drinking day)?** *Likert scale 0 (not intoxicated at all) to 10 (most intoxicated you've ever been)* Of the locations visited on **(specific drinking day)** at which were you the most drunk of intoxicated? Response options of where participants had drunk each day.	

	Survey questions after initial development	**Survey questions after expert review and PPI feedback**	**Survey questions after cognitive testing**
What (drink type)			
Drink type and serving size			
Selecting drink type	*Not present*	When drinking in **(location),** please select which of the following drink types you drank: 1. Beer or cider 2. Wine 3. Spirits, liquors or shots 4. Cocktails or Alcopops 5. No-alcohol and Low alcohol beer, cider and wine 6. Non-alcoholic drinks	

	Survey questions after initial development	**Survey questions after expert review and PPI feedback**	**Survey questions after cognitive testing**
Group 1: Beer and Cider	<u>Drink type:</u> 1. Normal strength beer/ lager/ stout (less than 6% by vol, e.g. Budweiser, Becks, Stella) 2. Strong beer/ lager/ stout (e.g. Tenants Extra, Special Brew) 3. Normal strength cider (less than 6% vol, e.g. Magners, Kopparberg)_ 4. Strong cider (e.g. Diamond White, Frosty Jack, Pulse, K Cider) <u>Serving size:</u> 1. Half pints 2. Pints 3. Litres 4. Glass 5. Small cans (up to 330ml) 6. Standard cans (440ml) 7. Large cans (500ml/ pint) 8. Small/ Continental bottle (up to 250ml) 9. Standard bottle (330ml-440ml) 10. 500ml/ pint bottle 11. 1 litre bottle 12. 2 litre bottle 13. 3 litre bottle 14. Jug/ pitcher (2 litre) 15. Other (specify)	When drinking within a (**location),** please select which of the following types of **Beer or cider** you drank (*Select all that apply)* 1. Normal strength beer/ lager/ stout (less than 6% by vol, e.g. Budweiser, Becks, Stella) 2. Strong beer/ lager/ stout (e.g. Tenants Extra, Special Brew) 3. Normal strength cider (less than 6% vol, e.g. Magners, Kopparberg)_ 4. Strong cider (e.g. Diamond White, Frosty Jack, Pulse, K Cider) Please select the serving size and amount of **Beer or cider** you drank in (**location)** If you only drank half a serving, e.g. half a bottle, please enter 0.5: 1. Pint 2. Small can (up to 330ml) 3. Standard can (440ml) 4. Large can (500ml/ pint) 5. Small/ Continental bottle (up to 250ml) 6. Standard bottle (330-440ml) 7. 500ml/ pint bottle 8. Jug/ pitcher (2L)	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Group 2: Wine and fortified wines	Drink type: Wine (including sparkling and Champagne) Serving sizes for wine: 1. Small glass (125ml) 2. Medium glass (175ml) 3. Large glass (250ml) 4. Glass(es) (unspecified size / size unknown) 5. Small bottle (275ml) 6. Standard bottle (750ml) 7. Large bottle (1.5 litre) of wine 8. Box / carton (3 litre) of wine 9. Other (Specify) Drink type: Sherry, port, fortified wine or martini (e.g. Vermouth, Buckfast, Madeira, Croft Original) Serving size for fortified wines: 1. Standard glass (50ml) 2. Large glass (75ml) 3. Standard Bottle(s) (750ml) 4. Large Bottle(s) (1 litre) 5. Other (specify)	When drinking within a **(location),** please select which of the following types of **wine** you drank (Select all that apply): 1. Wine (including sparkling and champagne) 2. Sherry, port, fortified wine or martini (e.g. Vermouth, Buckfast, Maderia, Croft Original) Please select the serving size and amount of **wine** you drank in (**location)** If you only drank half a serving, e.g. half a bottle, please enter 0.5: 1. Small wine glass (125ml) 2. Medium wine glass (175ml) 3. Large wine glass (250ml) 4. Glass(es) (unspecified size / size unknown) 5. Small bottle (275ml) 6. Standard bottle (750ml) 7. Large bottle (1.5 litre) of wine 8. Box / carton (3 litre) of wine Serving size for sherry etc 1. Standard sherry/ port glass (50ml) 2. Large sherry/port glass (75ml)	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Group 3: Spirits, liqueurs, and shots	<u>Drink type:</u> 1. Spirits (e.g. whisky, vodka, gin, cognac, brandy, rum, schnapps, tequila) 2. Liqueurs (e.g. Baileys, Cointreau, Malibu, Pimms, Jägermeister) <u>Serving size:</u> 1. Glass(es) (single nip / measure / shot) 2. Glass (es) (doubles) 3. Miniature bottle(s) (50ml) 4. Half bottle(s) / Hipflask bottle (350 / 375ml) 5. Standard bottle(s) (700ml) 6. Large bottle(s) (1 litre) 7. Other (Specify) <u>Drink type:</u> 1. Shots (undiluted spirits/ liqueurs tipped back in one shot e.g. Aftershock) <u>Serving size:</u> 1. Single shot glass(es) 2. Large Bottle same size as bottle of spirits (700ml) 3. 1 litre bottle 4. Other (Specify)	When drinking within a **(location),** please select which of the following types of **Spirits, liquors or shots** you drank (Select all that apply): 1. Spirits (e.g. whisky, vodka, gin, cognac, brandy, rum, schnapps, tequila) 2. Liqueurs (e.g. Baileys, Cointreau, Malibu, Pimms, Jägermeister) 3. Shots (undiluted spirits/ liqueurs tipped back in one shot e.g. Aftershock Please select the serving size and amount of **Spirits, liquors or shots** you drank in (**location)** If you only drank half a serving, e.g. half a bottle, please enter 0.5: 1. Single measure or shot (25ml) 2. Double measure or shot (50ml) 3. Miniature bottle (50ml) 4. Half bottle(s)/ Hipflask bottle (350/375ml) 5. Standard bottle (700ml) 6. Large bottle (1L) 7. Other	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Group 4: Cocktails and alcopops	Drink type: Cocktails (drinks containing a mix of alcohol) Serving size: 1. Glass(es) - standard cocktail / martini glass 2. Glass(es) (single nip / measure) 3. Glass(es) (double nip / measure) 4. Glass(es) (three or more nips) 5. Jug(s) (litres) 6. Jug(s) (pints) 7. Other (specify) Drink type: Alcopops or pre-mixed drinks (e.g. WKD, Bacardi Breezer) Serving size: 1. Glass(es) 2. Small Can 250ml (slimline) 3. Standard Can(s) 330ml 4. Large can 440ml 5. Standard bottle (275-330ml) 6. Large Bottle same size as bottle of spirits (700ml) 7. 1 litre bottle 8. Other (Specify)	When drinking within **(location),** please select which of the following types of **Cocktails or Alcopops** you drank (Select all that apply): 1. Cocktails (drinks containing a mix of alcohol) 2. Alcopops or pre-mixed drinks (e.g. WKD, Barcardi Breezer) Please select the serving size and amount of **Cocktails or Alcopops** you drank in (**location)** If you only drank half a serving, e.g. half a bottle, please enter 0.5: 1. Standard cocktail/ martini glass 2. Jug (litres) 3. Jug (pint) 4. Small can (250ml) 5. Standard can (330ml) 6. Large can (440ml) 7. Standard bottle (275-330ml) 8. Large bottle (700ml) 9. 1 Litre bottle 10. Other	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Group 5: Low and no- alcohol drinks	Drink type: 1. Low alcohol beer 2. Low alcohol cider 3. Low alcohol wine 4. No-alcohol beer 5. No-alcohol cider 6. No-alcohol wine Serving size: Same response options as beer, cider and wine.	When drinking within **(location),** please select which of the following types of **No-alcohol and Low alcohol beer, cider and wine** you drank (Select all that apply): 1. Alcohol-free beer 2. Alcohol-free wine 3. Alcohol-free cider 4. Low-alcohol beer 5. Low-alcohol wine 6. Low-alcohol cider Please select the serving size and amount of **No-alcohol and Low alcohol beer, cider and wine** you drank in (**location)** If you only drank half a serving, e.g. half a bottle, please enter 0.5: 1. Pint 2. Small can (up to 330ml) 3. Standard can (440ml) 4. Large can (500ml/ pint) 5. Small/ Continental bottle (up to 250ml) 6. Standard bottle (330-440ml) 7. 500ml/ pint bottle 8. Small wine glass (125ml) 9. Medium wine glass (175ml) 10. Large wine glass (250ml) 11. Glass(es) (unspecified size / size unknown) 12. Small bottle (275ml) 13. Standard bottle (750ml) 14. Large bottle (1.5 litre) of wine 15. Box / carton (3 litre) of wine Other (specify)	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Group 6: Mocktails	Drink type: Mocktails (drinks containing a mix of non-alcoholic drinks) Serving sizes: 1. Glass(es) - standard cocktail / martini glass 2. Jug(s) (litres) 3. Jug(s) (pints) 4. Other (specify)	*Incorporated with non-alcoholic drinks*	*Incorporated with non-alcoholic drinks*

	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing	Survey questions after initial development
Group 7: Non-Alcoholic drinks	Drink type: 1. Carbonated sugar drink (e.g. Coke, Pepsi, 7up, Fanta) 2. Carbonated sugar-free drink (e.g. Diet Coke, Pepsi Max) Serving size 1. Small can (330ml) 2. Small bottle (500ml) 3. Medium bottle (1 litre) 4. Large bottle (2 litre) 5. Half pint 6. Pint 7. Other (specify) Drink type: 1. Caffeinated energy drink (e.g. Redbull Monster energy) Serving size 1. Small can (250ml) 2. Large can (500ml) 3. Large bottle (500ml) 4. Other (specify) Drink type: 1. Hot drinks (e.g. coffee, tea, hot chocolate) 2. Water 3. Other (specify) Serving size: *Free text*	When drinking within **(location),** please select which of the following types of **Non-alcoholic drinks** you drank (Select all that apply): 1. Carbonated sugar drink (e.g. Coke, Pepsi, 7up, Fanta) 2. Carbonated sugar-free drink (e.g. Diet coke, Pepsi Max) 3. Caffeinated energy drink (e.g. Redbull, Monster Energy) 4. Hot drinks (e.g. coffee, tea, hot chocolate) 5. Water 6. Mocktails (non-alcoholic cocktails) 7. Other Please select the serving size and amount of **Non-alcoholic drinks** you drank in (**location)** If you only drank half a serving, e.g. half a bottle, please enter 0.5: 1. Small can (330ml) 2. Glass 3. Small bottle (500ml) 4. Medium bottle (1L) 5. Large bottle (2L) 6. Pint 7. Mug 8. Other	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Who (Drinking companions)			
Drinking companions	**Who was in the group of people who you were with? Please also include any children and other adults who were with you but not drinking alcohol. (*select all that apply)*** 1. Romantic partner or date 2. Children aged 13-17 3. Children aged 12 or under 4. Other family members 5. Other people I live with (e.g. flatmates) 6. Friends 7. Neighbours 8. Work colleagues 9. I drank alone	When drinking in **(location)**, who was in the group of people you were with? Please also include any children and other adults who were with you but not drinking alcohol *(Select all that apply)* 1. Romantic partner 2. Oher family members aged 18 and over I live with 3. Other family members aged 18 and over who live elsewhere 4. Friends 5. Neighbours 6. Work Colleagues 7. People I study with 8. I drank alone 9. Children aged 16-17 10. Children aged 13-15 Children aged 12 or younger	
Number of companions	**Within this group, how many adults were you with?** *Free-text numerical responses*	**Including yourself,** how many **adults** were you with? Please include all adults even if they were not drinking alcohol *Free-text numerical responses*	
Gender composition	**Within this group, what was the gender composition of the adults present?** 1. Male pair 2. Female pair 3. Mixed sex pair 4. Male group 5. Female group 6. Mixed sex group	Within your drinking group, what was the gender composition of the adults present? *Please include yourself within the gender composition, i.e., if you were with a male and a female you would be drinking within a mixed sex group* 1. Male pair 2. Female pair 3. Mixed sex pair 4. Male group 5. Female group 6. Mixed sex group	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Number of adults drinking	**How many of the adults within this group consumed an alcoholic drink?** *Free-text numerical response*	Of the (**embedded number from number of companions**) how many consumed an alcoholic drink? If you ae not sure, please give your best guess: *Free-text numerical response*	
Comparison to other adults drinking	**Do you think you drank more or less alcohol than the other people in the drinking occasion?** 1. I believe I drank much more 2. I believe I drank a little more 3. I believe I drank about the same 4. I believe I drank a little less 5. I believe I drank much less	Which of the following statements best described how much you drank in a **(location)** 1. I believe I drank **much more** than the other adults who drank alcohol 2. I believe I drank a **little more** than the other adults who drank alcohol 3. I believe I drank **the same as** the other adults who drank alcohol 4. I believe I drank a **little less** than the other adults who drank alcohol I believe I drank **much less** than the other adults who drank alcohol	
Children drinking	**Of the children aged 13-17 present in the occasion, did any of these children consume any alcohol?** 1. Yes 2. No 3. Prefer not to say	Within your group, did any children under the age of 16 drink any alcohol in this location? 1. Yes 2. No 3. Prefer not to say	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Child drinking consumption	**Which of the following drinks did they consume?** 1. Normal strength beer/ lager/ stout (less than 6% by vol, e.g. Budweiser, Becks, Stella) 2. Strong beer/ lager/ stout (e.g. Tenants Extra, Special Brew) 3. Normal strength cider (less than 6% vol, e.g. Magners, Kopparberg)_ 4. Strong cider (e.g. Diamond White, Frosty Jack, Pulse, K Cider) 5. Wine (including sparkling and Champagne) 6. Spirits (e.g. whisky, vodka, gin, cognac, brandy, rum, schnapps, tequila) 7. Liqueurs (e.g. Baileys, Cointreau, Malibu, Pimms, Jägermeister) 8. Shots (undiluted spirits/ liqueurs tipped back in one shot e.g. Aftershock) 9. Sherry, port, fortified wine or martini (e.g. Vermouth, Buckfast, Madeira, Croft Original) 10. Cocktails (drinks containing a mix of alcohol) 11. Alcopops or pre-mixed drinks (e.g. WKD, Bacardi Breezer) **How much did they consume?** 1. Just a sip 2. A few sips 3. Less than half a pint/ small glass of wine 4. Bottle or can of Beer 5. Glass of wine 6. One normal serving size 7. More than one serving size	**Which of the following drinks did they consume?** 1. Normal strength beer/ lager/ stout (less than 6% by vol, e.g. Budweiser, Becks, Stella) 2. Strong beer/ lager/ stout (e.g. Tenants Extra, Special Brew) 3. Normal strength cider (less than 6% vol, e.g. Magners, Kopparberg)_ 4. Strong cider (e.g. Diamond White, Frosty Jack, Pulse, K Cider) 5. Wine (including sparkling and Champagne) 6. Spirits (e.g. whisky, vodka, gin, cognac, brandy, rum, schnapps, tequila) 7. Liqueurs (e.g. Baileys, Cointreau, Malibu, Pimms, Jägermeister) 8. Shots (undiluted spirits/ liqueurs tipped back in one shot e.g. Aftershock) 9. Sherry, port, fortified wine or martini (e.g. Vermouth, Buckfast, Madeira, Croft Original) 10. Cocktails (drinks containing a mix of alcohol) 11. Alcopops or pre-mixed drinks (e.g. WKD, Bacardi Breezer) 12. Prefer not to say **How much did they consume?** 1. Just a sip 2. Less than a normal serving size (e.g. half a glass or can) 3. One normal serving size 4. More than one serving size 5. Prefer not to say	

	Survey questions after initial development	Survey questions after expert review and PPI feedback	Survey questions after cognitive testing
Change in contextual characteristics between locations	Did you move between locations when drinking, for example did you move from drinking within a home to a restaurant, from one pub to another, or from a restaurant to a pub? - Yes - No - Prefer not to say	**When you moved location to [new location] did any of the following change?** 1. Drinking motivations - the purpose of the occasion and your motive for drinking 2. Drinking activities - things you were doing while drinking 3. Drinking companions - the people you were with while drinking	

Alcohol-related harms	**During or after this drinking occasion, did you experience any of the following?** 1. I said or did embarrassing things 2. I had a hangover (headache, sick stomach) the morning after I had been drinking 3. I felt very sick to my stomach or threw up after drinking 4. I took foolish risks 5. I passed out from drinking 6. I drank larger amounts of alcohol to feel any effect, or found I could no longer get high or drunk on the same mount that used to get me high or drunk 7. I did impulsive things that I regretted later 8. I was not able to remember large stretches of time from the drinking occasion 9. I drove a car when I knew I had too much to drink to drive safely 10. I did not go to work because of drinking, a hangover, or illness caused by drinking. 11. I got into sexual situations I later regretted 12. I found it difficult to limit how much I drank 13. I became very rude, obnoxious or insulting after drinking 14. I woke up in an unexpected place after heavy drinking 15. I felt badly about myself because of my drinking 16. I had less energy or felt tired because of my drinking 17. The quality of my work suffered because of my drinking 18. I spent too much time drinking 19. I neglected my obligations to family and work because of drinking	**Over the past 7 days, did you experience any of the following?** *[For each day participants were asked to select if they had experienced the following things]* 1. I said or did embarrassing things 2. I had a hangover (headache, sick stomach) the morning after I had been drinking 3. I felt very sick to my stomach or threw up after drinking 4. I took foolish risks 5. I passed out from drinking 6. I drank larger amounts of alcohol to feel any effect, or found I could no longer get high or drunk on the same mount that used to get me high or drunk 7. I did impulsive things that I regretted later 8. I was not able to remember large stretches of time from the drinking occasion 9. I drove a car when I knew I had too much to drink to drive safely 10. I did not go to work because of drinking, a hangover, or illness caused by drinking. 11. I got into sexual situations I later regretted 12. I found it difficult to limit how much I drank 13. I became very rude, obnoxious or insulting after drinking 14. I woke up in an unexpected place after heavy drinking 15. I felt badly about myself because of my drinking 16. I had less energy or felt tired because of my drinking 17. The quality of my work suffered because of my drinking 18. I spent too much time drinking 19. I neglected my obligations to family and work because of drinking 20. My drinking created problems between myself and my partner, parents or other near relatives

	20. My drinking created problems between myself and my partner, parents or other near relatives	

8. What are the contextual characteristics associated with consumption by Heavy Drinkers and their Heavy Drinking Occasions? A comparison between on-, off-, and mixed-trade occasions

This chapter presents the final empirical study of this thesis, which uses the survey developed in chapter seven to collect cross-sectional data on drinking occasions. The aim was to identify within a sample of heavy drinkers, what contextual characteristics were associated with the number of units consumed within their (i) general drinking occasions, (ii) heavy drinking occasions (defined as drinking more than 6/8 units in a single occasion for women/men), and (iii) whether contextual or individual level characteristics explained more of the variance in the number of units consumed. Data was collected in the Autumn of 2021 after all COVID-19 restrictions were removed from the UK. The work included in this chapter is intended to be published in a revised format within a peer-reviewed publication.

8.1 Extended version of planned paper

Title: What are the contextual characteristics associated with consumption by Heavy Drinkers and their Heavy Drinking Occasions? A comparison between on-, off-, and mixed-trade occasions

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Author Contribution Statement:

OS, MO, MF & JH conceived the study design. OS carried out data collection on Prolific Academic. OS conducted data cleaning and data analysis on the data included within this chapter. OS prepared this manuscript with significant contribution from all other authors.

Declaration of competing interest: None.

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Author Contribution Statement:

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Abstract

Background: Heavy drinking and heavy drinking occasions are prevalent within the UK and are associated with acute and long-term negative consequences. Whilst heavy drinking and heavy drinking occasions occur within a range of locations, much of the literature focuses on the characteristics of on-trade establishments and overlooks off-trade occasions. Identifying the contexts associated with heavy drinker's on- and off-trade general drinking and heavy drinking occasions could therefore provide new insights for research and policy.

Methods: A stratified sample of 236 UK adults were recruited using Prolific Academic. Participants were all heavy drinkers, determined by drinking over the UK low risk drinking guidelines of 14 units per week. Participants completed a 7-day retrospective diary and were asked context-specific questions for up to three drinking locations per day. Within analyses, drinking occasions were classified as a period with no more than 2 hours between drinks. A series of multilevel Generalized Linear Models regression analyses were conducted, split by trade (on- and off-) and occasion type (general and heavy) where occasions (level 2) where nested within individuals (level 1).

Results: Through a series of multi-level regression analyses, characteristics from all contextual groups were associated with units consumed per occasion. Across all occasion types, planning to become intoxicated and drink type were consistently associated with units consumed per occasion. Our analyses identified differences in the characteristics associated with consumption in i) on-trade compared to off-trade occasions and ii) heavy drinker's general drinking compared to their heavy drinking occasions. Adding contextual characteristics to the model accounted for more variance in units consumed within occasions than individual characteristics alone.

Conclusions: This study identified the methodological implications of measuring a broad range of characteristics within event-level studies. Through identifying characteristics associated with increases and decreases in units consumed, avenues for targeted interventions or policy development are identified.

Key words: Drinking Context, Heavy Drinking, Drinking Occasion.

Introduction

In the UK, 29.2 million adults aged 16 and over consume alcohol, and 24% of adults in England and Scotland drink over the recommended guidelines of 14 units per week (1). There is a dose-response relationship between alcohol and harms, meaning that the more an individual drinks the more likely they are to experience harms from alcohol (519). Heavy drinking, also termed binge drinking or heavy episodic drinking (HED), is also highly prevalent within the UK, with 27% of drinkers engaging in heavy drinking occasions (HDOs) on their heaviest drinking days (1). Typically defined in the UK as females and males consuming over 6 and 8 units (1 units = 8g of ethanol) of alcohol respectively in a single drinking occasion (3), heavy drinking is associated with both acute and long-term negative consequences such as injury, road traffic accidents, and alcohol dependency (7,520). In much of the literature examining the predictors of heavy drinking, there has been a tendency to focus on individual characteristics such as age and sex, or psychological measures such as an individual's expectancies and motivations (521,522). Whilst examining individual predictors of heavy drinking has provided useful insights, recent evidence has found that including characteristics of the drinking occasion, such as its duration, alongside individual-level predictors within explanatory models can account for between 55-71% of the variance in drinking occasion alcohol consumption, which was substantially more than including individual-level predictors alone, which accounted for between 1-9% (506).

Within this body of literature, a range of contextual factors are currently measured and associated with increased consumption including drinking within a large group (253), drinking at the weekend (19), and drinking whilst using illicit substances (118). Whilst evidence identifying event-level characteristics associated with HDOs is useful, much of this literature has focused on convenience samples such as adolescents and young adults (22,254), which

potentially limits the generalisability of these findings as these populations may drink within different contexts compared to middle-aged and older adults (11). This is particularly problematic as population surveys found adults aged 45-64 were the age group to most regularly drink above the UK low-risk weekly guidelines (91). Additionally, there is evidence to suggest that the Covid-19 pandemic may have led to an increase in high-risk drinking, the volume of alcohol consumed by high-risk drinkers (523), and the frequency of consumption amongst middle aged drinkers (92). As such, it is important to explore the contextual characteristics associated with heavy drinkers and their HDOs in a more representative sample.

Furthermore, studies tend to focus on individual or a small number of factors, and do not provide theoretical frameworks for variable selection (22). As such it is important to examine a broader range of contextual variables to determine which contextual characteristics of drinking occasions are associated with heavy drinkers and their HDOs.

Whilst evidence exists to suggest that heavy drinking occurs within a range of location types (29), much of the literature focuses on the characteristics of on-trade establishments such as bars, restaurants, and nightclubs (77,524). As heavy drinking also occurs within off-trade locations such as the home (211), this is problematic as the characteristics of off-trade HDOs may differ to those in the on-trade. Mixed trade occasions, where individuals drink both in home type settings and in bars or pubs, are associated with longer occasion duration, which in turn is associated with greater consumption (506). Identifying the contexts associated with heavy drinkers on-trade, off-trade, and mixed-trade drinking and HDOs occasions could therefore provide new insights to inform targeted messaging or public health provisions.

Research questions

1. What contextual characteristics are associated with the number of units consumed by heavy drinkers within:

a) On-trade general occasions?

b) Off-trade general occasions?

c) Mixed-trade general occasions?

2. What contextual characteristics are associated with the number of units consumed within:

a) On-trade HDOs?

b) Off-trade HDOs?

c) Mixed-trade HDOs?

3. Do contextual or individual level characteristics explain more of the variance of units consumed in:

a) On-trade HDOs?

b) Off-trade HDOs?

c) Mixed-trade HDOS?

Method

Study population and design

A stratified quota sample (by age and sex) of UK adults (18+) was recruited using the crowdsourcing website Prolific Academic, in which a self-selecting panel comprising of members of the general public volunteer to take part in research tasks posted on the website. A *priori* sample size calculation was conducted using G*power 3.1.9.7, with a sample size of 274 recommended to detect a medium effect size based on 34 questions of analytical interest asked within the survey. As such, we attempted to recruit 274 participants. To be eligible, participants had to be: (1) over the age of 18; (2) currently living in the UK; and (3) a heavy drinker, as determined by drinking over the UK low risk drinking guidelines of 14 units per week (28). Participants were recruited to this study based on their heavy drinker status, rather than being

screened on having engaged in heavy drinking occasions. This was because Prolific did not have the capabilities to recruit based on the number of units drank in an occasion, whereas the number of units drank per week was a standardised recruitment question. It was felt that those who were heavy drinkers would be more likely to engage in heavy drinking occasions than the general population. Participants were screened for eligibility within Prolific Academic, with only those who met all three eligibility criteria and who were also able to complete the survey on a laptop able to take part.

Within both Prolific Academic and the survey in Qualtrics, participants were presented with a participant information sheet which described the purpose of the study. Once participants had read the participant information sheet, they were directed to a screening questionnaire within Qualtrics which provided cross-validation on the screening process which occurred in Prolific Academic, where-in participants were asked the same screening questions again to ensure eligibility. Once participants had undergone the screening validation, they were directed to the online consent form. To provide consent, participants had to tick a number of statements. If participants did not tick all statements, they could not proceed with the survey. Within the survey, participants were initially presented with questions on health-related characteristics (such as the AUDIT (525)). Participants were next presented with the context-specific survey, which collected information on the contextual characteristics of their drinking occasions. For each drinking day over the past week, participants were asked to recall up to three locations a day where they had consumed alcohol. For each drinking location, participants were asked detailed questions relating to the contexts in which they drank, for example when they drank (e.g. timing), why they drank (e.g. motivations for drinking), what they drank, what other activities they engaged in whilst drinking, and who they drank with (e.g. drinking companions). Within the final part of the online survey, participants were asked demographic questions, such as their age and gender. Based on the length of the cognitive interviews, the study was estimated

on Prolific Academic to take a maximum of 45 minutes. Participants were reimbursed with £5.63 worth of Prolific Academic points for their time. This study received ethical approval from the University of Sheffield's ethics committee (Ref: 039246).

Measures:

The study was pre-registered prior to data collection on Open Science Framework (https://osf.io/yr37a). A summary of the measures asked are included below:

Outcome variable

The outcome variable was the total units consumed per occasion by trade type. This was measured by asking participants about the quantity and serving size of any alcoholic drinks they had consumed within each drinking location. The alcoholic drinks which participants could report consuming included: normal strength beer and cider, high strength beer and cider, wine (including sparkling and champagne), sherry, port, fortified wine or martini (e.g. Vermouth, Buckfast, Maderia, Croft Original), spirits (e.g. whisky, vodka, gin, cognac, brandy, rum, schnapps, tequila), liqueurs (e.g. Baileys, Cointreau, Malibu, Pimms, Jägermeister), shots (undiluted spirits/ liqueurs tipped back in one shot e.g. Aftershock), cocktails (drinks containing a mix of alcohol), alcopops or pre-mixed drinks (e.g. WKD, Barcardi Breezer), and low-strength alcohol beer, cider, and wine.

Within each drinking location, the quantity and serving size of alcoholic drinks consumed was converted into alcoholic units by multiplying the total volume of a drink (in ml) by its ABV (measured as a percentage) and dividing the result by 1,000. In estimating the ABVs of each drink type, we were guided by ABV assumptions made within the Health Survey for England which are formulated by using NatCen Social Research's assumptions supplemented with market research data and figures from academic publications, and by consultation with a review of typical ABVs reported by Public Health England (526). We estimated normal strength beer

and cider at 4.4% ABV; strong beer and cider at 8.4% ABV; wine (including sparkling and champagne) at 12.5% ABV; sherry, port, fortified wine, or martini at 17% ABV; spirits and shots at 38% ABV; liqueurs at 17% ABV; cocktails at 15% ABV; alcopops at 4.5% ABV; and low-strength beer, cider, and wine at 1.2% ABV.

Individual-level predictor variables (Level 1):

Full AUDIT score: Participants were asked to complete the 10-item AUDIT (525). A total AUDIT score was calculated by summing the scores of the 10-item questionnaire.

Smoker status: Participants were asked the question "What is your smoker status". Participants who selected either (1) '*I smoke cigarettes (including hand-rolled) every day*', (2) '*I smoke cigarettes (including hand-rolled), but not every day*', or (3) '*I do not smoke cigarettes at all, but I do smoke tobacco of some kind (e.g. pipe, cigar or shisha)*' were classified as current smokers. Those who selected (4) '*I have stopped smoking completely in the last year'* were classified as recent ex-smokers. Those who selected (5) *'I stopped smoking completely more than a year ago'* were classified as long-term ex-smokers, with those who selected (6) *'I have never smoked any cigarettes'* classified as having never smoked. As this variable was measured as a categorical variable with more than 2 levels, to allow for comparison between groups within analyses, participants who had never smoked were the reference group.

Dieting status: Participants were asked the question "Are you currently on a diet with the intention to (1) *'lose weight', (2) 'maintain weight', (3) 'to gain weight',* or (4) *'I am not on a diet'*. Within analyses, participants who were not on a diet were the reference group as this variable was measured as a categorical variable with more than 2 levels, to allow for comparison between groups.

Reduction of alcohol consumption: Participants were asked the question "Are you currently trying to reduce your alcohol consumption". Participants who answered *yes* were coded as '1', with participants who answered *no* coded as '0'.

Reason for alcohol consumption: Participants who selected '*yes*' to reducing their alcohol consumption were asked the question "Which of the following, if any, do you think contributed to you making the most recent attempt to reduce your alcohol consumption?". For this question, the following response options were provided: (1) 'Advice from doctor/health worker', (2) 'Government TV/radio/press advert', (3) 'A decision that drinking was too expensive', (4) 'I knew someone else who was cutting down', (5) 'Health problems I had at the time', (6) 'A concern about future health problems', (7) 'Something said by family/friends/children', (8) 'A significant birthday or event, (9) 'Improve my fitness', (10) 'Help with weight loss', (11) 'Detox', (12) 'Own decision/ nothing', (13) 'Had a baby', (14) 'Family problems', (15) 'To give up alcohol for a month', (16) 'The coronavirus outbreak', (17) 'Other'. Within analyses, each reason for attempted alcohol reduction was coded as 1 if a response of 'yes' was given, or 0 if a response of 'no' was given.

BMI: BMI was calculated by asking for participants height and weight in either metric or imperial measurements.

Quality of life scores: The EQ-5D-EL (515) was administered to measure participants quality of life.

Age: Continuous in years

Gender: Categorical variable, males were coded as '0', females were coded as '1'.

Employment status: Participants were asked "which of the following best describes your current employment status". For this question, the following response options were provided: (1) = 'Employed full-time', (2) = 'Employed part-time', (3) = 'Self-employed', (4) =

‘Unemployed but looking for a job’, (5) = ‘Unemployed and not looking for a job/ long-term sick or disabled/ Homemaker’, (6) = ‘Retired’, (7) = ‘In full-time education’, (8) Other, or (9) ‘Prefer not to say’. Employment status categories were then recoded into the following mutually exclusive categories: (1) Full-time employment, (2) part-time employment, (3) Self-employment, (4) Unemployed, (5) Homemaker, (6) Retired, and (7) Full-time education. As this variable was measured as a categorical variable with more than 2 levels, to allow for comparison between groups, within analyses participants in full-time employment were the reference group.

Marital status: Participants were asked to “select which of the following best applied to them”. For this question, the following response options were provided: (1) ‘Single’, (2) ‘In a relationship’, (3) ‘Living with partner’, (4) ‘Married’, (5) Separated, (6) Divorced, (7) Widowed, (8) Same-sex civil partnership, (9) Formerly in a same-sex civil partnership, (10) Surviving partner from same-sex civil partnership, or (11) Prefer not to say. Marital status categories were then recoded into the following mutually exclusive categories: (1) Single, (2) In a relationship, (3) Married or in Civil partnership, (5) Separated, (6) Divorced, and (7) Widowed. Within analyses, participants who were married or in a civil partnership were the reference group as this variable was measured as a categorical variable with more than 2 levels, to allow for comparison between groups,

Ethnicity: Participants were asked to select the ethnicity which best represented them. For this question, the following response options were provided: (1) ‘White (including English/ Welsh/ Scottish/ NI/ British, Irish, Gypsy or Irish traveller, Any other white background)’, (2) ‘Mixed (Including White and Black Caribbean, White and Black African, Any other Mixed/ Multiple ethnic background)’, (3) ‘Asian or Asian British (including Indian, Pakistani, Bangladeshi, Chinese, Any other Asian)’, (4) ‘Black or Black British (African, Caribbean, Any other Black/

African/ Caribbean background)', (5) 'Other ethnic group'. Ethnicity categories were recoded into the following categories: White (1 = Yes, 0 = No), Non-white (1 = Yes, 0 = No).

Socioeconomic status: Participants were asked "What is the highest educational qualification obtained". For this question, the following response options were provided: (1) '1-4 O levels/ CSEs/ GCSEs (any grade), Entry levels, Foundation Diploma', (2) NVQ Level 1, Foundation GNVQ, Basic Skills, (3) '5+ O levels (passes)/ CSEs (grade 1)/ GCSEs (grades A*-C), School certificate, 1 A level/ 2-3 AS levels/ VCEs, Higher Diploma', (4) 'NVQ Level 2, Intermediate GNVQ, City and Guilds Craft, BTEC First/ General Diploma, RSA Diploma', (5) 'Apprenticeship', (6) '2+ A levels/ VCEs, 4+ AS levels, Higher School Certificate, Progression/ Advances Diploma', (7) 'NVQ Level 3, Advanced GNVQ, City and Guilds Advanced Craft, ONC, OND, BTEC National, RSA Advanced Diploma', (8) 'Degree (for example BA, BSc), Higher degree (for example MA, PhD, PGCE)', (9) NVQ Level 4-5, HNC, HND, RSA Higher Diploma, BTEC Higher Level, (10) 'Professional qualifications (for example teaching, nursing, accountancy)', (11) 'Other vocational/ work-related qualifications', (12) 'Qualifications from another country', and (13) 'No qualifications'. Response options were recoded into the following categories, those with the highest qualification being to GCSE equivalent and below *(i.e., under 16 qualifications)* were coded as '0', with those whose highest qualification was *above GCSE and* equivalent (*i.e., post-16 qualifications)* were coded as 1.

Household demographics*:* Participants were asked how many children aged below 18 lived within their homes.

<u>Occasion-level predictor variables (Level 2):</u>

Where

Drinking location*:* For each drinking day, participants were asked to select up to three drinking locations. Drinking locations included: (1) a restaurant, (2) a traditional pub, (3) a modern bar,

(4) a pub or bar restaurant, (5) a social club or sports club, (6) their own home (including the garden), (7) someone else's home (including the garden), (8) outdoors away from home, and (9) other.

Number of locations visited: Calculated from the number of drinking locations participants visited within each occasion.

Mode of transport to the drinking location: The type of transport each individual took to travel to their drinking venue was asked for every drinking location by the following question: "When travelling to this **location**, which of the following best describes your mode of transport". For this question, the following response options were provided: (1) I was already there, (2) I used public transport, (3) I hired a taxi, Uber or similar, (4) I drove my own car or motor vehicle, (5) I got a lift from another person I was with, **who was** drinking alcohol, (6) I got a lift from another person I was with, **who was not** drinking alcohol, (7) I got a lift from someone who came to collect me, (8) I walked, and (9) other. Each response option was coded as 1 if a response of 'yes' was given, or 0 if a response of 'no' was given.

When

Day of the week: Participants were asked to select each day of the week they had consumed an alcoholic drink (including non-alcoholic beer, cider, or wine) during the past 7 days.

Duration: Participants were asked to report the start and finish time of drinking within each location to the nearest 15 minutes. Using the start and finish times, we calculated the duration of drinking within each location by subtracting the start time from the finish time to provide a duration in minutes.

Drinking-related activities: Activities occurring whilst drinking were measured by the following two questions. Firstly, participants were asked "What other activities were you doing

whilst drinking in this occasion?". For this question, the following response options were provided: (1) 'Consuming food as a meal', (2) 'Consuming food as a snack', (3) 'Cooking or baking food', (4) 'Speaking with people over videoconferencing (Zoom, Skype etc)', (5) 'Watching TV or video on any device (including DVDs, Blu-Ray or streaming services)', (6) 'Spending time on social media (e.g. Facebook, Instagram, TikTok)', (7) 'Completing household chores (for example, ironing, cleaning)', (8) 'Playing a computer or console game (e.g. PlayStation, Xbox)', (9) 'Playing a non-computer game (e.g. card, board game)', (10) 'Playing pool, darts or similar bar-room game', (11) 'Listening to an audio device (e.g. radio or streaming service)', (12) 'Watching a live event (e.g. music, sport)', (13) 'Dancing', (14) 'Doing a pub quiz', (15) 'Playing drinking games', (16) 'Reading', (17) 'Working', and (18) 'Other'. Each response option was coded as 1 if a response of 'yes' was given, or 0 if a response of 'no' was given.

The second question measured other substance use at each location, by asking the following question: "Within this occasion did you use any of the following?". For this question, the following response options were provided: (1) 'Cigarette or cigar', (2) 'E-Cigarette (Vape)', (3) 'Cannabis', (4) 'Other recreational drugs (e.g. amphetamine or ecstasy)', and (5) 'None of the above'. Each response option was coded as 1 if a response of 'yes' was given, or 0 if a response of 'no' was given

Change from regular routine: Participants were asked if they were on holiday during the past 7 days. If participants were on holiday during the past 7 days, they were asked the location of this holiday, with those who were not on holiday coded as '0', those who were on holiday within the UK coded as '1', and those who were on holiday outside the UK coded as '2'.

Why

Drinking motives: Drinking motives were measured by asking the following three questions.

Firstly, participants were asked "Which of the following best describes your drinking occasion?". For this question, the following response options were provided: (1) 'Paying a visit (others visiting your home or you visiting someone else's home)', (2) 'Entertainment, game and hobby', (3) 'Festive occasion or party', (4) 'Meal', (5) 'No special occasion', and (6) 'Other (please specify)'. Each response option will be coded as 1 if a response of 'yes' was given, or 0 if a response of 'no' was given.

To measure the purpose for attending the drinking occasion, the second question asked "What was the *purpose of* attending this drinking occasion?", with the final question measuring the reason for drinking within the occasion asking "Why did *you* drink within this occasion?". For these questions, the following response options were provided: (1) 'To alleviate stress', (2) 'To relax', (3) 'To cope with a negative mood', (4) 'To celebrate and have fun', (5) 'To cope with boredom', (6) 'To socialise', (7) 'Out of habit', and (8) 'Other'. Each response option was coded as 1 if a response of 'yes' was given, or 0 if a response of 'no' was given.

Drinking intentions: Participants were asked two questions to establish drinking intentions within occasions. Firstly, they were asked how intoxicated they planned to get in each occasion, with participants then asked how intoxicated they actually go in each occasion. For both questions participants could respond using an 11-point Likert scale with 0 labelled as 'Not at all intoxicated' and 11 labelled as 'Most intoxicated I've ever been'.

What

Type of drink and serving size: Participants were asked the type of alcoholic and non-alcoholic drink and the serving size (e.g. pint, can, bottle) they consumed within each drinking location. Within each location, participants were asked if they had drank any of the following beverage types: (1) Beer or cider, (2) Wine, (3) Spirits, liqueurs or shots, (4) Cocktails or Alcopops, (5) No-alcohol and low alcohol beer, cider and wine, and (6) Non-alcoholic drinks. For each

beverage type participants reported consuming in each location, participants were then asked the serving size they had consumed. The following serving sizes were provided depending on the beverage consumed: (1) Pint, (2) Small can (up to 330ml), (3) Standard can (440ml), (4) Large can (500ml/pint), (5) Small/Continental bottle (up to 250ml), (6) Standard bottle (330ml – 440ml), (7) 500ml/pint bottle, (8) Small wine glass (125ml), (9) Medium wine glass (175ml), (10) Large glass wine (250ml), (11) Glass(es) (Unspecified size/ Size unknown), (12) Small bottle (275ml), (13) Standard bottle (750ml), (14) Large bottle (1.5L), and (15) Box/Carton (3 litres).

Who

Drinking companions: Others within the drinking location were measured by the following questions.

To measure who participants were with within each drinking location, participants were asked the following question: "When drinking in **this occasion**, who was in the group of people you were with?". For this question, the following response options were provided: (1) Romantic partner, (2) Other family members aged 18 and over I live with, (3) Other family members aged 18 and over who live elsewhere, (4) Friends, (5) Neighbours, (6) Work Colleagues, (7) People I study with, (8) I drank alone, (9) Children aged 16-17, (10) Children aged 13-15, and (11) Children aged 12 or younger. Each response option was coded as 1 if a response of 'yes' was given, or 0 if a response of 'no' was given.

To measure the number of adults within each drinking location, participants were asked the following question "Including **yourself**, how many **adults** were you with?". Participants were able to response with any numeric value.

To measure the gender composition within each drinking location, participants were asked the following question "Within your drinking group, what was the gender composition of adults

present?". For this question, the following response options were provided: (1) Male pair, (2) Female pair, (3) Mixed sex pair, (4) Male group, (5) Female group, and (6) Mixed sex group. Each response option was coded as 1 if a response of 'yes' was given, or 0 if a response of 'no' was given.

To measure the number of adults *drinking* within each location, participants were asked the following question: "Of the **[Number of adults]** adults present, how many consumed an alcoholic drink?". Participants were able to respond with any numeric value that was equal to or lower than the number of adults within each drinking location.

To measure how much participants drank in comparison to others drinking within the location, participants were asked the following question: "Which of the following statements best describes how much you drank in [Location]." For this question, the following response options were provided (1) I believe I drank much less than the other adults who drank alcohol, (2) I believe I drank a little less than the other adults who drank alcohol, (3) I believe I drank the same as the other adults who drank alcohol, (4) I believe I drank a little more than the other adults who drank alcohol, (5) I believe I drank much more than the other adults who drank alcohol. Participants who drank alone were coded as (0), with participants who were the sole drinker of alcohol in the location and therefore could not drink more or less than any other companions were coded as (6). As this variable was measured as a categorical variable with

more than 2 levels, to allow for comparison between groups, within analyses participants who were selected drinking the same as other adults who drank alcohol were the reference group.

Children's drinking: Within each drinking location, participants who reported children under the age of 16 being present were asked the following questions.

Firstly, participants were asked "Within your group, did any children under the age of 16 drink any alcohol in this location?". Response options were coded as 1 if a response of 'yes' was given, or 0 if a response of 'no' was given.

For participants who reported that a child under the age of 16 had drank alcohol in that location, they were asked the following two questions. Firstly, they were asked "Which of the following drinks did they consume?". For this question, the following response options were provided: (1) Normal strength beer/ lager/ stout (less than 6% by vol, e.g. Budweiser, Becks, Stella), (2) Strong beer/ lager/ stout (e.g. Tenants Extra, Special Brew), (3) Normal strength cider (less than 6% vol, e.g. Magners, Kopparberg), (4) Strong cider (e.g. Diamond White, Frosty Jack's, Pulse, K Cider), (5) Wine (including sparkling and Champagne), (6) Spirits (e.g. whisky, vodka, gin, cognac, brandy, rum, schnapps, tequila), (7) Liqueurs (e.g. Baileys, Cointreau, Malibu, Pimms, Jägermeister), (8) Shots (undiluted spirits/ liqueurs tipped back in one shot e.g. Aftershock), (9) Sherry, port, fortified wine or martini (e.g. Vermouth, Buckfast, Madeira, Croft Original), (10) Cocktails (drinks containing a mix of alcohol), and (11) Alcopops or pre-mixed drinks (e.g. WKD, Bacardi Breezer). Participants were then asked. "How much did they drink?". For this question, the following response options were provided: (1) Just a sip, (2) Less than a normal serving size (e.g. half a glass or can), (3) One normal serving size, and (4) More than one serving size.

Analysis plan

All analyses were conducted in Stata 17 (527).

Descriptive statistics were calculated using means, proportions, and standard deviations (or median and IQR) to characterise the sample included in the analysis based on sociodemographic data and contextual characteristics. Only participants with complete data on variables of interest were included in each analysis. To answer each research question, a series of multilevel Generalized Linear Models (GLM) regression analyses were conducted, where occasions (level 2) where nested within individuals (level 1). Given the large number of potential predictors, we had planned to conduct a series of best subset regressions for each research question using the *gvselect* package in Stata, with the best fit model of predictors decided based on Akaike information criterion (AIC) and Bayesian information criterion (BIC). Using best subset regressions is recommended above stepwise and Lasso models as they been found to have better prediction accuracy than the alternative regression models (528).

Calculating the total units consumed per occasion by trade type

To calculate the total units for each drinking location, the number of alcoholic drinks that participants reported consuming at each drinking location was converted into units by multiplying the total volume of drink consumed (measured in ml) by each beverage types' ABV (measured as a percentage) and dividing the result by 1000. The total number of units consumed within each beverage type was then summed to provide the total number of units consumed within each location. As the units consumed within each occasion were skewed, the total number of units consumed within each occasion underwent log-transformation (529).

Creating drinking occasions

In conceptualising drinking occasions, we applied the definition created by Mustonen et al. in that an occasion is a period of time where there is *no more than a 2-hour gap between alcoholic drinks* (37). This definition has also been used in studies typologising drinking occasions within the UK (11). In our study, multiple locations formed occasions when there was less than 2 hours between the time participants reported stopping drinking at one location and started

drinking at a later location. Within this study, drinking within “a restaurant”, “a modern bar”, “a traditional pub”, “a pub or bar restaurant”, “a nightclub”, or “a social club or sports club” were classified as on-trade occasions whereas drinking in “your own home (including the garden)”, “someone else’s home (including the garden)”, or “outdoors away from home” were classified as off-trade occasions. If an individual drank within both on-trade and off-trade locations without a 2-hour gap between drinking, this was classified as mixed-trade location.

Changes to the analysis plan

Mixed occasions

As outlined within the pre-registered study protocol, we had initially planned to conduct analyses on drinking occasion characteristics associated with on-, off-, and mixed trade consumption. However, after data collection there were only 91 mixed trade occasions, which was not considered powered enough to conduct a large statistical analysis. As a result, we separated mixed occasions into their on- and off-trade components and used a dummy variable to denote where this occasion was part of a mixed trade occasion.

Selecting predictor variables for the regression analyses

Given the large number of potential predictors, we had planned to conduct a series of best subset regressions for each research question using the *gvselect* package in Stata. However, when we attempted to run the *gvselect model*, as more predictors were added to the best subsets regression the processing time taken to run exponentially increased past the levels of practicality. Thirteen predictors returned an output within 3 minutes; however, when entering more than 20 predictors, the output did not return after running for two days. As it was impractical to continue to use *gvselect* we identified alternative approaches outlined in the literature on how to reduce the number of predictor variables (530).

Within the paper by Beard et al. (530) several alternative approaches to selecting predictor variables for regression models were suggested, all of which have important limitations and

challenges for the present research. The first approach suggested was to use a stepwise regression and enter variables through forward and backward selection to find an optimal subset of variables. However, given the vast amount of literature that finds stepwise selection increases the likelihood of Type 1 errors (531), stepwise regression approaches were not considered a viable alternative. The second approach suggested by Beard et al. (530) was to select variables based on their theoretical importance. Whilst this is a viable option in most studies, given that all contextual variables could be argued as theoretically important and that the purpose of the thesis was to take a comprehensive approach, we decided against pursuing this.

One of the remaining suggestions within the paper by Beard et al. (530) recommended conducting univariate analyses with each predictor variable and the dependent variable (total units consumed per occasion) and to only include each variable in the regression if the predictors were significant at the $p<0.025$ level. Initially, we had planned to take this approach and then enter each predictor which was significant into the *gvselect* model. However, after conducting univariate regression analyses there were still a large amount of predictor variables, and therefore given the issues encountered with *gvselect,* even conducting a best subsets regression with significant predictor variables at the $p<0.025$ level would have been infeasible.

As a result, we decided to run two models for each research question. The primary analysis focuses on the subset model suggested by Beard et al. (530), which is reported in the tables and text. Following the guidance by Beard et al. (530), after conducting univariate analyses with each predictor variable and the dependent variable (total units consumed per occasion), predictor variables were included in the subset model if they were significant at the $p<0.025$ level. Findings from a sensitivity analysis using the full model (all the predictors' variables measured within the survey) are also reported in the tables and compared with the subset model for consistency.

Results

Summary of participants

Two hundred and seventy-two participants accessed the study on Prolific Academic. Fifteen of these participants did not meet the eligibility criteria when re-screened in Qualtrics and therefore did not continue with the survey. Of the 257 participants who met the eligibility criteria, five dropped out prior to providing consent to take part in the survey. Of the 252 who consented to take part, one participant did not answer any questions. Participants who completed the survey took an average of 24.01 minutes. Of the 251 who completed the survey, 15 participants did not answer any demographic questions and were therefore removed from the sample, resulting in a total of 236 participants, a summary of which is presented in Table 1. The full sample (*n*=236) was predominantly White (94.92%) but balanced in terms of gender (49.58% female). Within the full sample, 236 participants reported a total of 1117 drinking occasions, with 279 occurring within on-trade and 838 occurring within off-trade locations. Out of the 1117 drinking occasions reported, 644 were HDOs, with HDOs accounting for 57.65% of drinking occasions.

Table 1: Participant demographics by trade type

	Full sample	**On-trade**	**Off-trade**
N of participants	236	141	216
N of occasions	1117	279	838
N of HDOs	644	164	480
Mean Age	44.96 (SE = 1.12)	39.41 (SE = 1.03)	50.58 (SE = 0.56)
Gender (% Female)	49.58%	45.88%	50.48%
Ethnicity (% white)	94.92%	92.47	96.90 %
Mean AUDIT	23.55 (SE = 0.35)	24.61 (SE = 0.34)	23.57 (SE = 0.21)
BMI Mean	27.48 (SE = 0.42)	26.28 (SE = 0.37)	27.88 (SE = 0.22)
Mean units drank per occasion	9.73 (SE = 0.43)	10.63 (SE = 0.47)	9.08 (SE = 0.23)
Mean Duration of occasions	3 hours 20 minutes	3 hours 20 minutes	3 hours 25 minutes

RSQ1a: Contextual characteristics associated with the number of units consumed by heavy drinkers within on-trade general drinking occasions

Table 2: Significant predictors of on-trade drinking from the full model and subset model

	Full model[a]					Subset model[b]				
	Regression Coefficients (β)	SE	P value	CI 95%		Regression Coefficients (β)	SE	P value	CI 95%	
Who										
Course mates	-0.9416745	0.32	0.003	-1.57	-0.31					
Drank much less than companions						-0.7821179	0.30	0.009	-1.37	-0.20
What										
High strength beer or cider	0.6530569	0.33	0.047	0.01	1.30					
Drinking cocktails	1.481012	0.70	0.035	0.10	2.86					
Drinking shots	1.639772	0.75	0.028	0.18	3.10					
Drinking low strength alcohol	-1.786177	0.79	0.025	-3.34	-0.23	-1.601279	0.63	0.011	-2.83	-0.37
Spirits as singles	-1.316386	0.42	0.002	-2.14	-0.49					
Spirits as doubles	-1.016122	0.45	0.023	-1.89	-0.14					
Spirits from 70cl bottles	1.702486	0.72	0.018	0.30	3.11					
Beer or cider from 2L Jug	1.442027	0.57	0.011	0.33	2.55					
Where										
Mixed occasion	-0.3108295	0.10	0.003	-0.51	-0.11	-0.3334374	0.08	<.001	-0.48	-0.18
Number of locations						0.1392314	0.07	0.047	0.00	0.28
When										
Duration of occasion	0.1102222	0.03	<.001	0.05	0.17	0.0940327	0.02	<.001	0.06	0.13
Start time of occasion	0.0257488	0.01	0.041	0.00	0.05					
Stop time of the occasion						0.003405	0.00	0.47	-0.01	0.01
Live event	0.5735825	0.17	0.001	0.25	0.90					
Dancing	-0.4766015	0.19	0.01	-0.84	-0.11					
Smoking a cigarette in the occasion						0.4092248	0.16	0.009	0.10	0.72
Why										
Purpose of occasion to alleviate boredom	0.6747752	0.32	0.034	0.05	1.30					
Purpose of occasion to socialise	0.2983716	0.13	0.023	0.04	0.55	0.3808743	0.10	<.001	0.19	0.57
Planned intoxication	0.1146932	0.04	0.002	0.04	0.19	0.1049326	0.03	<.001	0.05	0.16
Individual-level										
Marital status separated	-0.6112369	0.30	0.039	-1.19	-0.03					
QALY pain	-0.1801226	0.08	0.031	-0.34	-0.02					
Smoker status recent smoker	-0.5456374	0.25	0.031	-1.04	-0.05					
Employment status unemployed	-0.6420288	0.27	0.016	-1.16	-0.12					
Ethnicity non-white	0.563409	0.19	0.003	0.19	0.94					
BMI	0.0347065	0.01	0.002	0.01	0.06	0.0172571	0.01	0.036	0.00	0.03

[a] n = 279 occasions, 141 individuals $X^2(169) = 816.28$, $P < 0.001$
Log restricted likelihood is -252.16165

[b] n = 279 occasions, 141 individuals $X^2(53) = 387.48$, $P < 0.001$
Log restricted-likelihood = -245.92432

On average participants had 2.0 on-trade drinking occasions per week. The findings of both the full and subset models are presented in Table 2. Table 2 only presents the significant predictors of on-trade drinking from the full model and subset models. Within the full model 170 predictors were entered, with 54 entered into the subset model. A table displaying all predictors is presented in Table S1 supplementary materials.

In the primary subset regression model of heavy drinker's on-trade general drinking occasions, all contextual groups had characteristics significantly associated with units consumed per occasion. The characteristics associated with significant increases in units consumed per drinking occasion were largely within the *where, why,* and *when* contextual groups. Amongst these, smoking cigarettes within the occasion (0.41 units per occasion, 95% CI = 0.10, 0.72) and the purpose for the occasion being to socialise (0.38 units per occasion, 95% CI = 0.19, 0.57) were associated with the largest increases in units consumed per occasion.

The characteristics associated with significant decreases in units consumed per drinking occasion were identified within the *who, what,* and *where* contextual groups. Amongst these, drinking low strength alcohol drinks (-1.60 units per occasion, 95% CI = -2.83, -0.37), drinking less than others in the occasion (-0.78 units per occasion, 95% CI = -1.37, -0.20), and drinking as part of a mixed-trade occasion (-0.33 units per occasion, 95% CI = -0.48, -0.18) were the only characteristics associated with decreases in units consumed per occasion.

Some variables reliably predicted consumption in on-trade occasions amongst heavier drinkers in both the subset and full regression models, with these variables including occasion duration, drinking as part of a mixed occasion, and the purpose of the occasion being to socialise. However, when comparing the full model to the subset there were some differences, with the subset model highlighting significant predictors which did not reach significance in the full

model including the number of drinking locations within an occasion, smoking a cigarette within the occasion, and drinking less than other companions in the occasion.

RSQ1b: Contextual characteristics associated with the number of units consumed by heavy drinkers within off-trade general drinking occasions

Table 3: Significant predictors of off-trade drinking from the full model and subset model

	Full model[a]					**Subset model[b]**				
	Regression Coefficients (β)	SE	P value	CI 95%		Regression Coefficients (β)	SE	P value	CI 95%	
Who										
Drank little less than companions	-0.1780148	0.05	<.001	-0.27	-0.09	-0.1565557	0.05	0.002	-0.26	-0.06
Drank much less than companions	-0.2571611	0.09	0.006	-0.44	-0.07					
Drank a little more than companions	0.0868817	0.03	0.013	0.02	0.16	0.1243962	0.04	0.001	0.05	0.20
Number of adults drinking	0.020291	0.01	0.018	0.00	0.04					
What										
Drinking spirits	1.617863	0.65	0.013	0.35	2.89					
Drinking shots	-1.514304	0.67	0.023	-2.82	-0.21					
Drinking liqueurs	-1.66592	0.67	0.013	-2.98	-0.36					
Drinking low strength wine	-1.631922	0.39	<.001	-2.39	-0.88	-1.51043	0.32	<.001	-2.14	-0.88
Drinking high strength beer	0.3439053	0.15	0.018	0.06	0.63	0.5284707	0.12	<.001	0.30	0.76
Beer or cider from a standard can	0.227122	0.08	0.005	0.07	0.39					
Drinking beer from a large can	0.1861835	0.09	0.033	0.01	0.36					
Beer or cider from pint glasses	0.282606	0.09	0.002	0.10	0.46					
Wine from unspecified size glass	0.5339793	0.12	<.001	0.30	0.77					
Wine from medium glass	0.229419	0.08	0.003	0.08	0.38	0.1997592	0.05	<.001	0.11	0.29
Wine from large glass	0.2785976	0.07	<.001	0.13	0.42					
Wine from standard bottles	0.5108628	0.08	<.001	0.35	0.67	0.4469536	0.05	<.001	0.35	0.54
Wine from large bottles	1.083987	0.22	<.001	0.65	1.52	0.8071978	0.24	0.001	0.34	1.27
Wine from 3L box	0.651898	0.22	0.003	0.23	1.08	0.5503417	0.23	0.018	0.09	1.01
Drinking spirits from a hipflask	0.4668246	0.21	0.028	0.05	0.88					
Drinking sherry from a 50ml glass	-0.5242772	0.24	0.031	-1.00	-0.05					
Spirits from 70cl bottles	0.7132722	0.17	<.001	0.39	1.04	0.5710784	0.10	<.001	0.37	0.77
Spirits from 1L bottles	1.159034	0.25	<.001	0.67	1.65	0.9969287	0.20	<.001	0.60	1.39
Where										
Mixed occasion	-0.2095343	0.06	<.001	-0.33	-0.09					
Number of locations	-0.372829	0.18	0.036	-0.72	-0.02	0.2238331	0.07	0.001	0.09	0.36
Own home	0.4721092	0.20	0.017	0.09	0.86					
Others home	0.4758156	0.19	0.013	0.10	0.85					

Lift from a drinker in the occasion	0.4138137	0.18	0.024	0.06	0.77					
When										
Duration of occasion	0.051542	0.01	<.001	0.04	0.07	0.0896745	0.01	<.001	0.07	0.10
Drinking on a Saturday	-0.0801609	0.04	0.023	-0.15	-0.01					
Drinking on a Tuesday	-0.0884498	0.04	0.026	-0.17	-0.01					
Listening to the radio						0.1268776	0.05	0.014	0.03	0.23
Why										
Purpose of occasion to alleviate boredom	-0.1628707	0.07	0.025	-0.31	-0.02	-0.1552274	0.08	0.044	-0.31	0.00
No special occasion						0.0783539	0.03	0.013	0.02	0.14
Reason for drinking due to boredom	0.1408812	0.07	0.031	0.01	0.27					
Purpose of occasion to alleviate a negative mood	0.2518441	0.07	<.001	0.11	0.39	0.2196798	0.08	0.006	0.06	0.38
Purpose of occasion due to habit	-0.0956266	0.04	0.027	-0.18	-0.01					
Reason for drinking due to habit	0.0872349	0.04	0.04	0.00	0.17	0.1109302	0.05	0.018	0.02	0.20
Purpose of occasion to have fun	0.1988532	0.07	0.005	0.06	0.34					
Planned intoxication	0.0883827	0.01	<.001	0.06	0.12	0.0877415	0.02	<.001	0.06	0.12
Higher intoxication than planned	0.1287124	0.06	0.033	0.01	0.25					
Individual-level										
AUDIT score	0.0233455	0.01	<.001	0.01	0.04	0.0173075	0.01	0.004	0.01	0.03
QALY mobility	-0.2452979	0.08	0.002	-0.40	-0.09					
QALY total health	-0.006154	0.00	0.013	-0.01	0.00					
Gender	-0.1570981	0.06	0.005	-0.27	-0.05	-0.1320709	0.06	0.02	-0.24	-0.02
Attempting to reduce alcohol consumption	-0.1341895	0.06	0.02	-0.25	-0.02					
Being a parent	0.1927338	0.08	0.023	0.03	0.36					
BMI	0.009984	0.00	0.028	0.00	0.02					
Full-time education						-0.3055342	0.12	0.014	-0.55	-0.06

[a] n = 838 occasions, 216 individuals $X^2(182) = 2141.34$, $P < 0.001$ Log restricted likelihood is -411.14801

[b] n = 838 occasions, 216 individuals $X^2(89) = 1313.45$, $P < 0.001$ Log restricted-likelihood = -438.72522

On average participants had an average of 3.9 off-trade drinking occasions per week. The findings of both the full and subset models are presented in Table 3. Table 3 only presents the significant predictors of off-trade drinking from the full model and subset models. Within the full model 183 predictors were entered, with 90 entered into the subset model. A table displaying all predictors is presented in Table S2 supplementary materials.

In the primary subset regression model of heavy drinker's off-trade general drinking occasions, all contextual groups had characteristics significantly associated with units consumed per occasion. Of the multitude of characteristics associated with significant increases in units consumed per drinking occasion, most were within the *what* and *why* contextual groups.

Amongst these, characteristics such as serving size including consuming spirits from 1L large bottles (1.0 units per occasion, CI = 0.60, 1.39), 70cl standard bottles, and drinking from a large wine bottle (0.81 units per occasion, 95% CI = 0.34, 1.27) were associated with the largest increases in units consumed per occasion.

The characteristics associated with significant decreases in units consumed per drinking occasion were identified within the *who, what*, and *why* contextual groups. Amongst these, drinking low strength alcohol wine (-1.51 units per occasion, CI = -2.14, -0.88), drinking a little less than companions (-0.16 units per occasion, 95% CI = -0.26, -0.06), and the purpose of the occasion being to drink to alleviate boredom (-0.16 units per occasion, 95% CI = -0.31, 0.00) were the only characteristics associated with decreases in units consumed per occasion.

Some variables reliably predicted consumption in off-trade occasions amongst heavier drinkers in both the subset and full regression models, with these variables including occasion duration, drinking a little more than companions, and the purpose of the occasion being to alleviate a negative mood. However, when comparing the full model to the subset there were some differences, with the subset model highlighting significant predictors which did not reach significance in the full model including listening to the radio and drinking for no special occasion. Additionally, the number of locations visited in the full model was negatively associated with units consumed per occasion, yet in the subset model it was positively associated with units consumed per occasion.

RSQ2a: Contextual characteristics associated with the number of units consumed by heavy drinkers within on-trade HDOs

Table 4: Significant predictors of on-trade HDOs from the full model and subset model

	Full model[a]				**Subset model[b]**			
	Regression Coefficients (β)	SE	P value	CI 95%	Regression Coefficients (β)	SE	P value	CI 95%
Who								
Drinking alone	-4.840931	1.34	<.001	-7.47, -2.21				

With 12 years old or younger	-1.949026	0.50	<.001	-2.94, -0.96					
Female pair	-5.028114	1.37	<.001	-7.72, -2.34					
Mixed sex pair	-5.530217	1.41	<.001	-8.29, -2.77					
Mixed sex group	-4.82155	1.47	0.001	-7.70, -1.94					
Male group	-5.395076	1.78	0.002	-8.88, -1.91					
Female group	-5.489444	1.78	0.002	-8.98, -2.00					
Male pair	-5.204144	1.79	0.004	-8.72, -1.69					
What									
Cocktail	3.422799	1.30	0.009	0.87, 5.97					
Standard cocktail glass	-5.110892	1.55	0.001	-8.16, -2.06					
2L jug of beer	-3.799593	1.22	0.002	-6.20, -1.40					
Normal strength beer	2.104	0.50	0	1.12, 3.09					
Normal strength cider	1.633369	0.55	0.003	0.56, 2.71					
Beer standard can (440ml)	3.741696	1.38	0.007	1.04, 6.44					
Large can of beer					0.9853857	0.32	0.002	0.36	1.61
Pint bottle of beer	2.621248	1.06	0.014	0.54, 4.71	0.3406363	0.13	0.008	0.09	0.59
Medium Wine glass	-0.2911751	0.11	0.007	-0.50, -0.08					
Spirits from 70cl bottles					1.094232	0.30	<.001	0.50	1.69
Where									
Mixed occasion					-0.19317	0.06	0.003	-0.32	-0.07
Lift from an alcoholic drinker in occasion	-0.4212851	0.13	0.002	-0.69, -0.16					
Social club	-2.216644	0.90	0.014	-3.99, -0.45					
Modern bar	-2.573321	1.06	0.015	-4.65, -0.50					
Pub or bar restaurant	-2.602292	1.31	0.048	-5.18, -0.03					
Number of locations	3.27425	1.20	0.006	0.93, 5.62	0.0975863	0.05	0.038	0.01	0.19
Traditional pub	-2.919158	1.24	0.018	-5.34, -0.50	0.1871968	0.05	0.001	0.08	0.29
When									
Drinking on a Monday	0.9351278	0.39	0.017	0.16, 1.71					
Drinking on a Thursday	1.259224	0.33	<.001	0.61, 1.91					
Drinking on a Saturday	1.120764	0.27	<.001	0.59, 1.65					
Drinking on a Friday	1.016377	0.34	0.003	0.35, 1.69					
Eating a meal	1.391732	0.43	0.001	0.55, 2.23					
Eating a snack	0.5960037	0.25	0.018	0.10, 1.09					
Cooking	-3.999684	0.78	<.001	-5.53, -2.47					
Dancing	-1.291787	0.36	<.001	-2.00, -0.58					
Quiz	-1.3715	0.31	<.001	-1.97, -0.77					
Drinking games	1.962125	0.39	<.001	1.20, 2.72					
Playing board games	-2.782426	1.01	0.006	-4.76, -0.81					
PC game	3.772139	0.70	<.001	2.41, 5.14					
Whilst reading	-1.410277	0.67	0.036	-2.73, -0.09					
Vaping	1.74833	0.36	<.001	1.04, 2.45					
Playing pool	-0.874212	0.25	0.001	-1.37, -0.38					
Other drugs	3.22945	1.00	0.001	1.28, 5.18					
Working	-2.837362	1.16	0.014	-5.11, -0.57					

Watching television	1.107014	0.45	0.014	0.22, 1.99					
Smoking a cigarette within the occasion					0.3111798	0.11	0.007	0.09	0.54
Why									
Description visiting	-1.61777	0.41	<.001	-2.43, -0.81					
Why stress	-1.421269	0.36	<.001	-2.13, -0.71					
Purpose negative mood	-2.034887	0.60	0.001	-3.22, -0.85					
Purpose fun	0.844831	0.26	0.001	0.34, 1.35					
Why negative mood	2.663146	0.83	0.001	1.03, 4.30					
Why habit	0.8483896	0.38	0.026	0.10, 1.59					
Planned intoxication	0.0477742	0.02	0.003	0.02, 0.08	0.0644289	0.02	<.001	0.03	0.10
Individual-level									
Gender	-0.275145	0.07	<.001	-0.41, -0.14					
QALY usual activity	0.6653373	0.20	0.001	0.26, 1.07					
QALY total health	-0.019053	0.01	0.001	-0.03, -0.01					
QALY self-care					0.2402323	0.12	0.04	0.01	0.47
QALY pain	-0.25928	0.13	0.04	-0.51, -0.01					
Parental status	-1.017686	0.28	<.001	-1.57, -0.47					
Full time education	-1.206755	0.44	0.006	-2.06, -0.35					
Living with partner	-1.252684	0.49	0.011	-2.21, -0.29					
BMI					0.0123231	0.01	0.038	0.00	0.02

[a] n = 164 occasions, 104 individuals $X^2(161) = 8030.63$, P < 0.001
Log restricted likelihood = -109.11582

[b] n = 164 occasions, 104 individuals $X^2(45) = 231.20$ $P < 0.001$
Log restricted-likelihood = -78.845394

On average participants had 1.6 on-trade HDOs per week. The findings of both the full and subset model are presented in Table 4. Table 4 only presents the significant predictors of on-trade HDOs from the full model and subset models. Within the full model 162 predictors were entered, with 46 entered into the subset model. A table displaying all predictors is presented in Table S3 supplementary materials.

Within the subset model of heavy drinker's on-trade HDOs, all contextual groups aside from the *who* group had characteristics significantly associated with units consumed per occasion. The characteristics associated with significant increases in units consumed per drinking occasion were within the *what, where, when*, and *why* contextual groups. Amongst these, drinking from large cans of beer (0.99 units per occasion, 95% CI = 0.36, 1.61), drinking from standard size of spirit bottle (1.09 units per occasion, 95% CI = 0.50, 1.69), smoking cigarettes

in the occasion (0.31 units per occasion, 95% CI = 0.09, 0.54), having a higher planned intoxication (0.06 per occasion, 95% CI = 0.03, 0.10), and drinking within a traditional pub (0.19 units per occasion, 95% CI = 0.08, 0.29) were associated with increases in units consumed per occasion. Drinking as part of a mixed-trade occasion (-0.19 units per occasion, 95% CI = -0.32, -0.07) was the only contextual characteristic associated with decreases in units consumed per occasion.

In comparing the models, the majority of variables which significantly predicted consumption in on-trade HDOs were not significant within the full model, indicating issues with consistency between the models. Only having a higher planned intoxication significantly predicted units consumed in on-trade HDOs occasions in both models.

RSQ2b: Contextual characteristics associated with the number of units consumed by heavy drinkers within off-trade HDOs

Table 5: Significant predictors of off-trade HDOs from the full model and subset model

	Full model[a]				**Subset model[b]**			
	Regression Coefficients (β)	SE	P value	CI 95%	Regression Coefficients (β)	SE	P value	CI 95%
Who								
Romantic partner	0.102371	0.05	0.046	0.00, 0.20	0.088862	0.04	0.014	0.02, 0.16
With 12 years old or younger	-0.12776	0.06	0.047	-0.25, 0.00				
What								
Spirits from 70cl bottle	0.683812	0.15	<.001	0.39, 0.98	0.547849	0.07	<.001	0.41, 0.68
Spirits from 1L bottle	0.917627	0.21	<.001	0.51, 1.33	0.809463	0.13	<.001	0.56, 1.06
Wine box 3L	0.358862	0.16	0.023	0.05, 0.67				
Normal strength cider	-0.31697	0.14	0.022	-0.59, -0.05				
Normal strength beer	-0.26764	0.13	0.044	-0.53, -0.01				
High strength beer					0.32815	0.10	0.001	0.14, 0.52
High strength cider					0.480413	0.19	0.011	0.11, 0.85
Small can of beer (330ml)	-0.21412	0.10	0.035	-0.41, -0.01				
Standard can of beer (440ml)					0.149129	0.05	0.002	0.05, 0.24
Wine glass (unspecified size)	0.312657	0.11	0.006	0.09, 0.54				
Standard wine bottle (750ml)	0.209829	0.08	0.013	0.04, 0.37				
Sugar sweetened beverages	-2.11941	0.74	0.004	-3.57, -0.67				
Drinking beer or cider	0.294062	0.15	0.046	0.01, 0.58				
Large wine bottle (1.5litres)	0.847754	0.16	<.001	0.54, 1.16	0.609956	0.15	<.001	0.32, 0.90
Cocktail bottle (1L)	0.816834	0.41	0.047	0.01, 1.62				
Non-alcoholic drinks	2.027851	0.71	0.004	0.64, 3.41				
Where								

Other location	0.120135	0.06	0.044	0.00, 0.24				
Mixed occasion	-0.15934	0.07	0.029	-0.30, -0.02				
Number of locations					0.338489	0.06	<.001	0.22, 0.46
When								
Duration	0.028307	0.01	<.001	0.01, 0.04	0.035208	0.01	<.001	0.02, 0.05
Smoking a vape	0.381061	0.12	0.001	0.15, 0.61	0.244635	0.09	0.01	0.06, 0.43
Other drugs	-0.66442	0.24	0.006	-1.14 -0.19				
Live event	0.157598	0.06	0.005	0.05, 0.27				
Why								
Why other	0.155973	0.07	0.022	0.02, 0.29				
Why relax					0.097278	0.04	0.017	0.02, 0.18
Purpose negative mood					0.130959	0.05	0.011	0.03, 0.23
Planned intoxication	0.059503	0.01	<.001	0.03, 0.08	0.051224	0.01	<.001	0.03, 0.07
Higher than planned intoxication	-0.12093	0.06	0.032	-0.23, -0.01				
Individual-level								
On a diet to gain weight	-1.2832	0.40	0.001	-2.06, -0.51				
Gender	-0.12763	0.05	0.016	-0.23, -0.02	-0.13065	0.05	0.004	-0.22, -0.04
Qualification	-0.12402	0.06	0.036	-0.24, -0.01				
QALY total health	-0.00688	0.00	0.002	-0.01, 0.00	-0.00608	0.00	0.002	-0.01, 0.00
Homemaker					0.209348	0.10	0.035	0.02, 0.40
Parental status	-0.22666	0.08	0.003	-0.37, -0.08				

[a] n = 480 occasions, 160 individuals $X^2(174) = 1154.11$, $P < 0.001$
Log restricted likelihood is -143.70879

[b] n = 480 occasions, 160 individuals $X^2(88) = 935.65$, $P < 0.001$
Log restricted-likelihood = -69.307892

On average participants had 3 off-trade HDOs per week. The findings of both the full and sub-set model are presented in Table 5. Table 5 only presents the significant predictors of off-trade HDOs from the full model and subset models. Within the full model 175 predictors were entered, with 89 entered into the subset model. A table displaying all predictors is presented in Table S4 supplementary materials.

In the primary subset regression model of heavy drinker's off-trade HDOs, all contextual groups had characteristics significantly associated with increases in units consumed per drinking occasion.

Of the multitude of characteristics associated with increases in units consumed per drinking occasion, characteristics such as serving size including consuming spirits from 1L large bottles (0.81 units per occasion, CI = 0.56, 1.06), 70cl standard bottles (0.55 units per occasion, CI = 0.41, 0.68), and drinking from large wine bottles (0.61 units per occasion, CI = 0.32, 0.90) were associated with the largest increases in units consumed per occasion. No contextual groups had characteristics which were significantly associated with decreases in units consumed within

HDOs. Only the individual-level characteristics of being female (-0.13 units per occasion, CI = -0.22, -0.04), and having poor self-rated health (-0.01 units per occasion, CI = -0.01, 0.00) were associated with decreases in units consumed per occasion.

Some variables reliably predicted consumption in off-trade HDOs occasions amongst heavier drinkers in both the subset and full regression models, with these variables including drinking with a romantic partner, drinking from a large bottle of wine, and smoking a vape within the occasion. However, when comparing the full model to the subset there were some differences, with the subset model highlighting significant predictors which did not reach significance in the full model including drinking high strength beer and cider, drinking to relax, and the reason for the occasion being to alleviate negative mood.

RSQ3: Do contextual or individual level characteristic explain more of the variance of units consumed in off- and on-trade heavy drinking occasions (HDOs)?

On-trade HDOs

When all individual-level variables in the full model were entered together, these variables accounted for 36.7% of the variance in units consumed within on-trade HDOs (R^2 = 0.367). When all occasion-level variables were entered together, these variables accounted for 97.1% of the variance in units consumed per occasion (R^2 = 0.972). Adding the occasion-level variables increased the proportion of variance explained by 60.3 percentage points, which was significant (R^2 = 0.603, F(125, 20) = 3.293, p <.001).

When all individual-level variables in the subset model were entered together, these variables significantly accounted for 35.5% of the variance in units consumed within on-trade HDOs (R^2 = 0.355). When all occasion-level variables were entered together, these variables significantly accounted for 75.1% of the variance in units consumed per occasion (R^2 = 0.751). Adding the

occasion-level variables increased the proportion of variance explained by 39.6 percentage points, which was significant (R^2 = 0.396, F(35, 120) = 5.444, p <.001).

Off-trade HDOs

When all individual-level variables in the full model were entered together, these variables significantly accounted for 40.1% of the variance in units consumed within off-trade HDOs (R^2 = 0.401). When all occasion-level variables were entered together, these variables significantly accounted for 84.1% of the variance in units consumed per occasion (R^2 = 0.841). Adding the occasion-level variables increased the proportion of variance explained by 44 percentage points, which was significant (R^2 = 0.440, F(135, 326) = 6.680 p <.001).

When all individual-level variables in the subset model were entered together, these variables significantly accounted for 31.1% of the variance in units consumed within off-trade HDOs (R^2 = 0.311). When all occasion-level variables were entered together, these variables significantly accounted for 63.7% of the variance in units consumed per occasion (R^2 = 0.637). Adding the occasion-level variables increased the proportion of variance explained by 32.6 percentage points, which was significant (R^2 = 0.326, F(32, 437) = 12.287, p <.001).

Discussion

Using the newly developed context-specific survey, we collected data from a sample of UK heavy drinkers on the characteristics of their drinking occasions. We used this to explore which contextual characteristics were associated with the number of units consumed within their general drinking occasions and HDOs, in both the on- and off-trade. Within our sample, participants reported more drinking occasions within the off-trade than the on-trade, with this pattern also seen in individuals' HDOs. Within our subset analyses of all drinking occasions and HDOs within on- and off-trade locations, a range of contextual characteristics were associated with the units consumed within an occasion.

Across the four analyses, characteristics from all five contextual groups were associated with units consumed per occasion. Characteristics from the *what* and *why* contextual groups, for example the serving size of drinks consumed, were most frequently associated with units consumed per occasion, with characteristics from the *when*, *where*, and *who* groups least frequently associated. Given that previous research has tended to focus on a limited number of predictors of consumption ((22,29), the findings from this study suggest that measuring a wide breadth of characteristics is beneficial within alcohol event-level research to avoid important characteristics of occasions being overlooked or missed. Across all occasion types, planning to become intoxicated was consistently associated with increases in units consumed. Furthermore, within our analyses we found drink type, serving, and container sizes to be consistently associated with units consumed per occasion. Whilst previous studies have found duration to be strongly predictive of units consumed within occasions ((506), in our analysis we found modest effects of duration on units consumed within occasions, with no association found within HDOs in the on-trade.

Our findings offer some important insights which build upon the previous literature. In examining which characteristics were associated with units consumed per occasion, there were several differences between on-trade and off-trade drinking occasions. Fewer *why* characteristics were associated with units consumed within on-trade drinking occasions compared to off-trade occasions. Within the off-trade, the purpose for the occasion being to alleviate a negative mood was associated with increased consumption, whereas in the on-trade the purpose of the drinking occasion being to socialise was associated with increased units consumed per occasion. These findings suggest that occasions in the on-trade are more motivated by social reasons, with occasions in the off-trade motivated by emotive reasons, something which is reflected in the current literature (11). Although serving and container size of alcoholic drinks, such as drinking from a standard spirit bottle, were associated with

increases in units consumed within both trade types, a wider range of these characteristics was associated with increased unit consumption in the off-trade. Whilst research has examined the role of serving size in on-trade establishments ((506,532,533), limited research to date has focused on the impact of serving sizes in the off-trade, with much of this focused on wine serving sizes and not spirits and beer (534).

In looking at which characteristics were associated with units consumed per occasion, there were also several differences between general drinking occasions by heavy drinkers and their HDOs. Within general drinking occasions, drinking a little or much less than companions was associated with decreases in units consumed, with drinking a little more associated with increases. This contrasts with HDOs, where only drinking with a romantic partner in the off trade was significantly associated with increases in units consumed per occasion. Again looking at the role of drink type, our study found that high strength drinks, particularly beers and ciders, were associated with increased consumption, particularly within off-trade HDOs. This finding is of particular relevance to policy, with high strength alcoholic drinks a target of minimum unit pricing, whereby legislation prevents the sale of alcohol to consumers below a minimum price per unit to discourage the cheap sale of high strength alcohol (535). In comparison, within heavy drinker's general drinking occasions, low strength alcoholic drinks were associated with decreases in units consumed per occasion within both trade types. Low strength alcoholic drinks are a rapidly growing market which has expanded within the UK since the early 2010s and are often advertised as an alternative to regular strength alcoholic drinks (536,537). Within the literature, little is known about the occasions where low ABV drinks are consumed, with Vasiljevic et al. (538) suggesting that they are perceived as extensions to regular alcoholic drinks rather than substitutions. Given the differences in characteristics associated with units consumed across trade and occasion types, future research should ensure a range of occasion types are examined, not just heavy drinking ones.

Finally, in identifying the impact of individual and contextual characteristics on the variance of units consumed within HDOs, both the full and subset models within on- and off-trade HDOs were significant. Within both on- and off-trade HDOs, individual and contextual characteristics accounted for significant amounts of variance in units consumed. In exploring whether contextual or individual characteristics explained more of the variance in units consumed within HDOs, adding contextual characteristics to the model accounted for more variance in units consumed within occasions than individual characteristics alone. The findings are similar to those in previous research with both Stevely et al. (506) and Demers et al.(21) finding that adding contextual characteristics increases variance explained above individual characteristics.

Within our analyses, we found that occasions which involved drinking as part of a mixed trade occasion were negatively associated with the number of units consumed within all on-trade occasions. Whilst this is perhaps a surprising finding given that previous research has found drinking in mixed-trade occasions to increase consumption, for example engaging in pre-drinking (11,99,539), our findings may be explained by examining how mixed-trade occasions were classified in the current study. Whilst we had initially planned to analyse mixed-trade occasions separately to on- and off-trade occasions, due to the limited number of mixed-trade occasions in our data we split these occasions into their on- and off-trade components. In doing so, the units consumed in mixed-trade occasions were split across trade types; for example, if a participant drank a total of 12 units within an occasion, these 12 units would be split between units consumed in on-trade and off-trade. Our findings may therefore suggest that in occasions with a mixed-trade component, more of the units consumed may have been consumed within the off-trade part of the occasion than the on-trade part. Given these findings, we recommend future research examine mixed-trade occasions as a distinct occasion type to establish which contextual characteristics predict consumption. Given the few mixed trade drinking occasions

present in the sample, an alternative to using a dummy variable would have been to remove these 91 occasions and analyse the dataset in terms of on- and off-trade only occasions. However, given the high number of independent variables included in both the full and subset models, these analyses would have been underpowered.

This is the first study to use a newly developed context-specific survey to collect information on heavy drinker's general drinking occasions and their HDOs. Given that much of the previous research has focused on young adult's drinking occasions, we stratified our sample across age and sex groups. By doing this, we were able to capture drinking within middle and older aged adults, occasions which are not extensively captured within the existing literature (254,540). The majority of occasions within our sample were within the off-trade. Given that much of the existing literature focuses on the characteristics of on-trade establishments (77,524), our study provides further insight into which characteristics are associated with units in off-trade occasions. These findings have important implications for both policy and future research. Considering the amount of information collected within the context-specific survey, we did not experience evidence of high participant burden or high attrition rates. Participants took an average of 24.01 minutes to complete the survey, with only 1 participant withdrawing from the survey after consenting. After the removal of missing demographic data, 93.7% of participant provided responses which could be used in the final analyses, suggesting that a survey which allows for the collection of detailed information on drinking occasions is suitable for use amongst heavy drinkers.

In interpreting the results, there are important considerations that should be given to the sample. Participants were recruited via Prolific Academic, which may have introduced a self-selection bias within participants. Additionally, participants were predominantly from a white ethnic background, potentially limiting the generalisability to other populations. Whilst the results of this study suggest that contextual characteristics account for significantly more variance in

units consumed than individual characteristics, the findings of both the full and subset models should be interpreted with caution, given that there were some inconsistencies between the two models within analyses. As outlined within the methods section of this paper, given the large number of variables measured within the survey, we had planned to conduct a best subsets regression analysis to select a set of variables to enter within the multi-level regression models. However, as previously outlined, we experienced technical issues which prevented us from using this analysis method. As such we decided to run a full model with all predictors and a subset model which only included predictors which were significant within univariate analyses. We acknowledge that given the large number of predictors entered within the full model and some of the subset models some analyses are likely underpowered. Given this limitation of our study, future research should ensure that a large enough sample is recruited to avoid being underpowered, or alternatively a different analysis method is used.

Whilst using regression analyses in the current study allowed for insight on which variables might be important in predicting units consumed within occasions, this analysis method does not allow for exploration of how characteristics interact or for causal effects to be examined. Given that previous research has found characteristics within drinking occasion to be interlinked (506), future research should adopt methods such as directed acyclic graphs (DAGs) (478) to facilitate thinking about causal pathways between variables, and cluster analyses to elucidate inter-related factors, rather than looking at individual contextual factors in isolation.

Conclusion

Using the newly developed context-specific survey, we collected data from a sample of UK heavy drinkers on the characteristics of their general drinking and HDOs. Through a series of multi-level regression analyses, characteristics from the *what* and *why* contextual groups were most frequently associated with units consumed per occasion, with characteristics from the *when, where,* and *who* groups least frequently associated. Across all occasion types, planning

to become intoxicated and drink type were consistently associated with units consumed per occasion. Our analyses identified differences in the characteristics associated with consumption in both i) on-trade compared to off-trade occasions and ii) heavy drinkers general drinking compared to their HDOs. These findings suggest that researchers should take a broad approach to their study of drinking occasions, with this paper highlighting the methodological implications of measuring a wide range of characteristics within event-level studies. Finally, in exploring whether contextual or individual characteristics explained more of the variance in units consumed within HDOs, adding contextual characteristics to the model accounted for more variance in units consumed within occasions than individual characteristics alone. These findings can inform judgements and best practice recommendations on the contextual characteristics that should be measured within event-level alcohol research. Through identifying characteristics associated with increases and decreases in units consumed these findings may offer avenues for targeted intervention and may inform policy.

8.2 Supplementary Material

S1: Supplementary table presenting all predictors of on-trade drinking from the full and subset models

	Full model					Subset model				
	Regression Coefficients (β)	SE	P value	CI 95%		Regression Coefficients (β)	SE	P value	CI 95%	
Who										
Romantic partner	-0.01689	0.14	0.902	-0.29	0.25					
Family they live with	0.256789	0.22	0.232	-0.16	0.68					
Family who live elsewhere	0.321822	0.21	0.133	-0.10	0.74	0.102392	0.19	0.584	-0.26	0.47
Friends	0.250916	0.17	0.139	-0.08	0.58					
Neighbours	-0.57671	0.58	0.323	-1.72	0.57					
Work colleagues	0.42371	0.24	0.074	-0.04	0.89					
Course mates	-0.9416745	0.32	0.003	-1.57	-0.31					
Drinking alone	-0.19943	0.48	0.679	-1.14	0.75	0.042616	0.12	0.715	-0.19	0.27
Children aged 16-17	0.146672	0.47	0.756	-0.78	1.07					
Children aged 13-15	-0.55886	0.39	0.154	-1.33	0.21					
Children aged 12 and under	-0.07044	0.28	0.801	-0.62	0.48					
Number of adults in occ	-0.01229	0.01	0.144	-0.03	0.00					
Male pair	-0.32741	0.56	0.56	-1.43	0.77					
Female pair	-0.89803	0.53	0.091	-1.94	0.14					
Mixed pair	-0.46332	0.50	0.354	-1.44	0.52					
Male group	-0.59252	0.52	0.258	-1.62	0.43					
Female group	-0.80758	0.56	0.151	-1.91	0.29					
Mixed sex group	-0.60834	0.50	0.224	-1.59	0.37					
Number of adults drinking in occ	0.008977	0.01	0.423	-0.01	0.03					
Drank much less than companions	-0.41369	0.41	0.308	-1.21	0.38	-0.7821179	0.30	0.009	-1.37	-0.20
Drank a little less than companions	-0.01985	0.12	0.867	-0.25	0.21	0.002299	0.10	0.981	-0.18	0.19
Drank a little more	0.171615	0.11	0.108	-0.04	0.38	0.113159	0.09	0.216	-0.07	0.29
Drank much more	-0.20591	0.18	0.256	-0.56	0.15	-0.05233	0.13	0.696	-0.31	0.21
What										
Drinking beer or cider	-1.07655	0.72	0.132	-2.48	0.32					
Drinking wine/ fortified wine	0.615383	1.03	0.551	-1.41	2.64					
Drinking spirits/ liquors/ shots	0.056807	0.59	0.923	-1.10	1.21	0.229807	0.20	0.246	-0.16	0.62
Drinking cocktails/ alcopops	-1.0498	0.85	0.217	-2.72	0.62					
Drinking low alcoholic drinks	-1.786177	0.79	0.025	-3.34	-0.23	-1.601279	0.63	0.011	-2.83	
Drinking alcohol free drinks	-0.69829	0.91	0.441	-2.47	1.08					
Drinking non-alcoholic drinks	-3.17134	4.99	0.525	-12.96	6.62					

Drinking normal strength beer	0.648265	0.35	0.067	-0.04	1.34					
Drinking high strength beer	0.653057	0.33	0.047	0.01	1.30	0.316749	0.27	0.235	-0.21	0.84
Normal strength cider	0.447286	0.35	0.199	-0.24	1.13					
Pint of beer	0.396581	0.61	0.513	-0.79	1.58					
Small can of beer	0.471864	0.62	0.448	-0.75	1.69					
Standard can of beer	0.515857	0.63	0.413	-0.72	1.75					
Large can of beer	0.834124	0.69	0.224	-0.51	2.18					
Standard bottle of beer	0.40203	0.85	0.638	-1.27	2.08					
Pint bottle of beer	0.596085	0.65	0.36	-0.68	1.87					
2L jug of beer	1.442027	0.57	0.011	0.33	2.55					
Drinking wine	-0.44305	0.94	0.638	-2.29	1.40					
Small glass of wine	-0.14527	0.34	0.67	-0.81	0.52					
Medium glass of wine	-0.04811	0.28	0.863	-0.59	0.50					
Large glass of wine	0.116354	0.34	0.732	-0.55	0.78					
Glass of wine (unspecified size)	1.2849	0.65	0.051	0.00	2.57					
Standard bottle of wine	0.348075	0.33	0.289	-0.30	0.99					
Drinking spirits	1.156685	0.70	0.097	-0.21	2.52	-0.0345321	0.19	0.856	-0.41	0.34
Drinking liquor	0.555412	0.82	0.5	-1.06	2.17					
Drinking shots	1.639772	0.75	0.028	0.18	3.10					
Spirits as singles	-1.31639	0.42	0.002	-2.14	-0.49					
Spirits as doubles	-1.01612	0.45	0.023	-1.89	-0.14	-0.0822	0.15	0.587	-0.38	0.21
Hipflask	0.180237	0.71	0.8	-1.21	1.57	0.272047	0.58	0.64	-0.87	1.41
Spirits from 70cl bottles	1.702486	0.72	0.018	0.30	3.11					
Drinking cocktails	1.481012	0.70	0.035	0.10	2.86					
Drinking alcopops	3.396567	4.67	0.467	-5.75	12.54					
Standard cocktail glass	-0.51002	0.51	0.316	-1.51	0.49					
Large can of cocktails	-2.27352	4.68	0.627	-11.45	6.90					
Where										
Number of locations	0.23911	0.40	0.546	-0.54	1.02	0.1392314	0.07	0.047	0.00	0.28
Mixed occasion	-0.3108295	0.10	0.003	-0.51	-0.11	-0.3334374	0.08	0.001	-0.48	-0.18
Restaurant	-0.3036	0.43	0.481	-1.15	0.54					
Traditional pub	-0.02027	0.40	0.96	-0.81	0.77					
Modern bar	-0.12806	0.42	0.758	-0.94	0.69					
Pub or bar restaurant	-0.1449	0.42	0.727	-0.96	0.67					
Nightclub	0.196859	0.42	0.639	-0.62	1.02					
Social club	-0.02706	0.42	0.948	-0.85	0.79					
Other location 1	-0.24281	0.42	0.565	-1.07	0.58					
Other location 2	-0.08047	0.48	0.866	-1.02	0.86					
Other location 3	0.275492	0.82	0.736	-1.33	1.88					
No travel to location	0.339017	0.27	0.217	-0.20	0.88					
Travelled on public transport	-0.11248	0.20	0.575	-0.51	0.28					
Travelled in taxi	-0.06552	0.24	0.781	-0.53	0.40					
Drove to location	-0.26833	0.27	0.316	-0.79	0.26	-0.248874	0.15	0.108	-0.55	0.05
Lift from someone drinking at location	-0.13525	0.27	0.611	-0.66	0.39					
Lift from a non-drinker at location	0.179483	0.25	0.477	-0.32	0.67					

Lift from a non-drinker not at location	-0.10379	0.27	0.704	-0.64	0.43					
Other form of travel	-0.57245	0.31	0.069	-1.19	0.04					
Walked to location	-0.12471	0.20	0.525	-0.51	0.26					
When										
Monday	0.0013891	0.18	0.994	-0.35	0.36					
Tuesday	-0.1728119	0.17	0.323	-0.52	0.17					
Wednesday	0.0578035	0.16	0.726	-0.27	0.38					
Thursday	-0.0167181	0.17	0.921	-0.35	0.31					
Friday	-0.0331637	0.13	0.804	-0.29	0.23					
Saturday	0.1300466	0.14	0.34	-0.14	0.40					
Start time	0.025749	0.01	0.041	0.00	0.05					
Stop time	0.010498	0.01	0.117	0.00	0.02	0.003405	0.00	0.47	-0.01	0.01
Duration of occasion	0.1102222	0.03	0.001	0.05	0.17	0.0940327	0.02	0.001	0.06	0.13
Eating a meal	0.030337	0.17	0.858	-0.30	0.36					
Eating a snack	0.068714	0.14	0.623	-0.21	0.34					
Cooking	-0.60661	0.47	0.194	-1.52	0.31					
On a videocall	0.60382	0.51	0.236	-0.40	1.60					
Watching Tv	0.357935	0.23	0.122	-0.10	0.81					
On social media	0.294673	0.16	0.07	-0.02	0.61					
Doing chores	0.212364	0.52	0.686	-0.82	1.24					
Playing PC game	0.18539	0.42	0.658	-0.64	1.01	0.167305	0.28	0.551	-0.38	0.72
Playing board games	0.061435	0.40	0.879	-0.73	0.85	-0.113683	0.31	0.714	-0.72	0.49
Playing pool/ snooker	-0.29499	0.16	0.066	-0.61	0.02	0.102227	0.12	0.385	-0.13	0.33
Listening to the radio	-0.32286	0.21	0.122	-0.73	0.09					
Live event	0.573583	0.17	0.001	0.25	0.90					
Dancing	-0.4766	0.19	0.01	-0.84	-0.11					
Doing a quiz	0.086458	0.24	0.719	-0.38	0.56					
Playing a drinking game	0.333392	0.26	0.204	-0.18	0.85					
Whilst reading	0.137808	0.36	0.701	-0.56	0.84					
Whilst working	-0.56478	0.41	0.166	-1.36	0.23					
Other activities	0.110491	0.13	0.377	-0.13	0.36					
Smoking a cigarette in the occasion	0.085779	0.24	0.718	-0.38	0.55	0.4092248	0.16	0.009	0.10	0.72
Smoking a vape in the occasion	-0.29822	0.24	0.222	-0.78	0.18					
Using cannabis in the occasion	-0.82779	0.74	0.265	-2.28	0.63					
Using other drugs in the occasion	-0.28611	0.37	0.445	-1.02	0.45					
Using no cigarettes or drugs	-0.22337	0.27	0.417	-0.76	0.32					
Why										
Visiting others	0.021302	0.35	0.952	-0.67	0.71					
Entertaining others	-0.04901	0.35	0.888	-0.73	0.63					
Party	-0.05624	0.37	0.879	-0.78	0.67					
Going for a meal	0.020663	0.31	0.946	-0.58	0.62					
No special occasion	0.110847	0.33	0.737	-0.54	0.76					
Other type of occasion	0.119936	0.35	0.733	-0.57	0.81					
Purpose of occasion to alleviate stress	-0.10359	0.24	0.672	-0.58	0.38					

Purpose of occasion to relax	-0.05507	0.12	0.637	-0.28	0.17					
Purpose of occasion to alleviate negative mood	-0.68805	0.40	0.082	-1.46	0.09					
Purpose of occasion to have fun	-0.11876	0.14	0.411	-0.40	0.16					
Purpose of occasion to alleviate boredom	0.6747752	0.32	0.034	0.05	1.30					
Purpose of occasion to socialise	0.2983716	0.13	0.023	0.04	0.55	0.3808743	0.10	0.001	0.19	0.57
Purpose of occasion out of habit	-0.08794	0.16	0.589	-0.41	0.23					
Other purpose of occasion	-0.244	0.37	0.505	-0.96	0.47					
Reason for drinking to alleviate stress	0.022224	0.19	0.909	-0.36	0.40					
Reason for drinking to relax	0.003478	0.12	0.977	-0.23	0.24					
Reason for drinking to alleviate negative mood	-0.43112	0.36	0.228	-1.13	0.27					
Reason for drinking to have fun	0.071886	0.14	0.601	-0.20	0.34					
Reason for drinking to alleviate boredom	-0.05466	0.27	0.837	-0.58	0.47					
Reason for drinking to socialise	-0.17633	0.14	0.192	-0.44	0.09	-0.08548	0.10	0.395	-0.28	0.11
Reason for drinking out of habit	0.085627	0.15	0.565	-0.21	0.38	-0.037838	0.09	0.673	-0.21	0.14
Other reason for drinking	0.396495	0.36	0.27	-0.31	1.10					
Planned intoxication	0.1146932	0.04	0.002	0.04	0.19	0.1049326	0.03	0.001	0.05	0.16
Actual intoxication	0.000382	0.04	0.992	-0.08	0.08	-0.0154363	0.03	0.605	-0.07	0.04
Higher actual than planned intoxication	0.2383998	0.17	0.158	-0.09	0.57	0.153256	0.13	0.242	-0.10	0.41
Individual-level										
Total AUDIT score	0.003618	0.01	0.727	-0.02	0.02					
Current smoker status	-0.19834	0.21	0.341	-0.61	0.21	0.046935	0.16	0.764	-0.26	0.35
Recent smoker status	-0.5456374	0.25	0.031	-1.04	-0.05	-0.00995	0.24	0.967	-0.48	0.46
Long-term ex-smoker	-0.06696	0.13	0.595	-0.31	0.18	0.021612	0.11	0.846	-0.20	0.24
On a diet to lose weight	0.169902	0.12	0.146	-0.06	0.40	-0.043036	0.10	0.672	-0.24	0.16
On a diet to maintain weight	-0.01655	0.13	0.901	-0.28	0.24	-0.094204	0.13	0.48	-0.36	0.17
On a diet to gain weight	0.104698	0.32	0.746	-0.53	0.74	-0.293701	0.24	0.216	-0.76	0.17
Other diet status	-0.1659	0.42	0.691	-0.98	0.65	-0.468408	0.44	0.283	-1.32	0.39
Aiming to reduce alcohol consumption	-0.17988	0.11	0.095	-0.39	0.03					
PNS if reducing alcohol consumption	0.236921	0.57	0.676	-0.87	1.35					
BMI	0.0347065	0.01	0.002	0.01	0.06	0.0172571	0.01	0.036	0.00	0.03
QALY mobility	-0.16505	0.17	0.318	-0.49	0.16					
QALY self-care	0.288844	0.26	0.26	-0.21	0.79	0.126973	0.18	0.477	-0.22	0.48
QALY usual activity	0.019548	0.14	0.885	-0.25	0.28					

QALY pain	-0.1801226	0.08	0.031	-0.34	-0.02					
QALY Anxiety/ Depression	-0.06657	0.07	0.311	-0.20	0.06					
QALY Total health	-0.00292	0.00	0.509	-0.01	0.01	-0.001818	0.00	0.576	-0.01	0.00
Age	-0.00438	0.01	0.383	-0.01	0.01	0.0000783	0.00	0.987	-0.01	0.01
Gender	-0.07002	0.11	0.543	-0.30	0.16					
Employment status part-time	0.032371	0.16	0.842	-0.29	0.35	0.021455	0.13	0.869	-0.23	0.28
Employment status self-employed	-0.04059	0.16	0.799	-0.35	0.27	-0.131382	0.15	0.395	-0.43	0.17
Employment status unemployed	-0.64203	0.27	0.016	-1.16	-0.12	-0.260496	0.24	0.278	-0.73	0.21
Employment status homemaker	0.321794	0.26	0.216	-0.19	0.83	0.075399	0.23	0.744	-0.38	0.53
Employment status retired	-0.06243	0.18	0.729	-0.42	0.29	-0.119718	0.18	0.501	-0.47	0.23
Employment status FTE	-0.08193	0.17	0.637	-0.42	0.26	-0.016735	0.15	0.911	-0.31	0.28
Marital status single	-0.12553	0.21	0.549	-0.54	0.28	-0.110824	0.16	0.499	-0.43	0.21
Marital status in a relationship	0.038151	0.19	0.837	-0.33	0.40	-0.001566	0.16	0.992	-0.31	0.31
Marital status living with partner	-0.2572	0.16	0.104	-0.57	0.05	-0.233849	0.14	0.105	-0.52	0.05
Marital status separated	-0.6112369	0.30	0.039	-1.19	-0.03	-0.439277	0.31	0.153	-1.04	0.16
Marital status divorced	-0.11594	0.21	0.577	-0.52	0.29	0.123212	0.20	0.532	-0.26	0.51
Marital status widowed	0.217252	0.36	0.551	-0.50	0.93	0.023305	0.33	0.944	-0.63	0.68
Marital status PNS	-0.90377	0.96	0.348	-2.79	0.98	-0.142657	0.65	0.826	-1.41	1.13
Ethnicity non-white	0.563409	0.19	0.003	0.19	0.94					
Highest qual: Under 16	-0.0268	0.14	0.843	-0.29	0.24					
Parent	-0.23063	0.15	0.121	-0.52	0.06					

S2: Supplementary table presenting all predictors of off-trade drinking from the full and subset models										
	Full model					Subset model				
	Regression Coefficients (β)	SE	P value	CI 95%		Regression Coefficients (β)	SE	P value	CI 95%	
Who										
Romantic partner	0.068571	0.05	0.184	-0.03	0.17	0.037574	0.04	0.381	-0.05	0.12
Family they live with	0.131326	0.07	0.051	0.00	0.26					
Family who live elsewhere	0.106545	0.07	0.139	-0.03	0.25					
Friends	0.039861	0.06	0.532	-0.09	0.16					
Neighbours	0.133889	0.12	0.255	-0.10	0.36					
Work colleagues	0.003175	0.12	0.979	-0.24	0.24					
Course mates	-0.2316	0.16	0.144	-0.54	0.08					
Drinking alone	0.011823	0.09	0.897	-0.17	0.19	-0.01339	0.05	0.767	-0.10	0.08
Children aged 16-17	-0.05554	0.11	0.621	-0.28	0.16	-0.09037	0.12	0.455	-0.33	0.15
Children aged 13-15	-0.02151	0.09	0.814	-0.20	0.16	-0.12417	0.09	0.152	-0.29	0.05
Children aged 12 and under	-0.03243	0.07	0.636	-0.17	0.10					
Number of adults in occ	-0.00266	0.00	0.43	-0.01	0.00					
Male pair	-0.00115	0.06	0.984	-0.11	0.11					
Female pair	-0.06264	0.12	0.59	-0.29	0.17					
Mixed sex pair	-0.04392	0.08	0.597	-0.21	0.12	-0.02474	0.04	0.548	-0.11	0.06
Male group	-0.20104	0.12	0.09	-0.43	0.03					
Female group	-0.06221	0.13	0.623	-0.31	0.19					
Mixed sex group	-0.0138	0.09	0.883	-0.20	0.17					
Number of adults drinking in occ	0.020291	0.01	0.018	0.00	0.04					
Drank much less than companions	-0.25716	0.09	0.006	-0.44	-0.07	-0.1738	0.10	0.08	-0.37	0.02
Drank a little less than companions	-0.17801	0.05	0	-0.27	-0.09	-0.15656	0.05	0.002	-0.26	-0.06
Drank a little more	0.086882	0.03	0.013	0.02	0.16	0.124396	0.04	0.001	0.05	0.20
Drank much more	0.07091	0.05	0.134	-0.02	0.16	0.043604	0.05	0.383	-0.05	0.14
What										
Drinking beer or cider	0.148514	0.14	0.301	-0.13	0.43	-0.00237	0.05	0.962	-0.10	0.09
Drinking wine/ fortified wine	-0.14804	0.19	0.445	-0.53	0.23					
Drinking spirits/ liquors/ shots	1.617863	0.65	0.013	0.35	2.89					
Drinking cocktails/ alcopops	0.133833	0.66	0.839	-1.16	1.43	0.285203	0.22	0.192	-0.14	0.71
Drinking low alcoholic drinks	0.080751	0.19	0.673	-0.29	0.46					
Drinking alcohol free drinks	0.015172	0.31	0.961	-0.59	0.62					
Drinking non-alcoholic drinks	0.449353	0.27	0.091	-0.07	0.97					

Drinking normal strength beer	-0.08581	0.13	0.508	-0.34	0.17					
Drinking high strength beer	0.343905	0.15	0.018	0.06	0.63	0.528471	0.12	0	0.30	0.76
Normal strength cider	0.029649	0.14	0.826	-0.24	0.29					
High strength cider	0.462365	0.27	0.092	-0.08	1.00	0.256658	0.29	0.371	-0.31	0.82
Pint of beer	0.282606	0.09	0.002	0.10	0.46					
Small can of beer	-0.04518	0.10	0.649	-0.24	0.15					
Standard can of beer	0.227122	0.08	0.005	0.07	0.39	0.072187	0.06	0.228	-0.05	0.19
Large can of beer	0.186184	0.09	0.033	0.01	0.36	0.062919	0.07	0.371	-0.07	0.20
Small bottle of beer	0.014009	0.19	0.942	-0.36	0.39					
Standard bottle of beer	-0.04582	0.09	0.614	-0.22	0.13	-0.05153	0.08	0.495	-0.20	0.10
Pint bottle of beer	0.138944	0.09	0.132	-0.04	0.32					
2L jug of beer	0.391584	0.45	0.388	-0.50	1.28	0.075843	0.26	0.769	-0.43	0.58
Drinking wine	0.35129	0.20	0.076	-0.04	0.74					
Drinking sherry	0.476904	0.29	0.101	-0.09	1.05	0.109606	0.14	0.438	-0.17	0.39
Small glass of wine	0.051594	0.07	0.45	-0.08	0.19	0.029135	0.06	0.602	-0.08	0.14
Medium glass of wine	0.229419	0.08	0.003	0.08	0.38	0.199759	0.05	0	0.11	0.29
Large glass of wine	0.278598	0.07	0	0.13	0.42					
Glass of wine (unspecified size)	0.533979	0.12	0	0.30	0.77					
Small bottle of wine	-0.18629	0.19	0.323	-0.56	0.18					
Standard bottle of wine	0.510863	0.08	0	0.35	0.67	0.446954	0.05	0	0.35	0.54
Large bottle of wine	1.083987	0.22	0	0.65	1.52	0.807198	0.24	0.001	0.34	1.27
3L box of wine	0.651898	0.22	0.003	0.23	1.08	0.550342	0.23	0.018	0.09	1.01
Standard glass of sherry	-0.52428	0.24	0.031	-1.00	-0.05					
Large glass of sherry	-0.30971	0.26	0.242	-0.83	0.21	-0.01626	0.19	0.931	-0.38	0.35
Drinking spirits	1.617863	0.65	0.013	0.35	2.89					
Drinking liquor	-1.66592	0.67	0.013	-2.98	-0.36					
Drinking shots	-1.5143	0.67	0.023	-2.82	-0.21					
Spirits as singles	-0.05985	0.15	0.687	-0.35	0.23	-0.11937	0.06	0.055	-0.24	0.00
Spirits as doubles	0.207243	0.15	0.169	-0.09	0.50					
Mini bottle	0.444505	0.34	0.195	-0.23	1.12					
Hipflask	0.466825	0.21	0.028	0.05	0.88					
Spirits from 70cl bottles	0.713272	0.17	0	0.39	1.04	0.571078	0.10	0	0.37	0.77
Spirits from 1L bottles	1.159034	0.25	0	0.67	1.65	0.996929	0.20	0	0.60	1.39
Drinking cocktails	-0.17348	0.68	0.8	-1.51	1.17	-0.03908	0.15	0.788	-0.32	0.25
Small cocktail can	0.332185	0.69	0.632	-1.03	1.69					
Standard cocktail can	-0.36634	0.73	0.616	-1.80	1.06					
Large bottle of cocktails	-0.00741	0.61	0.99	-1.20	1.18					
Low-strength alcohol wine	-1.63192	0.39	0	-2.39	-0.88	-1.51043	0.32	0	-2.14	-0.88
Alcohol free beer	-0.19785	0.37	0.597	-0.93	0.54					
Alcohol free pint	0.331425	0.29	0.256	-0.24	0.90					
Sugar sweetened beverage	-0.49086	0.36	0.171	-1.19	0.21					
Non-sugar sweetened beverage	-0.3583	0.33	0.277	-1.00	0.29					
Hot drink	-0.46226	0.35	0.188	-1.15	0.23					
Where										
Number of locations	-0.37283	0.18	0.036	-0.72	-0.02	0.223833	0.07	0.001	0.09	0.36
Mixed occasion	-0.20953	0.06	0	-0.33	-0.09					

Own home	0.472109	0.20	0.017	0.09	0.86					
Others home	0.475816	0.19	0.013	0.10	0.85					
General outdoors	0.271117	0.21	0.205	-0.15	0.69					
Other location 1	0.069882	0.32	0.827	-0.56	0.70					
No travel to location	0.201392	0.14	0.158	-0.08	0.48					
Travelled on public transport	0.190645	0.16	0.238	-0.13	0.51	-0.06322	0.08	0.431	-0.22	0.09
Travelled in taxi	0.100026	0.21	0.638	-0.32	0.52	0.129411	0.17	0.447	-0.20	0.46
Drove to location	-0.01889	0.16	0.904	-0.33	0.29					
Lift from someone drinking at location	0.413814	0.18	0.024	0.06	0.77					
Lift from a non-drinker at location	-0.12331	0.16	0.438	-0.44	0.19					
Lift from a non-drinker not at location	-0.09112	0.22	0.675	-0.52	0.33					
Other form of travel	0.660915	0.34	0.05	0.00	1.32					
Walked to location	0.184964	0.15	0.211	-0.11	0.48					
When										
Monday	-0.05295	0.04	0.176	-0.13	0.02					
Tuesday	-0.08845	0.04	0.026	-0.17	-0.01					
Wednesday	-0.04338	0.04	0.28	-0.12	0.04					
Thursday	-0.07387	0.04	0.064	-0.15	0.00					
Friday	0.007575	0.04	0.839	-0.07	0.08					
Saturday	-0.08016	0.04	0.023	-0.15	-0.01					
Start time	0.005337	0.00	0.187	0.00	0.01	0.008352	0.00	0.056	0.00	0.02
Stop time	-0.00362	0.00	0.108	-0.01	0.00	-0.00382	0.00	0.112	-0.01	0.00
Duration of occasion	0.051542	0.01	0	0.04	0.07	0.089675	0.01	0	0.07	0.10
Eating a meal	0.064096	0.03	0.054	0.00	0.13					
Eating a snack	0.0167	0.04	0.673	-0.06	0.09					
Cooking	0.021375	0.04	0.586	-0.06	0.10					
On a videocall	-0.02395	0.11	0.834	-0.25	0.20					
Watching Tv	0.018268	0.03	0.585	-0.05	0.08					
On social media	-0.00322	0.04	0.938	-0.08	0.08	0.025919	0.04	0.552	-0.06	0.11
Doing chores	-0.00944	0.06	0.882	-0.13	0.12	0.016559	0.07	0.802	-0.11	0.15
Playing PC game	-0.06126	0.06	0.287	-0.17	0.05	0.023597	0.06	0.692	-0.09	0.14
Playing board games	0.011351	0.09	0.895	-0.16	0.18					
Playing pool/ snooker	-0.2696	0.14	0.052	-0.54	0.00					
Listening to the radio	0.079488	0.05	0.103	-0.02	0.18	0.126878	0.05	0.014	0.03	0.23
Live event	0.005227	0.07	0.94	-0.13	0.14	0.125149	0.07	0.079	-0.01	0.26
Dancing	0.073594	0.14	0.591	-0.19	0.34	0.05113	0.13	0.687	-0.20	0.30
Playing a drinking game	0.043749	0.14	0.757	-0.23	0.32	0.201523	0.13	0.112	-0.05	0.45
Whilst reading	0.029118	0.05	0.589	-0.08	0.13					
Whilst working	0.042434	0.10	0.656	-0.14	0.23					
Other activities	0.0153	0.06	0.787	-0.10	0.13					
Smoking a cigarette in the occasion	-0.06017	0.11	0.592	-0.28	0.16	-0.18213	0.12	0.12	-0.41	0.05
Smoking a vape in the occasion	0.214238	0.12	0.08	-0.03	0.45	0.069661	0.12	0.558	-0.16	0.30
Using cannabis in the occasion	0.28333	0.17	0.095	-0.05	0.62	0.288792	0.18	0.109	-0.06	0.64
Using other drugs in the occasion	0.009442	0.20	0.962	-0.38	0.40	-0.30676	0.20	0.126	-0.70	0.09

Using no cigarettes or drugs	0.117677	0.12	0.331	-0.12	0.36	0.01317	0.13	0.918	-0.24	0.26
Why										
Visiting others	0.110246	0.14	0.443	-0.17	0.39					
Entertaining others	0.286154	0.15	0.055	-0.01	0.58					
Party	0.09958	0.19	0.596	-0.27	0.47	0.029942	0.12	0.803	-0.20	0.26
Going for a meal	0.075088	0.14	0.588	-0.20	0.35	0.028479	0.05	0.537	-0.06	0.12
No special occasion	0.214329	0.14	0.115	-0.05	0.48	0.078354	0.03	0.013	0.02	0.14
Other type of occasion	0.09797	0.14	0.477	-0.17	0.37					
Purpose of occasion to alleviate stress	-0.05196	0.06	0.403	-0.17	0.07	0.026947	0.07	0.691	-0.11	0.16
Purpose of occasion to relax	0.083023	0.05	0.074	-0.01	0.17					
Purpose of occasion to alleviate negative mood	0.251844	0.07	0	0.11	0.39	0.21968	0.08	0.006	0.06	0.38
Purpose of occasion to have fun	0.198853	0.07	0.005	0.06	0.34					
Purpose of occasion to alleviate boredom	-0.16287	0.07	0.025	-0.31	-0.02	-0.15523	0.08	0.044	-0.31	0.00
Purpose of occasion to socialise	-0.04418	0.05	0.405	-0.15	0.06					
Purpose of occasion out of habit	-0.09563	0.04	0.027	-0.18	-0.01	-0.04477	0.05	0.343	-0.14	0.05
Other purpose of occasion	-0.02767	0.07	0.687	-0.16	0.11					
Reason for drinking to alleviate stress	-0.0178	0.06	0.774	-0.14	0.10	-0.04663	0.07	0.488	-0.18	0.09
Reason for drinking to relax	0.033335	0.05	0.47	-0.06	0.12					
Reason for drinking to alleviate negative mood	-0.0807	0.07	0.233	-0.21	0.05	-0.07927	0.08	0.299	-0.23	0.07
Reason for drinking to have fun	-0.07336	0.08	0.341	-0.22	0.08					
Reason for drinking to alleviate boredom	0.140881	0.07	0.031	0.01	0.27	0.104045	0.07	0.135	-0.03	0.24
Reason for drinking to socialise	0.037599	0.06	0.499	-0.07	0.15					
Reason for drinking out of habit	0.087235	0.04	0.04	0.00	0.17	0.11093	0.05	0.018	0.02	0.20
Other reason for drinking	0.054958	0.08	0.478	-0.10	0.21					
Planned intoxication	0.088383	0.01	0	0.06	0.12	0.087742	0.02	0	0.06	0.12
Actual intoxication	0.019069	0.02	0.224	-0.01	0.05	0.016347	0.02	0.321	-0.02	0.05
Higher actual than planned intoxication	0.128712	0.06	0.033	0.01	0.25	0.068706	0.06	0.287	-0.06	0.20
Individual-level										
Total AUDIT score	0.023346	0.01	0	0.01	0.04	0.017308	0.01	0.004	0.01	0.03
Current smoker status	0.099182	0.10	0.327	-0.10	0.30	0.135421	0.11	0.197	-0.07	0.34
Recent smoker status	-0.13275	0.14	0.342	-0.41	0.14	-0.12666	0.15	0.395	-0.42	0.17
Long-term ex-smoker	-0.05265	0.06	0.391	-0.17	0.07	-0.10008	0.07	0.127	-0.23	0.03
On a diet to lose weight	0.059261	0.06	0.317	-0.06	0.18					
On a diet to maintain weight	0.132781	0.10	0.167	-0.06	0.32					

On a diet to gain weight	-0.31779	0.40	0.428	-1.10	0.47					
Other diet status	-0.23471	0.42	0.573	-1.05	0.58					
Aiming to reduce alcohol consumption	-0.13419	0.06	0.02	-0.25	-0.02					
PNS if reducing alcohol consumption	0.51614	0.42	0.216	-0.30	1.33					
BMI	0.009984	0.00	0.028	0.00	0.02	0.0046894	0.00	0.291	0.00	0.01
QALY mobility	-0.2453	0.08	0.002	-0.40	-0.09					
QALY self-care	-0.02191	0.13	0.862	-0.27	0.22	-0.12957	0.13	0.324	-0.39	0.13
QALY usual activity	0.074014	0.07	0.298	-0.07	0.21	0.033138	0.07	0.645	-0.11	0.17
QALY pain	0.002052	0.04	0.961	-0.08	0.08					
QALY Anxiety/ Depression	-0.04453	0.04	0.242	-0.12	0.03	-0.042	0.04	0.278	-0.12	0.03
QALY Total health	-0.00615	0.00	0.013	-0.01	0.00	-0.00253	0.00	0.299	-0.01	0.00
Age	0.00408	0.00	0.14	0.00	0.01	0.003671	0.00	0.198	0.00	0.01
Gender	-0.1571	0.06	0.005	-0.27	-0.05	-0.13207	0.06	0.02	-0.24	-0.02
Employment status part-time	0.001428	0.08	0.986	-0.16	0.16	0.047821	0.09	0.578	-0.12	0.22
Employment status self-employed	0.175841	0.09	0.058	-0.01	0.36	0.155119	0.10	0.118	-0.04	0.35
Employment status unemployed	0.228452	0.17	0.178	-0.10	0.56	0.18766	0.17	0.257	-0.14	0.51
Employment status homemaker	-0.08486	0.13	0.502	-0.33	0.16	0.076196	0.13	0.549	-0.17	0.33
Employment status retired	-0.02552	0.09	0.784	-0.21	0.16	-0.04947	0.10	0.612	-0.24	0.14
Employment status FTE	-0.22994	0.13	0.069	-0.48	0.02	-0.30553	0.12	0.014	-0.55	-0.06
Marital status single	0.120637	0.10	0.209	-0.07	0.31	0.085695	0.10	0.389	-0.11	0.28
Marital status in a relationship	-0.01462	0.10	0.886	-0.22	0.19	-0.02182	0.11	0.836	-0.23	0.19
Marital status living with partner	-0.12329	0.08	0.128	-0.28	0.04	-0.12866	0.08	0.126	-0.29	0.04
Marital status separated	-0.25215	0.20	0.206	-0.64	0.14	-0.12474	0.21	0.546	-0.53	0.28
Marital status divorced	-0.14395	0.14	0.319	-0.43	0.14	-0.03183	0.15	0.831	-0.32	0.26
Marital status widowed	0.125536	0.23	0.589	-0.33	0.58	0.161055	0.25	0.523	-0.33	0.65
Marital status PNS	-0.21724	0.44	0.624	-1.09	0.65	0.176207	0.46	0.703	-0.73	1.08
Ethnicity non-white	0.083754	0.14	0.561	-0.20	0.37					
Highest qual: Under 16	0.100032	0.07	0.133	-0.03	0.23	0.055663	0.07	0.422	-0.08	0.19
Parent	0.192734	0.08	0.023	0.03	0.36	-0.16761	0.09	0.051	-0.34	0.00

S3: Supplementary table presenting all predictors of on-trade HDOs from the full and subset models										
	Full model					Subset model				
	Regression Coefficients (β)	SE	P value	CI 95%		Regression Coefficients (β)	SE	P value	CI 95%	
Who										
Romantic partner	0.115015	0.19	0.552	-0.26	0.49					
Family they live with	-0.109	1.06	0.918	-2.19	1.97					
Family who live elsewhere	0.044038	0.60	0.942	-1.14	1.22					
Friends	0.333867	0.35	0.34	-0.35	1.02					
Neighbours	1.611246	1.41	0.253	-1.15	4.37					
Work colleagues	-0.99327	0.48	0.037	-1.93	-0.06					
Course mates	-2.6751	1.40	0.056	-5.42	0.07					
Drinking alone	-4.84093	1.34	0	-7.47	-2.21					
Children aged 16-17	2.29484	1.22	0.06	-0.10	4.69					
Children aged 13-15	-0.98384	0.49	0.045	-1.95	-0.02					
Children aged 12 and under	-1.94903	0.50	0	-2.94	-0.96					
Number of adults in occ	-0.00367	0.03	0.908	-0.07	0.06					
Male pair	-5.20414	1.79	0.004	-8.72	-1.69					
Female pair	-5.02811	1.37	0	-7.72	-2.34	0.0166847	0.14	0.907	-0.26	0.30
Mixed pair	-5.53022	1.41	0	-8.29	-2.77					
Male group	-5.39508	1.78	0.002	-8.88	-1.91					
Female group	-5.48944	1.78	0.002	-8.98	-2.00					
Mixed sex group	-4.82155	1.47	0.001	-7.70	-1.94					
Number of adults drinking in occ	0.017866	0.05	0.705	-0.07	0.11					
Drank much less than companions	1.055498	1.17	0.366	-1.23	3.35					
Drank a little less than companions	0.859302	0.76	0.255	-0.62	2.34					
Drank a little more	0.597814	0.41	0.143	-0.20	1.40					
Drank much more	0.153342	0.61	0.801	-1.04	1.35					
What										
Drinking wine/ fortified wine	-0.4327542	0.77	0.574	-1.94	1.07	0.0752081	0.09	0.414	-0.11	0.26
Drinking spirits/ liquors/ shots	-3.648883	2.83	0.197	-9.19	1.90	0.0639116	0.13	0.624	-0.19	0.32
Drinking non-alcoholic drinks	-5.078189	3.10	0.101	-11.15	1.00					
Drinking normal strength beer	2.104	0.50	0	1.12	3.09	0.0731471	0.12	0.549	-0.17	0.31
Drinking high strength beer	-0.576806	0.94	0.541	-2.43	1.27					
Normal strength cider	1.633369	0.55	0.003	0.56,	2.71					
Pint of beer	2.393422	1.48	0.107	-0.51	5.30					
Small can of beer	0.5589836	0.99	0.571	-1.38	2.49					
Standard can of beer	3.741696	1.38	0.007	1.04,	6.44					
Large can of beer	0.3900325	1.21	0.747	-1.98	2.76	0.9853857	0.32	0.002	0.36	1.61

Standard bottle of beer	1.097808	3.74	0.769	-6.24	8.44					
Pint bottle of beer	2.621248	1.06	0.014	0.54,	4.71	0.3406363	0.13	0.008	0.09	0.59
2L jug of beer	-3.799593	1.22	0.002	-6.20,	-1.40					
Medium glass of wine	-0.2911751	0.11	0.007	-0.50,	-0.08					
Large glass of wine	-1.596583	0.76	0.36	-3.09	-0.11	-0.006056	0.10	0.953	-0.21	0.20
Glass of wine (unspecified size)	1.126756	0.71	0.114	-0.27	2.52					
Standard bottle of wine	-0.2933135	0.89	0.741	-2.03	1.44					
Drinking spirits	2.861154	3.22	0.375	-3.46	9.18	-0.036685	0.12	0.769	-0.28	0.21
Drinking liquor	-1.91418	2.76	0.487	-7.32	3.49					
Drinking shots	3.24151	2.29	0.157	-1.25	7.73					
Spirits as singles	1.397921	0.74	0.059	-0.05	2.85					
Spirits as doubles	-0.8565185	1.06	0.419	-2.94	1.22					
Mini bottle										
Hipflask	-0.3872035	0.92	0.673	-2.18	1.41					
Spirits from 70cl bottles	2.923582	1.40	0.0687	-0.17	5.68	1.094232	0.30	0.001	0.50	1.69
Drinking cocktails	3.422799	1.30	0.009	0.87,	5.97					
Drinking alcopops	-2.904946	2.22	0.191	-7.26	1.45					
Standard cocktail glass	-5.110892	1.55	0.001	-8.16,	-2.06					
Where										
Number of locations	3.27425	1.20	0.006	0.93,	5.62	0.0975863	0.05	0.038	0.01	0.19
Mixed occasion	-0.166653	0.06	0.053	-0.28	-0.06	-0.19317	0.06	0.003	-0.32	-0.07
Restaurant	-2.089321	1.12	0.063	-4.29	0.11					
Traditional pub	-2.919158	1.24	0.018	-5.34	-0.50	0.1871968	0.05	0.001	0.08	0.29
Modern bar	-2.573321	1.06	0.015	-4.65,	-0.50					
Pub or bar restaurant	-2.602292	1.31	0.048	-5.18	-0.03					
Nightclub	0.2945267	0.90	0.745	-1.48	2.07					
Social club	-2.216644	0.90	0.014	-3.99,	-0.45					
No travel to location	0.1167998	0.55	0.83	-0.95	1.19					
Travelled on public transport	0.2814231	0.29	0.328	-0.28	0.85	0.0045909	0.07	0.949	-0.14	0.15
Travelled in taxi	-0.1673338	0.28	0.545	-0.71	0.37					
Drove to location	1.205679	0.77	0.118	-0.31	2.72					
Lift from someone drinking at location	-0.4212851	0.13	0.002	-0.69,	-0.16					
Lift from a non-drinker at location	-0.8250045	0.68	0.225	-2.16	0.51					
Lift from a non-drinker not at location	-0.4174365	0.36	0.248	-1.13	0.29					
Other form of travel	0.3344555	0.70	0.631	-1.03	1.70					
Walked to location	-0.205439	0.54	0.705	-1.27	0.86					
When										
Monday	0.9351278	0.39	0.017	0.16	1.71					
Tuesday	0.440844	0.30	0.141	-0.15	1.03					
Wednesday	0.3958922	0.42	0.343	-0.42	1.21					
Thursday	1.259224	0.33	<.001	0.61,	1.91					
Friday	1.016377	0.34	0.003	0.35,	1.69					
Saturday	1.120764	0.27	<.001	0.59,	1.65					
Start time	0.1206436	0.09	0.199	-0.06	0.30	-0.0081188	0.01	0.352	-0.03	0.01
Stop time	0.0340001	0.02	0.125	-0.01	0.08	-0.0004941	0.00	0.879	-0.01	0.01
Duration of occasion	0.022514	0.14	0.871	-0.25	0.30	0.0231778	0.01	0.077	0.00	0.05

Eating a meal	1.391732	0.43	0.001	0.55,	2.23					
Eating a snack	0.5960037	0.25	0.018	0.10	1.09					
Cooking	-3.999684	0.78	<.001	-5.53,	-2.47					
On a videocall	-0.4702889	1.40	0.737	-3.21	2.27					
Watching Tv	1.107014	0.45	0.014	0.22,	1.99					
On social media	-0.0439003	0.32	0.889	-0.66	0.57					
Doing chores	-0.4837853	0.38	0.207	-1.24	0.27					
Playing PC game	3.772139	0.70	<.001	2.41,	5.14	0.3590936	0.21	0.092	-0.06	0.78
Playing board games	-2.782426	1.01	0.006	-4.76,	-0.81					
Playing pool/ snooker	-0.874212	0.25	0.001	-1.37,	-0.38					
Listening to the radio	-1.820547	1.15	0.114	-4.08	0.43					
Live event	0.1070283	0.33	0.745	-0.54	0.75					
Dancing	-1.291787	0.36	<.001	-2.00,	-0.58					
Doing a quiz	-1.3715	0.31	<.001	-1.97,	-0.77					
Playing a drinking game	1.962125	0.39	<.001	1.20,	2.72	0.0152359	0.12	0.899	-0.22	0.25
Whilst reading	-1.410277	0.67	0.036	-2.73	-0.09	0.3790118	0.24	0.108	-0.08	0.84
Whilst working	-2.837362	1.16	0.014	-5.11,	-0.57					
Smoking a cigarette in the occasion	-0.5596154	0.51	0.27	-1.55	0.43	0.3111798	0.11	0.007	0.09	0.54
Smoking a vape in the occasion	1.74833	0.36	<.001	1.04,	2.45					
Using other drugs in the occasion	3.22945	1.00	0.001	1.28,	5.18	0.0423749	0.21	0.843	-0.38	0.46
Using no cigarettes or drugs	-0.532751	0.90	0.553	-2.29	1.23	0.1651061	0.11	0.129	-0.05	0.38
Why										
Visiting others	-0.617773	0.41	0.551	-1.43	-0.81					
Entertaining others	0.0008899	0.43	0.998	-0.85	0.85					
Party	-0.0113044	0.41	0.978	-0.81	0.79					
Going for a meal	-0.631916	0.42	0.683	-1.46	-0.81					
No special occasion	-0.3438027	0.37	0.348	-1.06	0.37					
Other type of occasion	0.6232734	0.53	0.241	-0.42	1.66					
Purpose of occasion to alleviate stress	0.3510222	0.25	0.155	-0.13	0.83					
Purpose of occasion to relax	0.1863511	0.48	0.701	-0.76	1.14					
Purpose of occasion to alleviate negative mood	-2.034887	0.60	0.001	-3.22	-0.85					
Purpose of occasion to have fun	0.8448312	0.26	0.001	0.34	1.35					
Purpose of occasion to alleviate boredom	0.7527948	0.98	0.445	-1.18	2.68					
Purpose of occasion to socialise	0.3456048	0.81	0.669	-1.24	1.93	0.0544715	0.08	0.498	-0.10	0.21
Purpose of occasion out of habit	-0.0850546	0.53	0.873	-1.13	0.96	0.0454496	0.08	0.548	-0.10	0.19
Other purpose of occasion	0.9393587	0.53	0.077	-0.10	1.98					
Reason for drinking to alleviate stress	-1.421269	0.36	0	-2.13	-0.71	0.0628071	0.08	0.433	-0.09	0.22
Reason for drinking to relax	-0.021207	0.40	0.958	-0.81	0.76	-0.0773711	0.05	0.139	-0.18	0.03

Reason for drinking to alleviate negative mood	2.663146	0.83	0.001	1.03	4.30					
Reason for drinking to have fun	-0.7988466	0.58	0.171	-1.94	0.34					
Reason for drinking to alleviate boredom	0.2660408	0.32	0.404	-0.36	0.89					
Reason for drinking to socialise	-0.9221694	0.79	0.242	-2.47	0.62	0.0889594	0.08	0.24	-0.06	0.24
Reason for drinking out of habit	0.8483896	0.38	0.026	0.10	1.59					
Other reason for drinking	0.3019486	0.37	0.418	-0.43	1.03					
Planned intoxication	0.0477742	0.02	0.003	0.02,	0.08	0.0644289	0.02	0.001	0.03	0.10
Actual intoxication	0.017482	0.04	0.672	-0.06	0.10	0.0012037	0.02	0.939	-0.03	0.03
Higher actual than planned intoxication	-1.2526	0.57	0.028	-2.37	-0.13					
Individual-level										
Current smoker status	1.127651	0.98	0.25	-0.79	3.05	-0.0031788	0.12	0.978	-0.23	0.23
Recent smoker status	1.871849	1.26	0.137	-0.60	4.34					
On a diet to maintain weight	-0.39995	0.20	0.051	-0.80	0.00					
On a diet to gain weight	-2.02616	0.87	0.06	-3.74	-0.31					
Aiming to reduce alcohol consumption	0.35318	0.40	0.378	-0.43	1.14					
BMI	-0.0335286	0.03	0.31	-0.10	0.03	0.0123231	0.01	0.038	0.00	0.02
QALY mobility	0.596303	0.62	0.333	-0.61	1.80					
QALY self-care	-1.90207	1.02	0.062	-3.90	0.10	0.2402323	0.12	0.04	0.01	0.47
QALY usual activity	0.665337	0.20	0.001	0.26	1.07	-0.0587064	0.07	0.432	-0.21	0.09
QALY pain	-0.25928	0.13	0.04	-0.51	-0.01					
QALY Anxiety/ Depression	-0.01739	0.18	0.922	-0.37	0.33					
QALY Total health	-0.01905	0.01	0.001	-0.03	-0.01	0.0007039	0.00	0.747	0.00	0.00
Age	-0.01282	0.02	0.548	-0.05	0.03	0.0005078	0.00	0.86	-0.01	0.01
Gender	-0.275145	0.07	0.001	-0.41,	-0.14	-0.1230576	0.07	0.068	-0.26	0.01
Employment status part-time	0.6059411	0.35	0.081	-0.07	1.29					
Employment status self-employed	-0.3191402	0.61	0.598	-1.51	0.87					
Employment status unemployed	-1.573111	1.64	0.338	-4.79	1.65					
Employment status homemaker	-0.2440567	0.97	0.801	-2.14	1.65					
Employment status retired	0.2802298	0.58	0.63	-0.86	1.42					
Employment status FTE	-1.206755	0.44	0.006	-2.06,	-0.35					
Marital status single	-1.419307	0.78	0.068	-2.94	0.10	0.0708547	0.08	0.355	-0.08	0.22
Marital status in a relationship	-0.939538	0.80	0.243	-2.52	0.64					
Marital status living with partner	-1.252684	0.49	0.011	-2.21,	-0.29	-0.0546449	0.10	0.6	-0.26	0.15
Marital status separated	-0.939538	0.80	0.243	-2.52	0.64	-0.1831321	0.16	0.239	-0.49	0.12
Marital status widowed	0.6501089	0.56	0.244	-0.44	1.74					

Marital status PNS	2.607942	1.58	0.099	-0.49	5.70
Ethnicity non-white	-0.36109	0.18	0.053	-0.71	-0.01
Highest qual: Under 16	-0.2048	0.27	0.455	-0.74	0.33
Parent	-1.01769	0.28	0	-1.57	-0.47

S4: Supplementary table presenting all predictors of off-trade HDOs from the full and subset models										
	Full model					Subset model				
	Regression Coefficients (β)	SE	P value	CI 95%		Regression Coefficients (β)	SE	P value	CI 95%	
Who										
Romantic partner	0.1023709	0.05	0.046	0.00	0.20	0.0888623	0.04	0.014	0.02	0.16
Family they live with	0.0218011	0.05	0.684	-0.08	0.13					
Family who live elsewhere	0.1220464	0.08	0.139	-0.04	0.28					
Friends	0.0741731	0.06	0.211	-0.04	0.19	0.0337916	0.04	0.41	-0.05	0.11
Neighbours	-0.105349	0.12	0.377	-0.34	0.13					
Work colleagues	0.0451957	0.13	0.72	-0.20	0.29					
Course mates	-0.1392751	0.26	0.589	-0.64	0.37					
Drinking alone	0.0782656	0.10	0.447	-0.12	0.28	0.0115559	0.04	0.78	-0.07	0.09
Children aged 16-17	-0.1141037	0.09	0.204	-0.29	0.06					
Children aged 13-15	0.0412054	0.08	0.616	-0.12	0.20	-0.025348	0.06	0.675	-0.14	0.09
Children aged 12 and under	-0.1277607	0.06	0.047	-0.25	0.00					
Number of adults in occ	-0.0025487	0.00	0.348	-0.01	0.00					
Male pair	0.0690774	0.05	0.164	-0.03	0.17					
Female pair	0.0924083	0.10	0.348	-0.10	0.29					
Mixed pair	0.0505477	0.08	0.501	-0.10	0.20					
Male group	0.0220855	0.11	0.845	-0.20	0.24					
Female group	0.0864191	0.11	0.439	-0.13	0.31					
Mixed sex group	0.0857881	0.08	0.308	-0.08	0.25	-0.0364496	0.03	0.265	-0.10	0.03
Number of adults drinking in occ	-0.0024224	0.01	0.757	-0.02	0.01					
Drank much less than companions	-0.0356573	0.13	0.791	-0.30	0.23					
Drank a little less than companions	-0.07004	0.09	0.454	-0.25	0.11					
Drank the same as companions	-0.0356573	0.13	0.791	-0.30	0.23					
Drank a little more	0.0122013	0.08	0.885	-0.15	0.18					
Drank much more	0.0173959	0.09	0.839	-0.15	0.19					
What										
Drinking beer or cider	0.2940623	0.15	0.046	0.01	0.58	0.0514455	0.07	0.444	-0.08	0.18
Drinking wine/ fortified wine	0.2537399	0.33	0.439	-0.39	0.90	0.1875503	0.17	0.263	-0.14	0.52
Drinking spirits/ liquors/ shots	0.8597116	0.59	0.147	-0.30	2.02	-0.0386912	0.10	0.694	-0.23	0.15
Drinking cocktails/ alcopops	0.7847194	0.59	0.186	-0.38	1.95	-0.1302817	0.10	0.186	-0.32	0.06
Drinking low alcoholic drinks	-0.0276168	0.27	0.917	-0.55	0.49					
Drinking alcohol free drinks	-0.0031002	0.20	0.988	-0.40	0.40					
Drinking non-alcoholic drinks	2.027851	0.71	0.004	0.64	3.41					

Drinking normal strength beer	-0.2676421	0.13	0.044	-0.53	-0.01	-0.0531417	0.07	0.422	-0.18	0.08
Drinking high strength beer	0.2219271	0.12	0.062	-0.01	0.45	0.3281499	0.10	0.001	0.14	0.52
Normal strength cider	-0.3169748	0.14	0.022	-0.59	-0.05					
High strength cider	0.2659243	0.22	0.221	-0.16	0.69	0.4804128	0.19	0.011	0.11	0.85
Pint of beer	-0.0281325	0.08	0.727	-0.19	0.13					
Small can of beer	-0.2141173	0.10	0.035	-0.41	-0.01					
Standard can of beer	0.135869	0.07	0.066	-0.01	0.28	0.1491293	0.05	0.002	0.05	0.24
Large can of beer	0.1005616	0.07	0.162	-0.04	0.24	0.1036563	0.05	0.05	0.00	0.21
Small bottle of beer	-0.0596118	0.21	0.773	-0.46	0.34					
Standard bottle of beer	-0.0179954	0.08	0.823	-0.18	0.14					
Pint bottle of beer	0.0438416	0.08	0.59	-0.12	0.20					
2L jug of beer	0.1767447	0.44	0.687	-0.68	1.04					
Drinking wine	-0.1694195	0.32	0.594	-0.79	0.45	0.0350258	0.18	0.844	-0.31	0.38
Small glass of wine	-0.0163933	0.08	0.831	-0.17	0.13	-0.0472319	0.06	0.454	-0.17	0.08
Medium glass of wine	0.0189221	0.07	0.797	-0.12	0.16	-0.073247	0.06	0.252	-0.20	0.05
Large glass of wine	0.0349664	0.08	0.653	-0.12	0.19	-0.0680017	0.06	0.264	-0.19	0.05
Glass of wine (unspecified size)	0.3126569	0.11	0.006	0.09	0.54					
Small bottle of wine	-0.4488601	0.26	0.079	-0.95	0.05					
Standard bottle of wine	0.2098292	0.08	0.013	0.04	0.37					
Large bottle of wine	0.8477538	0.16	0	0.54	1.16	0.6099557	0.15	0	0.32	0.90
3L box of wine	0.3588624	0.16	0.023	0.05	0.67	0.0794418	0.15	0.589	-0.21	0.37
Standard glass of sherry	-0.0141841	0.41	0.972	-0.82	0.79					
Drinking spirits	-0.8371903	0.61	0.167	-2.02	0.35	0.0851574	0.10	0.383	-0.11	0.28
Drinking liquor	-0.5736805	0.59	0.334	-1.74	0.59					
Drinking shots	-1.005922	0.64	0.114	-2.25	0.24					
Spirits as singles	-0.0828278	0.12	0.504	-0.33	0.16					
Spirits as doubles	-0.020865	0.14	0.878	-0.29	0.25					
Hipflask	0.0062651	0.19	0.973	-0.36	0.37					
Spirits from 70cl bottles	0.6838124	0.15	0	0.39	0.98	0.5478494	0.07	0	0.41	0.68
Spirits from 1L bottles	0.9176273	0.21	0	0.51	1.33	0.8094633	0.13	0	0.56	1.06
Drinking cocktails	-0.8896649	0.61	0.143	-2.08	0.30					
Drinking cocktails from a small can	-0.6692932	0.59	0.259	-1.83	0.49					
Large bottle of cocktail	-0.2859255	0.55	0.601	-1.36	0.78	0.36606	0.34	0.283	-0.30	1.03
1L cocktail bottle	0.816834	0.41	0.047	0.01,	1.62					
Sugar sweetened beverage	-2.119414	0.74	0.004	-3.57	-0.67					
Non-sugar sweetened beverage	0.0620091	0.25	0.806	-0.43	0.56					
Where										
Number of locations	0.2183222	0.31	0.475	-0.38	0.82	0.338489	0.06	0	0.22	0.46
Mixed occasion	-0.1593448	0.07	0.029	-0.30	-0.02	0.0179346	0.05	0.732	-0.08	0.12
Own home	-0.0468398	0.26	0.855	-0.55	0.46					
Others home	-0.0669272	0.25	0.79	-0.56	0.43	0.0078409	0.05	0.882	-0.10	0.11
General outdoors	0.0151407	0.31	0.961	-0.59	0.62					
Other location	0.120135	0.06	0.044	0.00	0.24					
No travel to location	0.1926924	0.15	0.186	-0.09	0.48	0.0794129	0.04	0.066	-0.01	0.16
Travelled on public transport	0.1306975	0.16	0.42	-0.19	0.45	0.038387	0.07	0.571	-0.09	0.17

Travelled in taxi	0.0920236	0.18	0.614	-0.27	0.45	-0.0507116	0.10	0.626	-0.25	0.15
Drove to location	0.0471579	0.16	0.767	-0.26	0.36					
Lift from someone drinking at location	0.272317	0.19	0.159	-0.11	0.65					
Lift from a non-drinker at location	0.1477207	0.17	0.389	-0.19	0.48					
Lift from a non-drinker not at location	0.0498466	0.22	0.824	-0.39	0.49					
Other form of travel	0.2700307	0.24	0.264	-0.20	0.74					
Walked to location	0.1997002	0.16	0.22	-0.12	0.52					
When										
Monday	-0.0151912	0.03	0.661	-0.08	0.05					
Tuesday	-0.0374856	0.04	0.299	-0.11	0.03					
Wednesday	-0.0000972	0.04	0.998	-0.07	0.07					
Thursday	-0.0101869	0.03	0.769	-0.08	0.06					
Friday	-0.0167833	0.04	0.634	-0.09	0.05					
Saturday	0.0289629	0.03	0.371	-0.03	0.09	0.0435605	0.02	0.062	0.00	0.09
Start time	0.0071001	0.00	0.099	0.00	0.02	0.00672	0.00	0.088	0.00	0.01
Stop time	0.0000395	0.00	0.984	0.00	0.00	0.0002469	0.00	0.891	0.00	0.00
Duration of occasion	0.0283071	0.01	0	0.01	0.04	0.0352082	0.01	0	0.02	0.05
Eating a meal	0.0359939	0.03	0.268	-0.03	0.10	0.0424581	0.03	0.159	-0.02	0.10
Eating a snack	-0.0071206	0.04	0.844	-0.08	0.06					
Cooking	0.041964	0.03	0.226	-0.03	0.11	-0.0177664	0.03	0.578	-0.08	0.04
On a videocall	-0.0487474	0.09	0.605	-0.23	0.14					
Watching Tv	-0.0296876	0.04	0.412	-0.10	0.04	-0.0466901	0.03	0.123	-0.11	0.01
On social media	-0.024392	0.04	0.49	-0.09	0.04					
Doing chores	0.0626943	0.05	0.24	-0.04	0.17	0.0693461	0.05	0.127	-0.02	0.16
Playing PC game	-0.0481259	0.05	0.289	-0.14	0.04	-0.0400166	0.04	0.346	-0.12	0.04
Playing board games	-0.010073	0.06	0.874	-0.13	0.11					
Playing pool/ snooker	-0.0815685	0.13	0.541	-0.34	0.18	-0.0247427	0.12	0.831	-0.25	0.20
Listening to the radio	-0.0050637	0.04	0.906	-0.09	0.08	0.0241628	0.04	0.527	-0.05	0.10
Live event	0.1575984	0.06	0.005	0.05	0.27					
Dancing	0.129127	0.14	0.369	-0.15	0.41	0.1495175	0.09	0.112	-0.04	0.33
Playing a drinking game	-0.0142833	0.14	0.916	-0.28	0.25	-0.0830821	0.11	0.444	-0.30	0.13
Whilst reading	-0.0552263	0.05	0.259	-0.15	0.04					
Whilst working	0.0973001	0.07	0.159	-0.04	0.23					
Other activities	0.1201347	0.06	0.044	0.00	0.24					
Smoking a cigarette in the occasion	-0.0490828	0.10	0.606	-0.24	0.14	-0.0944509	0.09	0.281	-0.27	0.08
Smoking a vape in the occasion	0.3810608	0.12	0.001	0.15	0.61	0.244635	0.09	0.01	0.06	0.43
Using cannabis in the occasion	0.2499604	0.16	0.124	-0.07	0.57	0.2036012	0.14	0.157	-0.08	0.49
Using other drugs in the occasion	-0.6644165	0.24	0.006	-1.14	-0.19	-0.2632727	0.19	0.173	-0.64	0.12
Using no cigarettes or drugs	0.0442251	0.12	0.703	-0.18	0.27	-0.0410923	0.10	0.687	-0.24	0.16
Why										
Visiting others	0.0118294	0.15	0.937	-0.28	0.31					
Entertaining others	0.0231137	0.16	0.884	-0.29	0.33	0.0055495	0.07	0.936	-0.13	0.14
Party	0.1223282	0.19	0.524	-0.25	0.50					
Going for a meal	0.0449893	0.14	0.752	-0.23	0.32	0.0195882	0.04	0.627	-0.06	0.10

No special occasion	0.020409	0.13	0.879	-0.24	0.28					
Other type of occasion	0.0635276	0.14	0.644	-0.21	0.33					
Purpose of occasion to alleviate stress	0.0718755	0.05	0.157	-0.03	0.17	0.0419503	0.04	0.237	-0.03	0.11
Purpose of occasion to relax	-0.0190257	0.04	0.661	-0.10	0.07	-0.0149165	0.04	0.708	-0.09	0.06
Purpose of occasion to alleviate negative mood	0.0946251	0.05	0.081	-0.01	0.20	0.1309589	0.05	0.011	0.03	0.23
Purpose of occasion to have fun	-0.0343529	0.07	0.61	-0.17	0.10					
Purpose of occasion to alleviate boredom	-0.1011971	0.06	0.078	-0.21	0.01	-0.0947507	0.05	0.054	-0.19	0.00
Purpose of occasion to socialise	0.0273991	0.05	0.57	-0.07	0.12	0.0223711	0.03	0.454	-0.04	0.08
Purpose of occasion out of habit	-0.0411739	0.04	0.291	-0.12	0.04					
Other purpose of occasion	-0.101185	0.07	0.132	-0.23	0.03					
Reason for drinking to alleviate stress	-0.0469901	0.05	0.349	-0.15	0.05					
Reason for drinking to relax	0.0838435	0.05	0.068	-0.01	0.17	0.0972779	0.04	0.017	0.02	0.18
Reason for drinking to alleviate negative mood	-0.0318385	0.05	0.53	-0.13	0.07	-0.0691698	0.05	0.138	-0.16	0.02
Reason for drinking to have fun	0.0470676	0.07	0.514	-0.09	0.19	0.036958	0.04	0.37	-0.04	0.12
Reason for drinking to alleviate boredom	0.086396	0.05	0.092	-0.01	0.19	0.0638961	0.04	0.147	-0.02	0.15
Reason for drinking to socialise	-0.035293	0.05	0.504	-0.14	0.07					
Reason for drinking out of habit	-0.0065291	0.04	0.866	-0.08	0.07					
Other reason for drinking	0.1559734	0.07	0.022	0.02	0.29					
Planned intoxication	0.0595033	0.01	0	0.03	0.08	0.0512243	0.01	0	0.03	0.07
Actual intoxication	0.0178452	0.01	0.193	-0.01	0.04	0.0203343	0.01	0.086	0.00	0.04
Higher actual than planned intoxication	-0.1209315	0.06	0.032	-0.23	-0.01					
Individual-level										
Current smoker status	0.0514514	0.10	0.617	-0.15	0.25	0.0310324	0.09	0.737	-0.15	0.21
Recent smoker status	-0.1207397	0.13	0.351	-0.37	0.13	-0.0305516	0.12	0.791	-0.26	0.20
Long-term ex-smoker	0.0228935	0.06	0.693	-0.09	0.14	-0.0113365	0.05	0.828	-0.11	0.09
On a diet to lose weight										
On a diet to maintain weight	-0.0636316	0.11	0.562	-0.28	0.15					
On a diet to gain weight	-1.283195	0.40	0.001	-2.06	-0.51					
Aiming to reduce alcohol consumption	0.0922678	0.05	0.078	-0.01	0.19					
BMI	-0.0000153	0.00	0.997	-0.01	0.01					
QALY mobility	-0.1287069	0.10	0.182	-0.32	0.06					
QALY self-care	0.0614559	0.11	0.591	-0.16	0.29	0.0682617	0.10	0.511	-0.14	0.27
QALY usual activity	0.0172129	0.07	0.805	-0.12	0.15	-0.0706055	0.06	0.219	-0.18	0.04
QALY pain	-0.0573207	0.04	0.153	-0.14	0.02					

QALY Anxiety/ Depression	0.0060456	0.04	0.866	-0.06	0.08	-0.0404625	0.03	0.194	-0.10	0.02
QALY Total health	-0.0068834	0.00	0.002	-0.01	0.00	-0.0060841	0.00	0.002	-0.01	0.00
Age	0.00232	0.00	0.377	0.00	0.01	-0.0001215	0.00	0.956	0.00	0.00
Gender	-0.1276334	0.05	0.016	-0.23	-0.02	-0.1306521	0.05	0.004	-0.22	-0.04
Employment status part-time	-0.0390495	0.07	0.587	-0.18	0.10	-0.0250601	0.07	0.705	-0.15	0.10
Employment status self-employed	-0.0343782	0.09	0.688	-0.20	0.13	0.0357049	0.08	0.647	-0.12	0.19
Employment status unemployed	0.1708572	0.14	0.232	-0.11	0.45	0.1810355	0.12	0.146	-0.06	0.43
Employment status homemaker	0.0279646	0.12	0.814	-0.20	0.26	0.209348	0.10	0.035	0.02	0.40
Employment status retired	0.0627445	0.09	0.476	-0.11	0.24	0.0040163	0.08	0.959	-0.15	0.16
Employment status FTE	-0.0283347	0.15	0.846	-0.31	0.26	-0.075325	0.11	0.475	-0.28	0.13
Marital status single	0.0689628	0.18	0.706	-0.29	0.43	0.044278	0.07	0.512	-0.09	0.18
Marital status in a relationship	0.1773314	0.19	0.356	-0.20	0.55	0.140866	0.08	0.095	-0.02	0.31
Marital status living with partner	-0.0566636	0.19	0.763	-0.42	0.31					
Marital status separated	-0.0228497	0.22	0.917	-0.45	0.41					
Marital status widowed	-0.0826691	0.26	0.747	-0.59	0.42					
Marital status PNS	-0.071221	0.40	0.857	-0.85	0.70	0.3544532	0.33	0.276	-0.28	0.99
Ethnicity non-white	-0.0636316	0.11	0.562	-0.28	0.15					
Highest qual: Under 16	-0.1240199	0.06	0.036	-0.24	-0.01	-0.1052069	0.05	0.052	-0.21	0.00
Parent	-0.2266643	0.08	0.003	-0.37	-0.08					

9 Discussion

This thesis aimed to identify the most suitable method for measuring the contextual characteristics of drinking occasions and to determine the salient characteristics which should be measured to develop and test a data collection method for the quantitative study of occasion-level alcohol use. This chapter summarises the main findings from this PhD thesis. It then discusses the key methodological reflections taken throughout the thesis, suggestions for future research and implications for both research and policy and practice.

9.1 Summary of thesis

This thesis contributes to the literature on event-level alcohol consumption by developing and testing a novel context-specific survey which comprehensively measures the contextual characteristics of a drinking occasion, otherwise known as *where, what, when, with whom,* and *why* an individual drinks. Following the introduction to the thesis, chapter three established how drinking occasions have previously been defined within both theory and the existing literature. Chapter four built on this by reviewing the existing empirical research conducted on drinking occasions, established which concepts have previously been measured within a drinking occasion, and provided an overview of the different measurement approaches taken.

Chapter five presented a systematic review of the data collection techniques used to measure drinking occasions and assessed the identified techniques in terms of their methodological strengths and limitations. Chapter six then presented a content analysis of a sample of postings made by users on three UK-centric online alcohol support discussion forums, which identified the most mentioned contextual characteristics of heavy drinking occasions. This is the first study to use this design within event-level alcohol research and therefore provides novel data.

Chapter seven detailed the development stages undertaken to create a novel context specific survey which captures the contextual characteristics of drinking occasions. Informed by the

key methodological findings from chapters five and six, this chapter detailed the process undertaken to create and test this survey. Development of the context-specific survey had three stages. Firstly, a comprehensive set of drinking occasion concepts were compiled based on the findings from theory and the literature identified in previous chapters of this thesis, with these concepts undergoing internal expert review. Secondly, measures were identified or developed based on the key concepts identified in stage one. These measures also underwent external expert review. Thirdly, the developed measures underwent advisory input from an alcohol PPI group to ensure that the questions were appropriate before undergoing cognitive testing to assess the face validity and usability of this survey. The chapter summarises the key changes made to the developed survey throughout the development process.

Chapter eight then presented the final empirical chapter of this thesis, which used the survey developed in chapter seven to collect cross-sectional quantitative data on heavy drinker's (defined as those drinking above the low-risk guidelines of 14 per week (28)) general drinking occasions and their heavy drinking occasions (HDOs) (defined as males and females drinking over 8 and 6 units respectively in a single occasion). The work presented in this chapter identifies the contextual characteristics associated with on-trade (e.g. in a bar or restaurant etc.), off-trade (e.g. within the home etc.) and mixed-trade (drinking in both on- and off-trade) drinking occasions and HDOs within a sample of heavy drinkers. As such, this study identifies which characteristics are most associated with heavy drinking and suggests areas for policy development and research intervention.

This current chapter discusses the findings in the context of the overall aim of the thesis: to drive forward occasion-level alcohol research by undertaking literature-based and primary research to develop and test a data collection method for collecting occasion-level data. It will also detail planned and reactive changes made to the planned research throughout the project

and highlight recommendations for future methodological and empirical research in addition to practice and policy.

9.2 Main thesis findings

The overarching aim of this thesis was to drive forward occasion-level alcohol research by undertaking literature-based and primary research to develop and test a context specific survey to measure drinking occasions. In order to achieve this, I evaluated different methods for collecting contextually specific occasion level data, identified factors which should be measured, and developed a survey to measure them. Details on the main findings related to each of the four stages of the thesis are presented below.

9.2.1 Evaluating data collection techniques used to measure drinking occasion characteristics

In assessing the data collection methods in terms of their methodological strengths and limitations, we found that many papers describing previous event-level research did not explicitly report on measures of participant burden and so proxy measures, such as time spent completing a survey, had to be created to allow for these techniques to be assessed. In identifying the most suitable technique to use in the collection of drinking occasion characteristics, no single methodological approach was superior across measures of reliability, validity, and feasibility, with substantial variation of performance within and between methods. Studies using experimental methods had the highest response rates, and methods recalling specific events had the lowest attrition. Studies using ecological momentary assessment methods typically had low average response rates and high attrition. Few studies reported measurement error or participant burden, and only 28.8% included validated event-level measures.

Papers explicitly reporting on reactivity, measurement error, and participant burden were scarce, with only one paper reporting participants to have experienced burden in relation to the method used (231). Methods such as EMA or daily diaries which administered repeated measures or continuous measures throughout a study were more likely to assess participant reactivity (153,222,223). Due to the scarcity of studies that explicitly reported these measures, we were unable to offer any firm conclusions regarding the performance of each data collection technique. It is likely that many studies included will have experienced issues relating to participant burden, measurement error, and reactivity, but have not explicitly reported these.

In summary, the review found that the event-level literature on alcohol drinking occasions provides little empirical evidence on the reliability, validity, and feasibility of its measures and data collection techniques. To permit future reviews to assess methodological strengths and limitations, researchers should aim to be more transparent on issues encountered when disseminating research. Specifically, we recommend including explicit measures of reactivity, measurement error, and participant burden when disseminating research findings from event level studies. Furthermore, within this review validated event-level measures were used in less than a third of the included literature, with a previous review finding a similar lack of validated event-level measures (214). This highlights the importance of developing and validating measures for use in event-level alcohol research in the future.

9.2.2 Identifying which contextual characteristics should be measured drinking occasion surveys

To identify relevant characteristics to measure, in addition to the published literature the second study identified contextual characteristics of HDOs that appear salient on online alcohol discussion forums. To our knowledge, this study is the first to use online discussion forum posts to identify HDO characteristics. By utilising this approach we have been able to capture naturalistic interactions which demonstrate how individuals describe and discuss their

experience of these types of occasions Through content analysis of user-initiated posts made to three discussion forums, five inter-related groups of contextual characteristics were identified as salient within discussion of heavy drinking occasions: timing of the occasion (*when,* mentioned in 33.8% of posts), drink type (*what, 19.6%*), reason for drinking (*why,* 16.4%), drinking companions *(who, 16.2%),* and drinking location *(where, 14.0%).*

More than one contextual characteristic was mentioned in the majority of posts (*n*=921, 76.8%), for example, drinking wine in the evening and drinking wine with a romantic partner. This demonstrates the complexity of HDOs and highlighting the importance of measuring a range of characteristics and their interrelations within event-level alcohol research.

Whilst the findings of our study are largely consistent with the existing literature, new characteristics were identified through our analysis which are important for future research. One characteristic identified in our work which is not measured extensively within the existing literature is drinking to cope with boredom. Currently the DMQ-R (44) does not measure boredom as a motivation for consuming alcohol. Given the frequency of this characteristic within posts and within other research, future research would benefit from actively measuring and exploring the both extent to which, and how boredom is distinct from established drinking motives within the DMQ-R (44) and whether the term 'boredom' accurately captures the scope of this additional dimension.

9.2.3 Developing and testing the context-specific survey

Work presented in chapter seven detailed the iterative process undertaken in developing and testing the context-specific drinking occasion survey. By mapping the concepts capturing contextual characteristics that we identified both within the literature and within the second study of this thesis to theory, we were able to consider a key limitation of the existing literature (22). By undertaking a diverse and comprehensive development and testing approach, both

academic experts and members of the general public, including the advisory PPI group, were able to provide valuable feedback on the development of the context-specific survey. Through involving academic experts, we were able to ensure the drinking occasion concepts and measures within the survey were appropriate within a research context, and by involving the PPI group we were able to assess whether the questions included were comprehensive and easy to understand. A good example of the value of external perspectives is modifications to our operationalisation of a drinking occasion. Originally, we had planned to have participants determine their own drinking occasions based on the two-hour rule but following feedback from experts and the PPI group we asked participants to respond to a location-specific survey and applied the two-hour definition ourselves post data collection.

The cognitive interviews also yielded important methodological insights. Participants understood the questions included in the survey well, demonstrating that the survey had adequate face validity from a lay perspective. Through cognitive testing we were able to identify missed response options (e.g. walking to a drinking location) and technical issues within the survey, for example the '*other*' location following through to later questions, an issue which was rectified prior to the survey being fielded within the final study of this thesis.

9.2.4 Use of the context-specific survey to explore what contextual characteristics are associated with event-level consumption

The final study used the context-specific survey developed and tested within this thesis to collect data on a sample of UK heavy drinker's drinking occasions. In doing so, this study investigated which contextual characteristics were associated with units consumed within their general drinking occasions and HDOs, in both the on- and off-trade. Participants reported more drinking occasions within the off-trade than the on-trade.

Across the four analyses, characteristics from all five contextual groups were associated with units consumed per occasion. Characteristics from the *what* and *why* contextual groups, for example the serving size of drinks consumed, were most frequently associated with units consumed per occasion, with characteristics from the *when*, *where*, and *who* groups least frequently associated. Given that previous research has tended to focus on a limited number of predictors of consumption (22,29), the findings from this study suggest that measuring a wide breadth of characteristics is beneficial within alcohol event-level research to avoid important characteristics of occasions being overlooked or missed. Across all occasion types, planning to become intoxicated was consistently associated with increases in units consumed. Furthermore, within our analyses we found container and serving size of alcoholic drinks to be consistently associated with units consumed per occasion.

This study identified additional differences in characteristics associated with units consumed per occasion across trade and occasion types. Amongst these differences, occasions with the on-trade tended to be motivated by social reasons and occasions in the off-trade tended to be motivated by more emotive reasons. Furthermore, when looking at the role of drink type, within heavy drinker's general drinking occasions low strength alcoholic drinks were associated with decreases in units consumed per occasion. In comparison, our study found that high strength drinks, particularly beers and ciders, were associated with increased consumption, particularly within off-trade HDOs.

Finally, in exploring whether contextual or individual characteristics explained more of the variance in units consumed within HDOs, adding contextual characteristics to the model accounted for more variance in units consumed within occasions than individual characteristics alone.

9.3 Critical reflection on stages in the survey development process

This section reflects on the methodological and pragmatic decisions made within each chapter in the development of the context-specific survey. The work described within the systematic review and content analysis in practice ran concurrently, with the findings from both studies feeding into the development of the context-specific survey.

9.3.1 Systematic review

Prior to developing a tool to measure the contextual characteristics of a drinking occasion, there was a need to identify which data collection technique was most suited to the study of drinking occasions. From undertaking a literature review within the introductory chapters of this thesis, I was aware that the data collection techniques used in this area tended to be highly heterogeneous (22,29), with a range of techniques such as retrospective diaries, EMA, and in-street intercept surveys commonly used (5).

To allow for the data techniques used within the event-level literature to be assessed, in our approach to identifying studies we decided to use the papers and search strategy developed within a published mapping review of the event-level literature (22). As the last search for papers in the published mapping review occurred on the 8th January 2019, I re-ran this search multiple times throughout my studies, with the final search for the studies included in this thesis conducted on the 29th November 2021 to allow the paper to be written and sent for publication at a peer-reviewed journal.

In creating inclusion and exclusion criteria for my review, I made the decision to exclude studies where the sample was exclusively formed of underage drinkers, pregnant women, and homeless populations. As the thesis intended to measure drinking occasions within the general population it was felt that there may be additional barriers to collecting information about the drinking occasions of these sub-groups compared to a general population sample. Whilst this

survey was not specifically created for use within these excluded groups, the characteristics measured in the survey would likely apply to these groups. However, before this survey is used within these populations, further testing should be conducted to ensure the additional barriers that these groups face, such as stigma and higher participant burden, are considered.

A challenge within this review was to identify which methodological competencies, such as participant burden, reliability, and validity, each data collection technique should be assessed against. Given that no data collection methodological framework suitable for use in this review existed, I decided to search the literature to establish which methodological criteria the data collection techniques should be assessed against. In reviewing the methodological literature, I became aware of literature which had assessed the methodological suitability of individual data collection techniques, most commonly EMA (162,164). However, I encountered no literature which had methodologically attempted to assess a range of data collection techniques. As such, when identifying measures of participant burden, reliability, and validity for the data collection techniques used in this area, I devised a framework by reviewing the literature and selecting methodological competencies which had been assessed in a range of papers and disciplines.

When starting this review, I had aimed to identify a *gold standard* data collection technique for use in measuring the contextual characteristics of drinking occasions. Ultimately, reflecting on the findings of the review, in that performance on methodological competencies varies across techniques, selecting a data collection technique required careful thought. As we knew we wanted to take a comprehensive approach in developing a drinking occasion tool, in that we wanted to collect event-level data on a range of contextual characteristics, we felt that some data collection tools identified within the review were unsuitable. For example, specific-event recall was considered unsuitable for use in this context, as we wanted to capture a range of drinking occasions rather than a specific event. Similarly, using intercept and portal data

collection tools were not considered suitable for use in this context, given that we wanted to capture drinking over the course of a week rather than the course on a specific evening. Additionally, we felt that experimental and field studies were not suitable for use in this tool, given that both often required participants to be observed in naturalistic or controlled environments, which may have enacted a high researcher or participant burden.

Of the remaining data collection techniques identified and assessed within the review, EMA, prospective and retrospective diaries were considered as a way to collect data on drinking occasions within this thesis. Whilst EMA would have allowed for drinking to be studied in real-time and therefore would be less prone to recall error, issues with compliance were identified, with studies experiencing low response and high attrition rates. Given that EMA methods were found to enact a high participant burden due to repeated measures and the mode of data collection commonly used within EMA (e.g. mobile application assessments), we felt that using EMA would not be suitable for use in this study. In deciding between using prospective and retrospective diaries, whilst retrospective diaries did involve a longer recall than prospective diaries, after considering the potential participant burden enacted by repeated measures and the higher attrition rates of studies using prospective diaries, we decided that using a retrospective drinking diary to collect data on drinking occasions would be most suited to this thesis. Whilst using a retrospective survey has many benefits in that it enacts a low participant burden and has one of the highest response rates out of all the data collection techniques reviewed, we acknowledge selecting this method means that there are some contextual characteristics which cannot be feasibly measured. For example, whilst measuring round-buying practices would be a theoretically useful characteristic to measure within drinking occasion research, it is a difficult characteristic to accurately recall and therefore measure within a drinking occasion survey and would therefore be more suited to observational field-based research.

9.3.2 Content analysis of online discussion forums

When deciding on the methodological approach to identify which characteristics should be measured within a drinking occasion survey, I had initially planned to conduct a review of the concepts measured within the literature and provide a narrative synthesis of these findings. However, given that a review mapping the contextual characteristics of drinking occasions measured within the event-level literature had been recently published by colleagues within the Sheffield Alcohol Research Group, producing another review in this area would not have contributed or advanced knowledge in this area. Given that I wanted to explore and identify which characteristics should be measured within a drinking occasion survey, I decided that the second study of the thesis should adopt qualitative methodologies. By using both quantitative and qualitative methodologies within the development of this survey, the thesis was able to take a mixed-method approach to allow for a deeper and broader understanding of phenomenon than what would have been attained by sticking to a single methodology (193,194).

In selecting a qualitative method, focus groups and one-to-one interviews, had previously been used to gain a deeper understanding of how specific contextual characteristics are associated with HDOs (15,16,460). Whilst these methods are useful in explaining how event-level characteristics are related to consumption, studies adopting these methods may experience social desirability, whereby respondents may give researchers an answer they believe to be more socially acceptable than truly representative of their behaviour or experiences (461), thus potentially compromising the validity of the findings. As a result, the types of characteristics elicited from face-to-face interviews may not cover all relevant characteristics of drinking occasions, particularly the heavier drinking occasions.

When deciding on which qualitative method would be best suited to identifying the contextual characteristics of HDOS, one approach identified was online ethnography, a method involving

the usually covert observation of individual's conversations and activity within an online setting (462). In looking at how this method had been used in similar research, previous online ethnographic research on alcohol-related topics had examined the general content of interactions on alcohol-related forums (463), in addition to investigating how such forums can provide a support network for those experiencing addiction (464,465). Reflecting on this, I decided that analysing posts made to online discussion forums would be a useful tool in identifying which characteristics are most mentioned or salient within HDOs. As many forums allow users to post anonymously, I felt that participants may be more honest about potentially sensitive subjects, including HDOs, than in an in-person setting. Additionally, examining existing posts on alcohol discussion forums can provide rich data at no material cost to the researcher or participant.

In identifying forums to use, I had to balance both the relevance of the forum and the ethical implications of using specific websites. Following scoping searches, four websites were identified as suitable for analysis in this study: Mumsnet, Patient Info, Reddit and Soberistas. These websites were identified as suitable as they all had dedicated alcohol consumption forums, large numbers of website users and the format of the websites were similar, in that each discussion thread starts off with an original poster from a member of the online community to which other members can respond.

In relation to ethical considerations, informed consent within this field has been subject to much debate within the literature using online discussion forums. Some authors have argued that if a discussion forum is within the public domain (i.e. that no registration is required to view the post), that there is no need to gain the consent of the research participants (541,542). However, more recently it has been suggested that regardless of the public or private nature of the forums, from an ethical perspective consent should be sought(470). Given that seeking consent from all discussion forum users would be impractical, both Townsend and Wallace (466), and The

British Sociological Association(470) recommend examining the website's terms and conditions to establish who has permission to grant consent for the content to be used. After consulting the terms and conditions for the identified websites, the decision was made to contact the websites. In contacting the websites, we initially contacted Patient Info. However, Patient Info did not reply to the request, and as such posts from their online discussion forums were not used in the study. Whilst I acknowledge that all discussion forums are used within this study were alcohol support forums, and therefore the types of occasions and characteristics captured within this study might be biased towards perceiving excessive alcohol consumption negatively, given the ethical considerations of this study, gaining consent to use posts on other websites such as Facebook or Twitter would have been challenging.

Finally, when initially deciding on the analysis approach within this study, I had planned to use thematic analysis as outlined by Braun and Clarke (543) to identify the most salient contextual characteristics associated with heavy drinking occasions. However, after my confirmation review, it was felt by both myself and my examiners that using content analysis was more suited to this study. Whilst thematic and content analysis are both similar analysis methods, content analysis allows for text to be assessed to quantify and analyse the presence of certain words, themes or concepts within qualitative data (471). Given that we wanted to establish which characteristics were most mentioned, being able to quantify the qualitative analyses was considered more suitable than thematic analysis.

9.3.3 Developing and testing the drinking occasion survey

When developing the context-specific drinking occasion survey, we wanted to take a broad and comprehensive approach given that a critique of the existing event-level literature is that studies only focus on a few contextual characteristics within data collection and analyses (22). An additional critique of the existing drinking occasion literature is the lack of variables selected based on theory (22). Within the literature review of this thesis, I identified a set of theories

which had previously been used within the event-level alcohol research to explore drinking occasions. In trying to advance this field of study, when identifying which characteristics should be measured within this survey, we attempted to map the contextual characteristics identified within the literature and the second study of this thesis onto these theories. When reflecting on this exercise, I became aware that as a retrospective survey had been selected as the data collection technique, some contextual characteristics identified within theory and the literature as important could not be feasibly measured using this technique. As such, our final analysis of the survey was not motivated by theory as we wanted to explore which characteristics were associated based on a broad perspective. As such, there remains an unresolved tension between the value of focusing on components of a single theory compared to achieving comprehensiveness.

When initially defining a drinking occasion within the context specific survey, we made the decision to define an occasion as a period of time with no longer than a two-hour gap between drinks. This definition was conceptualised by Mustonen et al. (37) and has been applied within other studies to conceptualise a drinking occasion (11,37). We made this decision as we felt that asking participants to classify their drinking using this definition would contribute to the literature on how to conceptualise drinking occasions. In practice, this definition was not easily understood by members of the public as was evidenced by feedback from the PPI group within development. This group found the two-hour definition to be both confusing and "too wordy", with individuals feeling it would require a lot of effort from participants to understand this definition which may have induced a higher participant burden. Following feedback from experts and the PPI group, we asked participants to respond to a location-specific survey and applied the two-hour definition ourselves post data collection. Reflecting on this, whilst it is useful to conceptualise a drinking occasion to allow for standardisation across studies on what is meant by an occasion, these findings show it is important to consider how participants define

their own occasions. Recently, research has found that the way in which participants view their drinking occasions has shifted as a result of COVID, with Caluzzi et al. (544) finding through qualitative methods that the COVID-19 pandemic and associated lockdowns altered the routines and responsibilities which we typically define a drinking occasion by. As such, the authors found new drinking patterns which were incongruent with established notions of drinking occasions. Reflecting on this, our work shows that whilst academics may think a definition is conceptually sound (e.g. two hours), from a practical point of view this does not always translate to participants. When creating these definitions of occasions, it is therefore imperative that if we ultimately want participants to report on drinking occasions that we create a definition that makes sense to them.

The work conducted in chapter seven to develop and test the context-specific survey was conducted from May 2020 to February 2021. As such, the COVID-19 pandemic did influence the methodological approach taken within this chapter. Firstly, when deciding on how to seek feedback from the key academic stakeholders of the study (e.g. academics in the field of drinking occasions) we had initially planned to present the drinking occasion concepts at the KBS 2020 conference which was due to take place in person, and to then circulate the survey individually to these academics for feedback at a later stage of development. Due to the COVID-19 pandemic, this conference was cancelled and therefore presenting the concepts in a workshop format to many academics at the same time became unfeasible. Given that circumstances related to the COVID-19 pandemic delayed the development of the survey, we made the decision to circulate the concepts of the drinking occasion survey to drinking occasion experts within the Sheffield Alcohol Research Group, and to then send a version of the developed survey to external experts for comment. Whilst this decision was made based on practicality, it did mean that when seeking feedback instead of gaining a consensus through a

workshop, individual expert feedback was collated by myself and then reviewed which lengthened the development process.

Additionally, the COVID-19 pandemic was problematic in terms of the methodology of the cognitive interviews. As previously outlined, the cognitive interviews occurred whilst parts of the UK were in a Tier 3 lockdown, where on-trade establishments such as pubs and restaurants were not allowed to open. Given that the final study of the thesis was interested in comparing both on- and off-trade occasions, we needed to ensure that characteristics measured were also applicable to on-trade occasions. To test the understanding and appropriateness of questions specific to the on-trade, we asked half of respondents to think back to a time when they would drink in on-trade establishments. As a result, the quantitative data collected as part of this study may have additional biases related to the longer recall period given as some respondents were recalling data from months prior. Given the main purpose of this study was to establish the face validity of the questions and ensure that the format of the survey was user-friendly, we felt that continuing with the cognitive interviews at this time but making changes to the procedure was an appropriate alteration, given that the alternative was collecting no data about on-trade drinking occasions.

Finally, within the systematic review presented in chapter five I found few examples of studies using validated event-level measured to capture drinking motives, with these studies typically using measures adapted or modified versions of the DMQ-R at the day-level (111,495). Whilst it would have been of value to use a validated measure to measure drinking motives within the context-specific survey, creating and validating a measure through psychometric development fell outside of the scope of this thesis. Additionally, considering the timeline constraints by COVID-19, there was not enough time to create and validate measures through psychometric analysis. Given the evidence suggesting that the characteristics of drinking occasions can

explain more variance in consumption than individual levels, I feel that developing validated event-level measures, particularly of drinking motives, is an important next step for this field.

9.3.4 Cross-sectional analysis of heavy drinkers drinking occasions

In recruiting participants for this study, given that the aim of this study was to explore the contextual characteristics associated with HDOs, I decided to recruit heavy drinkers (determined by drinking over the UK low risk drinking guidelines of 14 units per week), with the rationale that heavy drinkers may be more likely than lighter drinkers to have HDOs. In recruiting these participants, I decided to use Prolific Academic, a crowdsourcing website which is used as alternative to MTurk. In comparing Prolific Academic to MTurk, I felt that Prolific Academic was more suited for recruiting participants in this study. Prolific Academic has a larger participants base in the UK than MTurk and Prolific Academic allows participants to be screened on a range of criteria before beginning a study (545). Considering the sample, given the large number of variables entered into the analysis models, we were likely underpowered and therefore should have recruited more participants to strengthen the findings of this study. However, given that I had a limited research and training budget provided during this PhD, sample size was ultimately limited by financial barriers.

Following the development of the survey within the previous chapter, within the survey we decided to include questions on both the purpose for the occasion and the reason for drinking within the occasion. Feedback from the PPI group and cognitive interviews were mixed on these questions, with some feeling they measured distinctly different concepts, with others feeling the questions asked the same things. In trying to provide some consensus on whether both should be asked as separate questions, or if they should combine into one question, the findings from cross-sectional analysis may contribute to this debate. Within off-trade drinking general occasions, both the purpose of the occasion being to alleviate boredom and the purpose of the occasion being from habit were associated with decreases in units consumed per

occasion, whereas the reason for drinking being to alleviate boredom and drinking due to habit were associated with increases in units consumed per occasion. A similar trend was also observed within on-trade HDOs with the characteristic of negative mood, in that the purpose of the occasion was associated with decreases and the reason for drinking was associated with increases in units consumed per occasion. Taken together, these findings may suggest that within the survey the purpose for the occasion and the reason for drinking within the occasion are capturing two different concepts that operate independently. Given that this evidence is preliminary, I recommend that future research uses both qualitative and quantitative methods to explore how the purpose for the occasion and the reason for drinking within the occasion differ.

Given the large number of potential predictors, we had planned to conduct a series of best subset regressions for each research question using the *gvselect* package in Stata. However, when we attempted to run the *gvselect model,* as more predictors were added to the best subsets regression the processing time taken to run exponentially increased past the levels of practicality. Thirteen predictors returned an output within three minutes; however, when entering more than 20 predictors the output did not return after running for two days. As it was impractical to continue to use *gvselect* we identified alternative approaches outlined in the literature on how to reduce the number of predictor variables (530). From the alternative approaches identified I felt conducting univariate analyses with each predictor variable and the dependent variable (total units consumed per occasion), and only including each variable in the regression if the predictors were significant at the $p < 0.025$ level, was the best alternative given the methodological guidance (530). Initially, we had planned to take this approach and then enter each predictor which was significant into the *gvselect* model. However, after conducting univariate regression analyses there were still a large number of predictor variables, and therefore given the issues encountered with *gvselect*, even conducting a best subsets regression

with significant predictor variables at the $p < 0.025$ level would have been infeasible. Given this, we decided to run two models for each research question, with the primary analysis focusing on the subset model. Whilst it would have been beneficial to have reduced the number of predictors through using a best subsets regression, we felt this approach was the best choice in the circumstances.

The evidence from this study shows that measuring a broad range of characteristics is useful, as all contextual groups had characteristics associated with units consumed. The benefit of collecting such a broad range of characteristics is that the data collected using this survey can be used in both larger analyses (such as LCA) and more targeted analyses with fewer variables. Reflecting on the work in this chapter, further consideration and thought is required on how variables should be selected within more targeted analysis, given that *gvselect* took a long time to run for the number of variables.

Finally, whilst using regression analyses in the current study allowed for insight on which variables might be important in predicting units consumed within occasions, selecting this analysis method did mean that we were limited in our exploration of how characteristics interact. This is a limitation of this work given that previous research has found characteristics within drinking occasion to be interlinked (506). Nonetheless, the decision to conduct regression analyses to answer the research question is still justified. Firstly, the majority of studies using event-level methods use regression techniques to analyse data on drinking occasions (29), making the work in this chapter comparable. Secondly, cluster analyses such as latent class analyses are quite data-hungry and therefore require large samples to identify a meaningful and stable set of occasions. Given the practical constraints on budget, it would not have been feasible to recruit enough participants within the final study.

9.4 Changes to method

This section described three major changes to this thesis that were made following confirmation review.

Following feedback from my confirmation review, the final study of my thesis changed. Initially the final study was planned as a longitudinal study looking at how the characteristics of a drinking occasion change as individuals try to reduce their alcohol consumption over a period of six weeks. However, following feedback from the internal examiners we decided that it would be more in keeping with the thesis aim to instead demonstrate that the survey can capture high-quality cross-sectional data before the survey is used in a longitudinal manner.

In the final study of the thesis, the data collection and analysis plans were pre-registered on Open Science Framework. In relation to this pre-registered document, two changes to the analysis approach were made after data collection. Firstly, we had initially planned to conduct analyses on drinking occasion characteristics associated with on-, off-, and mixed trade consumption. However, after data collection there were only 91 mixed trade occasions, which was not considered powered enough to conduct a large statistical analysis. As a result, we separated mixed occasions into their on- and off-trade components and used a dummy variable to denote where this occasion had a mixed trade component. Given the few mixed trade drinking occasions present in the sample, an alternative to using a dummy variable would have been to remove these 91 occasions and analyse the dataset in terms of on- and off-trade only occasions. However, given the high number of independent variables included in both the full and subset models, such analyses would have been underpowered and therefore there would be no analytical advantage. Whilst this is an issue encountered within this thesis, it is not unique to this work with other event-level researchers experiencing issues with classifying and analysing mixed trade occasions, which suggests these need further investigation (546).

Secondly, as we were collecting a large number of predictor variables we had aimed to conduct a best subsets regression in Stata using the *gvselect* function to identify which variables should be entered within each of the regression models. In practice, when we attempted to run the *gvselect model,* as more predictors were added to the best subsets regression, the processing time taken to run exponentially increased past the levels of practicality. Thirteen predictors returned an output within three minutes; however, when entering more than 20 predictors, the output did not return after running for two days. As it was impractical to continue to use *gvselect*, we identified alternative approaches outlined in the literature on how to reduce the number of predictor variables (530).

9.5 Strengths

This thesis developed and tested a novel context-specific drinking occasion survey. Much of the previous research on drinking occasion characteristics within the UK has used data from Kantar Alcovision, a survey designed for market research (11,506). Whilst market research surveys can often recruit large samples, the measures used within them are not always designed based on best academic practices and are driven by different goals. In developing this survey, we took a detailed and iterative process both in considering which characteristics should be measured and how they should be measured. By undertaking a diverse and comprehensive development and testing approach, both academic experts and members of the general public, including those who had lived experiences, were able to provide valuable feedback on the development of the context-specific survey. Involving multiple stakeholders in the design of survey tools is recommended as best practice by survey development experts (480). As such, this survey is perhaps more suitable for use in academic research than market research surveys.

In deciding how data on drinking occasions should be measured, we took a comprehensive approach in reviewing the data collection techniques used in studies within the existing event-

level literature. This comprehensive review covered over 300 studies and allowed the choice of data collection tool to be informed by the methodological suitability of these techniques. In identifying what should be measured within a drinking occasion survey, alongside reviewing the characteristics currently measured in the literature, this thesis used content analysis to identify which characteristics were most mentioned within individual's accounts of their HDOs made to online alcohol support forums. To our knowledge, this study is the first to use online discussion forum posts to identify HDO characteristics. By utilising these posts, we were able to capture naturalistic interactions which demonstrated how individuals experienced HDOs.

In using the newly developed survey to identify which characteristics are associated with units consumed per occasion, we captured a high amount of drinking occasions occurring in the off-trade, and through stratifying our sample by age and sex, we collected information on middle- and older-aged adult's drinking occasions, something which to date has been overlooked within the literature.

In assessing the practical application of the survey within the final study of the thesis, heavy drinkers completed the survey in a mean time of approximately 24 minutes. Furthermore, 93.7% of participants who consented to take part provided data which could be used within the analysis. Within guidance pertaining to the length of web-based surveys, surveys are recommended to take no longer than 20 minutes to complete (508). However, given the level of detail included within this survey, the consideration that heavy drinkers may be likely to have more drinking occasions per week than lighter drinkers, and the low attrition rate within the final study, the broad approach taken to measurement of characteristics within data collection does not appear to be overly burdensome to participants. The work in this thesis was primarily designed to contribute to the methodological literature on event-level alcohol consumption. Given this, we report on the development process of the survey in detail to guide other researchers conducting event-level research, and to avoid the duplication of

research effort within this area. In disseminating the learning from chapter seven, we plan to publish this chapter as a standalone technical report and make it widely available.

9.6 Limitations

9.6.1 Limitations of developing and testing the survey

Whilst the systematic review included a large number of studies, no grey literature searching was undertaken as part of this review. Whilst searching the grey literature is beneficial within systematic reviews, the leading experts within event-level alcohol research were consulted and were unaware of any significant body of grey literature relevant to this review. In conducting this review, papers were identified and screened by a single reviewer. To mitigate this limitation, a colleague independently re-assessed a sub-set of 20 papers to check papers were correctly included. There was no disagreement between reviewers regarding inclusion, indicating good reliability.

In a practical sense, the COVID-19 pandemic put constraints upon both the methodology and timeline of the thesis. Whilst the decision to use a retrospective diary survey was not altered by the pandemic, the decision to conduct both the cognitive interviews and the final survey online was largely dictated by the constraints placed on face-to-face interviewing. In designing and testing the survey on Qualtrics, we had initially planned to test the survey on a range of device types including mobile phones, given the recommendation that surveys are designed for the smallest screen possible with the implication being that if a survey works on a small screen, it will work equally as well on a larger one (510). As cognitive interviews took place remotely, we decided that cognitively testing the context-specific survey on mobile devices would not be feasible. Since the survey may appear differently on a smaller screen, further testing of the context-specific survey is required before it can be administered on mobile devices. Additionally, the approach taken was practically constrained given the time sensitive nature of

a PhD and the impact of COVID-19. Feedback was sought from key stakeholders such as drinking occasion experts and the PPI advisory group in a sequential approach. If this research did not have a strict time limit, then the adoption of a Delphi method, an iterative process whereby multiple rounds of feedback on a survey are provided by stakeholders simultaneously (e.g. academic experts, PPI groups etc), would have been beneficial (511).

Whilst the analysis of data collected via the context-specific survey identified findings important for both policy and research, the findings of both the full and subset model should be interpreted with caution. This is primarily due to the inconsistencies between the full and subset models and the limited number of participants in some analyses compared to the number of predictors entered. When pre-registering the analysis for the final study, we had planned to reduce the number of predictors using a best subsets regression within Stata. However, when analysing the data, as more predictors were added to the best subsets regression, the processing time taken to run exponentially increased past the levels of practicality. Based on methodological guidance, we conducted univariate analyses and only entered variables which were significant with the outcome variable (i.e. total number of units consumed per occasion). Additionally, whilst using regression analyses in the final study allowed for insight on which variables might be important in predicting units consumed within occasions, this analysis method did not allow for exploration of how characteristics may interact or for causal effects to be examined. Given that previous research has found characteristics within drinking occasions to be interlinked (506), future research should adopt methods such as directed acyclic graphs (DAGs) (478) to facilitate thinking about causal pathways between variables, and cluster analyses to elucidate inter-related factors, rather than looking at individual contextual factors in isolation.

9.6.2 Limitations of the final tool

Firstly, whilst the second study of the thesis identified new contextual characteristics, such as drinking to cope with boredom, through content analysis of online discussion forums, greater validation of these characteristics within qualitative research would be beneficial. Secondly, the survey was only administered once cross-sectionally within the thesis on a specific population of heavy drinkers. Whilst this provides insight on drinking occasions at this time point, the survey should be re-administered at different time points throughout the year; firstly, to establish the temporal effect of occasions; and secondly to assess the reliability of measures over time. Finally, within the systematic review presented in chapter five we found few examples of studies using validated event-level measures to capture drinking motives. These studies typically used measures adapted from, or modified versions of, the DMQ-R-SF at the day-level (111,495). As such, drinking motives were not measured in this survey using a validated scale. Whilst it would be of value to use a validated measure of drinking motives within the context-specific survey, creating and validating a measure through psychometric development fell outside of the scope of this thesis. Given the evidence suggesting that the characteristics of drinking occasions can explain more variance in consumption than individual characteristics (21,506), future research should aim to develop validated event-level measures of drinking motivations.

9.7 Recommendations for future research, policy, and practice

9.7.1 Implications for research

Creation of validated event-level measures

The first recommendation for future research arising from the limitations in this thesis is to develop validated measures for use at the event-level. When developing the drinking occasion survey in chapter seven based on the findings of systematic review in chapter five, there were

limited or no examples of validated event-level measures, particularly for event-level drinking motivations. Furthermore, when identifying which characteristics should be measured within the context-specific survey, chapter six identified motivations for drinking which are currently not covered in validated measures, including drinking due to habit and drinking due to boredom. These new motivations were found in a content analysis of posts within alcohol support forums and therefore require further exploration via both quantitative and qualitative methods to establish if these are motives which should be captured within validated measures. In creating quantitative measures, we would recommend that the new motivations identified within this thesis are explored more to establish how they differ psychometrically from the drinking motives within existing validated scales.

Broader populations

The context-specific survey developed in this thesis was influenced by characteristics of HDOs, as these occasions are typically associated with both acute and long-term negative consequences such as injury, road traffic accidents, and alcohol dependency (7,520). Whilst it is still important for future research to capture heavy drinkers and their HDOs, as the findings of this thesis suggest the contextual characteristics of their occasions are associated with units consumed per occasion, future research should explore the suitability of this survey within other populations. A dose-response relationship exists between alcohol and harms, meaning that the more an individual drinks the more likely they are to experience harms from alcohol (519). As such, even drinking within the UK low-risk guidelines may result in negative consequences.

Future research should test the survey on different populations, for example non-heavy drinkers within the general population. In testing the context-specific survey within this population, research should establish two things. Firstly, research should establish whether the

characteristics currently measured in this survey are applicable to non-heavy drinkers. Secondly, if the characteristics currently included are applicable to non-heavy drinker populations, the survey can be used to compare how the characteristics of heavy drinker's occasions differ from those who are not heavy drinkers. Previous research conducted in Canada using national surveys to investigate the role of drinking context within a general population sample found that contextual variables explained the amount of alcohol consumed (547).

A critique of the event-level research to date is the focus on young drinker populations particularly within the US college system (22). This thesis has attempted to progress knowledge in this area by collecting information on middle- and older aged adults drinking occasions, a population who are frequently overlooked in event-level alcohol research. Future research should continue to study these populations within event-level studies, especially as population surveys have found that adults aged 45-64 are the age group who most regularly drink above the UK low-risk weekly guidelines (91).

Theory testing

A critique of the existing drinking occasion literature is the lack of variables selected based on theory (22). In trying to advance this field of study, within chapter seven we attempted to map the contextual characteristics, currently measured within the literature and identified in the second study of this thesis onto theories identified within the literature review of this thesis. Whilst we attempted to map contextual characteristics onto theoretical perspectives currently used within research to conceptualise drinking occasions, in our analysis of the final survey we were not motivated by theory as we wanted to explore which characteristics were associated based on a broad perspective. As such, there remains an unresolved tension between the value of focusing on components of a single theory compared to achieving comprehensiveness. Given that theory can guide the selection of variables, particularly when

a large number of predictors are collected, future research should use and further adapt this survey based on contextual characteristics which are theory driven.

Mixed occasions

In the final study of this thesis, we had initially planned to conduct analyses on mixed-trade occasions as a distinct occasion type. Through typologising UK drinking occasions, Ally et al. (11,99,539) found mixed-trade heavy drinking to be an increasing risk drinking occasion type. However, due to limited mixed-trade occasions within our data we decided to separate mixed occasions into their on- and off-trade components and used a dummy variable to denote where this occasion was part of a mixed trade occasion. Within this thesis, occasions which involved drinking as part of a mixed trade occasion were negatively associated with the number of units consumed within all on-trade occasions. Our findings may therefore suggest that in occasions with a mixed-trade component, more of the units consumed may have been consumed within the off-trade part of the occasion than the on-trade part. Given these findings, we recommend future research examine mixed-trade occasions as a distinct occasion type to establish which contextual characteristics predict consumption.

9.7.2 Implications for policy and practice

The work presented in this thesis was part of a primarily methodological PhD, and as such, we did not expect to generate major policy or practice recommendations. However, the findings from chapters six and eight provide insights which may be useful to policy development. Through our focus on heavy drinkers and their HDOs we identified a range of characteristics associated with increased consumption. Within chapter six of the thesis, consuming wine, drinking within an evening, and at the weekend were found to be some of the most salient characteristics within user-initiated posts of HDOs. Within chapter eight when examining which characteristics were associated with increased and decreased consumption within heavy

drinkers' occasions, when drinking within both on- and off-trade locations, larger serving sizes were associated with increased consumption within each occasion. To date, within the wider literature serving sizes, particularly within the off-trade, have not been studied widely. Studies exploring serving sizes within the off-trade have predominantly focused on wine container and serving size (548), with no studies examining the impact of reducing container size for beer (534)Given this, findings from this thesis may identify targets for policy development in relation to serving size and the sale of container sizes for drinks consumed within off-trade occasions.

In looking at the role of drink type, this thesis found that high strength drinks, particularly beers and ciders, were associated with increased consumption, particularly within off-trade HDOs. This finding is of particular relevance to policy, with high strength alcoholic drinks a target of minimum unit pricing, whereby legislation prevents the sale of alcohol to consumers below a minimum price per unit to discourage the cheap sale of high strength alcohol (535). In comparison, within heavy drinker's general drinking occasions low strength alcoholic drinks were associated with decreases in units consumed per occasion within both trade types. Low strength alcoholic drinks are a rapidly growing market which has expanded within the UK since the early 2010s and are often advertised as an alternative to regular strength alcoholic drinks (536,537). Given this, policy and practice should consider the role of low strength alcoholic drinks in prevention efforts.

10 Conclusions

This thesis has developed and tested a context-specific survey for the quantitative study of drinking occasions. In this thesis, I used novel methods to identify contextual characteristics which should be measured within quantitative research. Whilst no gold-standard data collection approach was found, retrospective drinking diaries were identified as most appropriate for the current research due to good compliance rates and low participant burden. In identifying which characteristics should be measured, *why, where, with whom, when,* and *what* an individual drank were salient within discussions of their heavy drinking occasions. Through an iterative development and testing process, involving feedback from expert and public input, this thesis produced a novel context-specific drinking occasion survey which contained key characteristics relevant to heavy drinking. These characteristics help to explain variation in consumption amongst heavy drinkers. In using this survey, contextual characteristics accounted for significantly more variance in consumption than individual characteristics within heavy drinker's general occasions and their heavy drinking occasions. These findings can inform judgements and best practice recommendations on the contextual characteristics that should be measured within future drinking occasion research and may offer avenues for targeted interventions or inform policy.

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