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Studying individual-level factors relating to changes in alcohol and other drug use, and seeking treatment following Minimum Unit Pricing implementation

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The mission of the MRC/CSO Social and Public Health Sciences Unit is to provide the most robust and timely evidence possible to inform policies to improve public health and reduce inequalities in health.

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Note

Since this report was submitted, the study team has undertaken further analysis which more fully accounts for missing data. The results reported here are based on single imputation, but subsequent analysis has used multiple imputation and pooled the results across models.

The main differences in the models are that there is a clearer trend towards a drop in consumption after MUP for some participants in the multiply imputed data; and less convincing evidence for a rise in other drug use.

This additional analysis and the unimputed data can be found at the public project repository osf.io/ESW4D/.

This report was funded by **Alcohol Change UK**. Alcohol Change UK works to significantly reduce serious alcohol harm in the UK. We create evidence-driven change by working towards five key changes: improved knowledge, better policies and regulation, shifted cultural norms, improved drinking behaviours, and more and better support and treatment.

Find out more at alcoholchange.org.uk.

Opinions and recommendations expressed in this report are those of the authors.

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Background

The harms from alcohol use in Scotland costs around £3.6 billion per year, and alcohol is a major contributor to liver disease, cancer, and premature mortality as well as being associated with wider social harms including antisocial behaviour, violence and child neglect (NHS Health Scotland, 2019). Alcohol related deaths are strongly associated with poverty, with a sevenfold difference in mortality comparing those living in the 10% most and least deprived areas (Giles and Robinson, 2019).

There is evidence that price of alcohol influences population levels of alcohol consumption (Meier et al., 2016). Pricing increases appear equally effective in reducing drinking among the general population and heavier drinkers (Byrnes et al., 2016), and alcohol policy modelling have suggested that the implementation of a minimum price per unit of alcohol (Minimum Unit Price: MUP) would lead to a greater reduction in alcohol related harm for heavier drinkers (Brennan et al., 2016).

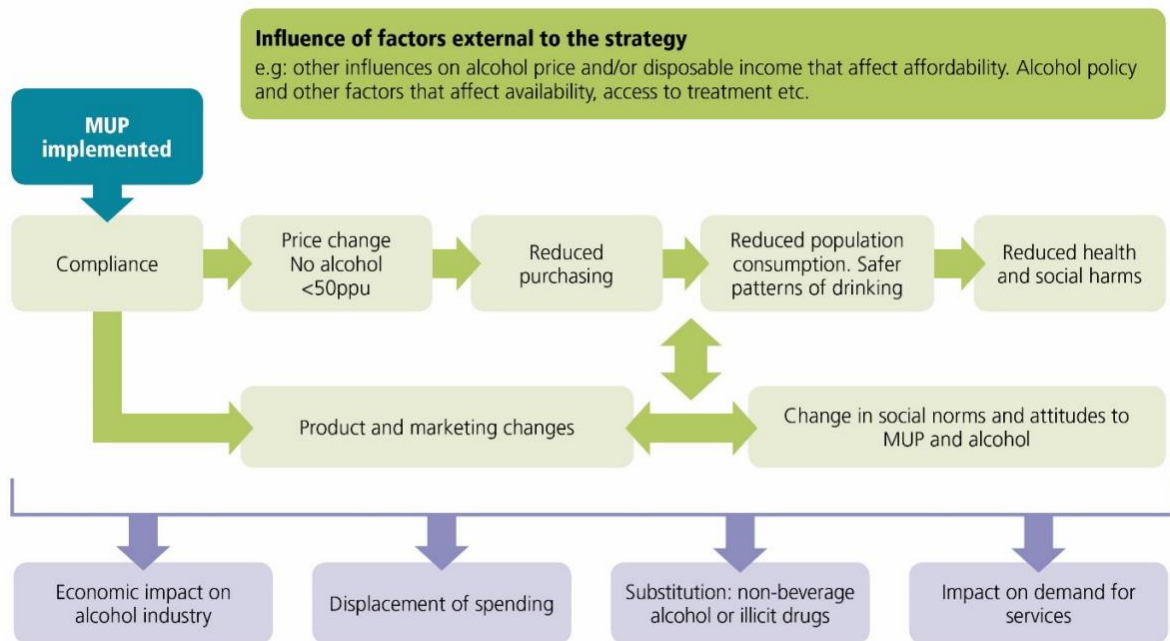
Alcohol policy in Scotland

To address the increasing health burden and widening inequalities around alcohol related harm, the Scottish Government implemented legislation for MUP, meaning that alcohol cannot be sold to the public for less than 50 pence per unit of alcohol. The law came into effect on the 1st of May 2018. The MUP legislation includes a clause meaning that the Scottish Parliament must choose to extend the law, or it will expire six years after being implemented. The decision of Scottish Government will be informed by the scientific evidence of the effect MUP has had on Scotland. NHS Health Scotland is undertaking a formal evaluation on behalf of Scottish Government, and a number of separately funded studies - including this study – will contribute to the wider evaluation of MUP legislation.

Processes underlying the MUP theory of change

A theory of change is a description of the relationships between different events or activities that explain the mechanisms through which a Policy or intervention will plausibly lead to an outcome (Weiss, 1995). This may include both the intended and unintended consequences. *Figure 1* shows the theory of change that NHS Health Scotland has proposed for MUP legislation. The graph shows a causal pathway which leads from the law being implemented, onto sellers complying with the law, leading to a change in price, a subsequent change in purchasing, and then consumption, and then ultimately a change in harms. Additionally, there are changes in how products are marketed, and a change in social attitudes to the MUP policy itself. The lower grey boxes show some of the other potential consequences on MUP, and the upper grey box represents the other factors - besides MUP - that could also influence price, sales, consumption and harm. The light green chain of arrows shows the core path through which MUP should have its desired effect. The Scottish Government-mandated evaluation will assess each of these change points at the population level.

Figure 1: NHS Health Scotland: Theory of change for Minimum Unit Pricing



This theory of change outlines the change processes and that are theorised to occur at the population level. Within Scotland’s population, there is the potential for great heterogeneity, with some individuals contributing to some observed changes and not others. Price change may lead some individuals to substitute to other substances but not others, price change itself may reduce off-trade purchasing for certain individuals, but others – even those drinking at similar levels or with similar sociodemographic characteristics – may not reduce overall their total alcohol purchases. The N of 1 design provides one approach to better understand what leads to heterogeneous responses to MUP.

This project is intended to provide information that complements the many strands of the core evaluation. First, it uses novel methods to provide a richer understanding of the factors that influence individuals’ drinking on a dynamic basis, and how these may be influenced by MUP. This approach falls between a statistical approach looking at trends between population subgroups and between time periods, and a narrative qualitative approach, based on individuals reporting their experiences and perceptions. The N of 1 approach may help identify between individual differences that may be masked using a group-based statistical approach, and which may triangulate information on the idiosyncratic experiences reported qualitatively.

Second, it provides further information around daily changes in consumption, contact with services, and substitution to other substances. This complements the statistical information on wider population trends in these factors.

Third, it provides greater context on the factors that may influence the extent to which MUP influences alcohol, service contact, or drug substitution.

Fourth, the study implemented a participatory approach, where peer researchers with lived experience of substance dependence participated in designing the study and carrying out the fieldwork.

Finally, it will give information on how feasible it is to use this novel study design for policy evaluation, and for community-based research among people affected by dependent substance use.

Approaches to evaluating interventions and policies

The main questions for the MUP evaluation are (Beeston et al., 2019) :

1. To what extent has implementing MUP in Scotland contributed to reducing alcohol-related health and social harms?
2. Are some people and businesses more affected (positively or negatively) than others?

These research questions are being answered well by taking a theory-driven approach to look at the range of ways that MUP contributes to the changes outlined in Figure 1, drawing on traditional evaluation methods based on estimating the magnitude of health effects, as well as a broader range of methods. Below we provide some background to evaluation approaches that don't draw on traditional effect size estimates, and how the N of 1 study relates to these theoretical approaches.

Rather than quantifying an effect and how it varies between groups; realist approaches consider the processes, mechanisms, and contextual features that could influence whether or not an 'effect' occurs. The realist perspective asks "What works, for whom, in what circumstances and why?" (Marchal et al., 2012, Pawson and Tilley, 1997). The additional questions posed by a realist evaluation makes it explicit that: any policy or intervention may not work as planned; and, there are contextual, structural, social, and biological factors that could explain the relative strength, or absence of an effect. Realist evaluation's task is to uncover these contextual features and the range of plausible mechanisms. Having collected data on how individuals experience changes over time, and their social interactions and networks, the N of 1 design can begin to unpick mechanisms relating to within person change, and whether such changes are related to the wider context in which individuals make drinking choices.

Systems approaches to health improvement are becoming more common. Systems thinking pays greater attention to the dynamic nature of health and society, and expresses phenomena of interest as a result of multiple interactions between a diverse range of individuals and organisations. This approach conceptualises an intervention as starting an event within a system (Hawe et al., 2009) which can lead to A.) a change in the system structure in response to the intervention event, and B.) diffusion, amplification, or negation of further events taking place. These diffusion, amplification or negation processes ultimately explain whether the intervention produces different outcomes. The systems approach aligns with the realist focus on explanatory mechanisms but does so within a framework that pays greater attention to the interplay of structure and agency among a diverse range of intervention-implementing and intervention-affected agents (Porter, 2015).

Systems methods provide formal approaches for characterising diverse views and perspectives, as opposed to the realist approach which is grounded first in the intervention as initially theorised, and second in the research evidence and the updated theory. The N of 1 design allows us to look at dynamic changes in how

individuals experience their social worlds, and the variety of ways in which this may influence alcohol use. Within the context of the MUP evaluation, the N of 1 design can help explore the variety of individual responses to their environment which give rise to the observed aggregate trends at the population level that are the focus of the quantitative studies in the MUP evaluation portfolio.

This study aims to provide information that can shed greater insight into the nature of the system in which the MUP policy has taken place, by particularly focussing on the different processes which may affect individual choices around alcohol use, substitution to other drugs, and contacting treatment services.

N of 1 methodology

The N of 1 design facilitates ‘precision’ behaviour change studies (Johnston and Johnston, 2013, McDonald et al., 2017). It examines within-person variability over time by repeatedly measuring a set of factors within the same individual. This approach contrasts with traditional statistical approaches which aim to ascertain between group differences, over and above any between-person variability. The approach has been used to understand biological responses to changing treatment regimens (Davidson et al., 2014b), and to look more closely at behavioural theory (Hobbs et al., 2013). At its core, the N of 1 approach is a case study of the factors that explain trajectories of change in one individual. This in-depth level of analysis provides a method to understand social and behavioural mechanisms, which can plausibly account for the overall trends that can be seen in statistical comparisons at the population level, or within personal accounts of their lived experiences.

As the name implies, the analytical approach focuses on individuals, rather than comparisons across a sample (although data can be aggregated using methods such as multilevel modelling). Every individual may have a unique set of predispositions, social and environmental context, and thresholds at which they will enact certain behaviours. While a traditional sample-based approach searches for regularities averaged over the population of interest, an N of 1 design, run in parallel across several individuals, gives information about the nature and extent of differences between individuals. Such an approach can provide rich additional information for evaluation from a range of perspectives. Within an evaluation setting, it gives information about the breadth of plausible causal mechanisms that underpin a theory of change. Within a realist paradigm, N of 1 can describe a range of context-mechanism-outcome configurations that explain when change does or does not occur. From a systems perspective, it can give insight into the diversity of agent behaviours - and their dynamics – that may underpin change within the system and that may interact with system structure.

A key feature of our use of the N of 1 approach is to explore the diversity of mechanisms of change relating to alcohol use, rather than attribution of an impact. While N of 1 can be used as an evaluative study design, this is better suited to

treatment regimens where treatment can be provided and withdrawn, and effects observed over a short time period, for example, switching between drug and placebo in ABAB format (e.g. One day taking the placebo, next day switching treatment to the drug, and the following day switching to taking the drug again etc.). In this study, we have implemented the N of 1 as an observational design looking at change mechanisms within the context of an AB change in the policy environment (one time period without the Policy, and next time period with the policy, but no switch back to previous period without a policy).

There are a number of within-person change mechanisms which would align with the proposed theory of change through which MUP reduces alcohol harms:

- a.) Reduced consumption each day
 - The increased price means that an individual chooses to buy fewer units each time they shop for alcohol, which reduces unit consumption on that day.
- b.) Shorter drinking periods or 'benders'
 - A 'bender' is the colloquial term for drinking continuously for several days. During the development of the study, the peer research team advised that benders could start with high price alcohol (e.g., on sales alcohol in a pub or club) and then switch to cheaper alcohol over the subsequent days until the drinkers run out of money. A higher price for previously cheaper alcohol could shorten the period of the bender, as money would run out more quickly.
- c.) Increased motivation
 - Saving money is one motivating factor to reduce alcohol use (Marlatt and Donovan, 2005). The knowledge that the cheapest alcohol has a higher price could thus provide a stronger motivation for those wishing to control or reduce their drinking.

Additionally, the approach also provides insight into the diversity of processes, mechanisms and behaviour that may underlie population averages or overall effect sizes; and may give some insight into typologies or regularities in within-person change processes.

While the N of 1 approach is promising for systems style evaluations, there are important considerations for using the method (Kwasnicka et al., 2019). Firstly, it is a time-intensive method with a high participant burden as it requires continued repetitive frequent engagement with the study. Secondly, it heightens participants' awareness of the issues being studied as the daily assessment acts as a reminder of the issues being assessed (Wray et al., 2014). In the context of MUP, we must also consider the fact that traditional quantitative social surveys tend to have poor reach to marginalised groups, including those drinking at harmful levels. It is thus important to ascertain the extent to which an N of 1 design has similar response rate difficulties, and whether it is possible to mitigate against these difficulties.

Participatory methodology

The primary design of the study was to use an N of 1 approach to contribute to the evaluation of MUP; but the project also incorporated approaches from participatory methods (Livingston and Perkins, 2018) with the Scottish Drugs Forum peer research team. This approach was justified for several reasons.

Firstly, including peer researchers in the study from the beginning provides the best opportunity to equalise the power imbalance between conducting an evaluation of a government policy on alcohol, and meaningfully representing the voice of those affected by alcohol dependence in how research is conducted, within the constraints on the topic and methodology of this element of evaluation.

Secondly, participant involvement provides the best opportunity to sense check, pilot, and revise study materials for research, which is of particular importance for an N of 1 study of a specific policy, where pre-existing survey items may not be available nor appropriate.

Thirdly, involving peer researchers throughout the study helped build greater trust and respect between the study respondents and the research team. This approach helps to overcome barriers to participation which scientific researchers would face when attempting to recruit marginalised groups into a study which has as high a respondent burden as an N of 1 study.

Aims and research questions

In this study, we applied an N of 1 design to understand the determinants of stopping, switching, and seeking treatment. That is, what are the factors associated with change in alcohol use, change in the use of other drugs, and change in seeking treatment or support for alcohol dependence? The use of the N of 1 method serves as a complementary approach to better understand MUP as a policy intervention and the processes that may explain MUP's influence on health.

Research question 1: What are the individual and social determinants of within-person change in:

- A. Alcohol use
- B. Other drug use
- C. Contacting treatment and support services

Research question 2: What contextual and environmental factors are related to research question 1 outcomes:

- A. Minimum Unit Pricing implementation
- B. Social networks and social support

Research question 3: How feasible is an N of 1 study design to conduct research with participants who are heavy alcohol users?

Methods

This study took a mixed methods approach to collecting information for each N of 1 case. This included smartphone-administered daily surveys, an egonet qualitative interview (Chamberlain, 2006) and ecological momentary assessment data prompted interview (Kwasnicka et al., 2015). Participants were also given the option to take photographs of their experiences of alcohol use and recovery through photovoice activities (Wang and Burris, 1997). While some participants engaged with the photographic element, only a single respondent attended a follow up photovoice workshop so we opted not to publish or disseminate the photographs without the photographer's participation. We also used a delphi workshop and peer feedback to develop the survey questions and study materials.

Survey design

Many scales and measures have been developed which provide robust and valid measures for deployment in large samples. Psychometric scales are designed so that responses to multiple items can be used to ascertain the value of an underlying latent trait, or a set of items used to compute scores that indicate the likely presence of 'caseness' or a certain health risk categorisation. As well as the validity of these measures for identifying their target characteristics, they are often developed to

provide test-retest reliability – that is, the property of providing the same output when administered at different time points.

Within an N of 1 design, the aims of the study differ substantially, and hence the format of questions differs from existing question batteries and survey items. N of 1 explores dynamic changes over time; rather than aiming to determine stable ‘caseness’. As such, questions for an N of 1 should aim to capture within person variability on factors that are directly related to the aims of the study. We utilised a modified delphi method to develop the questions for the study. Details of the delphi project appear in the appendix.

Additionally, the delphi workshop group provided feedback on the content of questions for a baseline survey. The baseline survey format focussed on quick to administer demographics and social wellbeing measures, as well as questions asked upon entry to substance use treatment that allowed comparison with the national Drug Misuse Database.

Final questions

Table 1, Table 2, and

Table 3 show the final questions included in the survey, the conceptual domain they relate to, and the format in which the questions were answered.

Table 1: Behavioural concept, question and answer formats for survey; motives, resources and regulation

Concept	Question	Answer format
Resources	Over the last 24 hours, how would you rate your mood ?	0 - Very down, 100 – Very happy
Resources	Over the last 24 hours, how stressed did you feel?	0 – Not at all, 100 – Very stressed
Resources	Have you experienced withdrawal?	Yes/No
Resources	How would you rate your withdrawal symptoms?	0 – Very mild, 100 - Severe
Motives	How do you feel about your drinking over the last 24 hours ?	0 – Very negative, 100 – Very positive
Motives	How motivated did you feel to reduce or stop drinking, or stay stopped?	0 - Not at all, 100 – Very
Regulation	How tempted were you to have a drink?	0 - Not at all, 100 – Very
Motives	How much have you tried to reduce or stop drinking, or stay stopped ?	0 - Not at all, 100 – a lot

Table 2: Behavioural concept, question and answer formats for survey; environmental factors

Concept	Question	Answer format
Environment	Over the last 24 hours, have you met up with?	Friends Family/Partners/Children Professional Workers Support group peers Others
Environment	How did you get on with [Friends/ Family / Professionals / Support group / Others] over the last 24 hours?	0 - Very negative, 100 - Very positive
Environment	How much did money influence the amount you drank?	0 – Not at all, 100 – A lot
Environment	How much did money influence the type of alcohol you drank?	0 - Not at all, 100 – A lot
Environment	How much of the time were you in situations where alcohol was available to you?	0 – Not at all, 100 – All the time
Environment	How did money influence how much of the drug you used?	0 - Not at all, 100 - A lot
Environment	How did money influence the type of drugs you used?	0 - Not at all, 100 - a lot
Environment	Did you get any help or support from AA / mutual aid over the last 24 hours?	0 – Not at all, 100 – spent almost all day

Table 3: Behavioural concept, question and answer formats for survey part 3

Concept	Question	Answer format
Outcome	Did you have an alcoholic drink in the last 24 hours?	Yes/No
Outcome	Where did you drink?	At home In pub/club/restaurant Someone's house Outdoors Other (Write in)
Outcome	Did you drink:	Beer, Cider, Spirits, Wine Other
Outcome	How much did you drink?	<u>If drank in pub/club restaurant</u> Pints beer Pints cider Measures Spirits Glasses Wine <u>If drank in other places</u> Cans Beer Litres Cider (Half) bottles spirits Bottles Wine Other
Outcome	Did you take drugs or other mood-altering substances in the last 23 hours?	Yes / No
Outcome	If yes, did you take:	Cannabis Cocaine Ecstasy Solvents / Gases Valium / Diazepam / other downers Speed Heroin Methadone Suboxone/Subutex Pregabalin/Gabapentin Other [Write in]
Outcome	How would you describe your use of *drug name* over the last 24 hours?	0 – A bit, 100 – A lot
Outcome	Did you get any help or support from drug & alcohol services?	0 – Not at all, 100 – spent almost all day
Outcome	Did you seek help from drug & alcohol services in the last 24 hours?	Yes /No
Open response format	Please tell us about anything that affected how you were feeling, or that had an impact on your drinking that we haven't asked about	Open text – question always appeared as last and was not randomised

The answer format for the drink questions were “half-bottle”, and then whole numbers up until “ten or more”. This mean that, for respondents who drank more than ten cans of beer in a day, the calculation of their total alcohol consumption was an underestimate of the true amount.

Fieldwork and recruitment

While not entirely adopting participatory action research principles around the initial choice of study topic and research design, we have drawn on the philosophy of participatory methods throughout the study development, funding application and conduct of the study. Throughout this report, we refer to *participants* as the peer research team who participated in the design and conduct of the study, and *respondents* as those who were recruited by the participating peer researchers and who provided data for analysis. The Scottish Drugs Forum (SDF: www.sdf.org.uk) trains and manages a peer researcher team. SDF peer researchers have lived experience of alcohol and other drug dependence, and undertake training in research skills such as recruitment, obtaining informed consent, and administering interviews. The SDF peer team undertook an induction session in administering the study materials, including obtaining consent, explaining how to operate the smartphone and complete the daily survey, maintaining contact throughout the study, safeguarding and signposting, and conducting egonet interviews.

Participants were recruited via the peer team's contacts within their local communities. These were partly drug and alcohol using communities, and also people in contact with treatment services, mutual aid or recovery groups.

Recruiters explained the purpose of the study, the voluntary nature of participation, and explained that respondents would receive daily texts with a link to complete an online survey. Those agreeing to take part completed a baseline survey, and given a demonstration of the online survey. Respondents were offered a smartphone pre-loaded with sufficient data to complete the online surveys if they did not have a smartphone or did not wish to use their own phone.

Inclusion and exclusion criteria

The peer team identified potential respondents who self-identified as heavy drinkers (defined as drinking alcohol at a level that is likely to be harmful to health and wellbeing); or who identified as having stopped or cut down (this included people who perceived themselves as "in recovery", those who were abstinent, and those who were controlling their drinking). We avoided the use of terminology around addiction or recovery as they were viewed as terms with political or social connotations in the communities where the fieldwork took place. Respondents were not recruited if the peer team perceived them as being too intoxicated to provide informed consent, or if literacy and language difficulties would prevent them from participating in the study.

Recruitment site

Recruitment took place from rural areas and intermediate sized towns in an area in the East of Scotland that was not a recruitment site for any of the other research projects studying Minimum Unit Pricing. No information on location was used in analysis.

Participant contact and support

The peer team made regular contact with respondents during the 12 weeks of the daily surveys, contacting them via text or face to face at least weekly. This regular contact involved some signposting to support services, facilitating early withdrawal from the study and the return of study equipment, and providing practical support on using the phones. Two respondents who had hand mobility difficulties and found the phones difficult to use were also supported by the peer team to complete the daily surveys on paper – this information is analysed below, due to missing printed pages, alcohol use data was incomplete for some of these respondents.

Baseline recruitment survey

The baseline survey collected information on gender, age, alcohol and other drug use history using the same survey format as the Drug Misuse Database (available from isdscotland.org) administered in treatment services, this was based on the suggestion of the peer team as the question format would be familiar to those who had ever been in contact with treatment services, and some brief information on the extent of contact with family, friends, and the Social outcomes index (SIX) scale (Priebe et al., 2008).

Daily survey data collection

Respondents received daily surveys sent directly to their mobile phone or to the mobile phone that they received from the research team to use in this study. All surveys were set to be delivered daily for 12 weeks at 7pm each day (time-based assessments). Respondents received the same survey each day with questions randomised within each block (as per Tables 3-5) and with comment box at the end of each survey asking them to add any contextual information that was not captured through quantitative questions. The questions were designed to capture information relevant to the last 24 hours, e.g., amount and type of alcohol consumed. We used built-in question logics to shorten the surveys, e.g., only respondents reporting use of other substances were prompted to describe type of other substance used. The survey data was set up in Qualtrics (Qualtrics LLC, Utah, USA) with each participant set-up as a separate database and delivered through automated text messages with embedded survey link sent daily. The frequent survey data collection method in the literature is also called Ecological Momentary Assessment (EMA) (Shiffman et al., 2008). It holds promise for substance use research as it captures data patterns and trajectories better than retrospective questionnaires (Shiffman, 2009).

Face to face interview

After all respondents had completed the smartphone survey element of the study, respondents were invited to take part in a face to face interview with a peer researcher. This interview involved completing an egonet social network component (Chamberlain, 2006), and a data prompted interview component (Kwasnicka et al., 2015). At the peer researcher training session, we discovered that the majority of the peer research team were not confident in interpreting and explaining the summaries of quantitative data, so these were not used uniformly in the interviews. The proposed process for the data prompted interview as per protocol is described below. The beginning of the interview asked respondents if there had been any change in their

alcohol, other drug, or service use status since taking part in the phone survey and then proceeded onto the next stage(s) below.

Data prompted interview

Respondents were to be presented with a summary of the preliminary analysis of their quantitative data and their opinions about this would be discussed as part of the interview. The interview prompts were: a visual network of variables, with significant partial correlations depicted as connecting lines (see Figure 2); and a text summary (see Figure 3) of the significant correlations.

Figure 2: Sample variable plot for data prompted interview

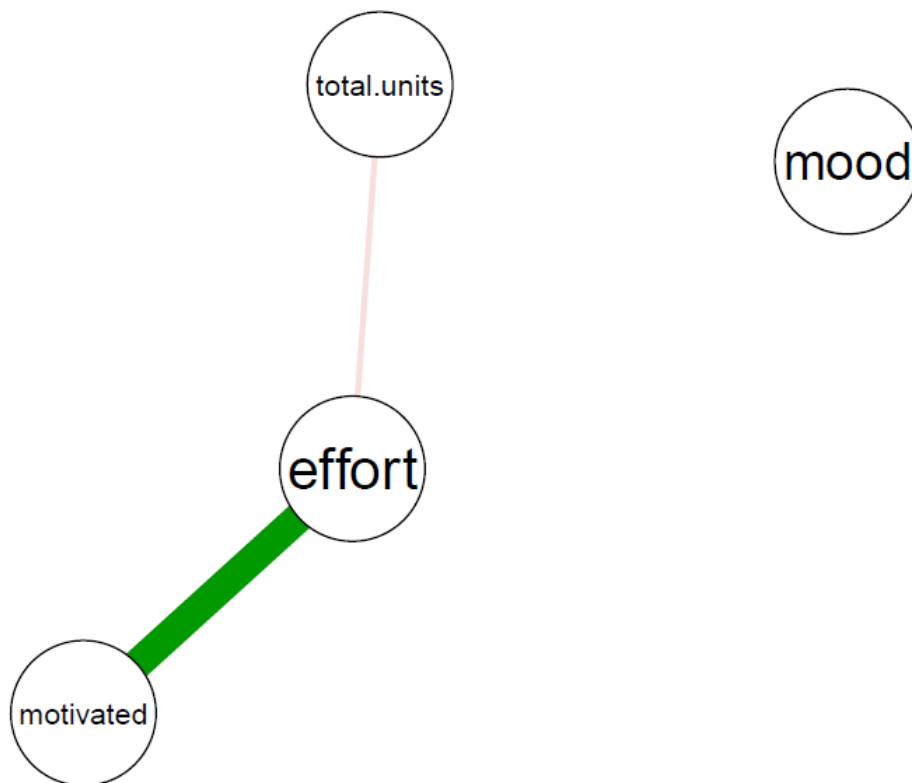


Figure 3: Sample text summary for data prompted interview (same data as Figure 2)



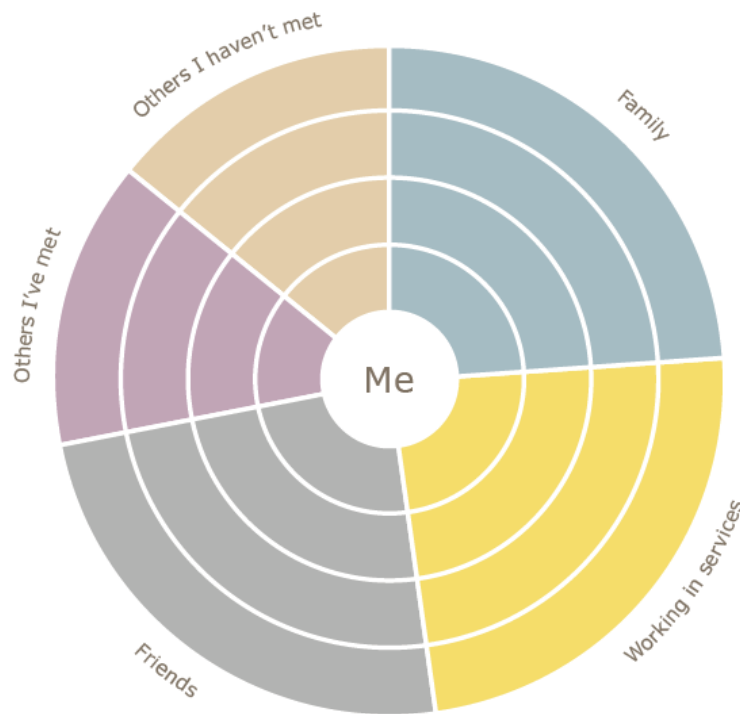
Social network data collection

Respondents were invited to complete an egonet interview: a semi structured drawing task to collect information about people in their lives during the time they took part in the study. In social network analysis terminology, the participant who is providing information is referred to as 'ego', and others that they have social connections with (about whom they provide information during the interview) are referred to as 'alters'. The egonet interview involves guiding the respondents through the four tasks: 1. name generator – creating a list of names of people in the respondent's social network; 2. name interpreter, assessing the characteristics and qualities of the ego-alter relationship; 3. alter attributes – characteristics about the alters; and 4. alter-alter ties, determining whether or not alters are connected.

Figure 4 below shows the visual prompt that was used for the interview. At the start of the interview, respondents were asked to list the names of people they had met during the time they were taking part in the study (task 1). The approach used an interaction-based name generator (who they had recently interacted with), but also integrated a position-generator approach (Bidart and Charbonneau, 2011) by using segments to identify people in different social positions, and information on those that may be important to the respondent but the respondent may not have interacted with recently. The interviewer prompted by each segment of the circle to generate a list of alters in each area where appropriate (task 2), the names were written on post it notes along with information about the alters' gender, age, alcohol, other drug use, and substance treatment service use status (task 3). Interviewers asked respondents to place the named individuals on the diagram, with the alters that the respondent felt closest to in

the centre, and others further away from the centre according to how close they were (task 2).

Figure 4: Egonet diagram used during interviews



The names or initials of the alters were drawn on the page with a circle around them. Then, respondents drew lines to connect circles if the individuals knew each other with the prompt “if they passed each other in the street, would they stop and talk to each other?” (task 4). Asking about these alter-alter ties provides information on social structure beyond simply the amount of social contact an individual has, and provides the opportunity to analyse the structure of social groups (Crossley et al., 2015). For example, having five social who all know each other is a very different social context than having five social contacts who do not interact at all. Having fully connected social groups may act as a social constraint on the respondent, as this social group may share information, ideas and opinions about the respondent; by comparison, having five social contacts who don't know each other may be less constraining, as interactions with one of these contacts is entirely independent of the others.

Finally, respondents were given different coloured pens and asked to circle individuals with red or blue according to the level of support they received. “*Thinking about staying in good health, feeling good, or using alcohol and drugs: draw circles around people that made things easier (in blue) or made things harder (in red)*” (task 4). This compound question accounted for the fact that a currently drinking respondents may have influences on their substance use, while those that had stopped drinking would have influences on how they were feeling about their substance use, but not substance use itself.

At each stage of the interview, interviewers prompted discussion of their choices, e.g., why was this person placed as close / very close /distant? Why were they a positive influence or negative influence? How did the respondent know the alter? How did these two alters know each other? This led respondents to provide a detailed account of the nature of the social relationships and how they perceived others in their surroundings.

At the end of the interview, respondents were asked if they had heard about the change in alcohol Minimum Unit Price, and whether this had affected their drinking. Interviews were transcribed verbatim and coded using NVivo. The egonet drawings were transcribed using Vennmaker software according to a transcription protocol developed by the research team (MA & MMcC). The transcription process also involved listening to the audio recording of the egonet interview and modifying the digital egonet data where appropriate, for example – one respondent had used red pen to indicated positive rather than negative alters, so this was changed in the transcribed data.

Analysis

The daily survey database

The daily survey study covered 1,514 person-days in total (Two people, taking part in a survey for ten days each, gives twenty person-days). While this was the total period that the study covered, respondents didn't complete the survey on every single day. After removing missing days, the total number of records in the database was 668 (44% response rate). The descriptive statistics and multilevel model (linear and logistic mixed models) analyses used the complete case database with 668 records. Missing values were imputed for the data from respondents with moderate (50%) or high (60%) quality data according to response rate (see Table 6) and used for correlation plots.

Descriptive statistics

We computed the mean and median values of variables over time for each participant to show their average levels on the variables and computed the standard deviation and percentage of responses falling one standard deviation above or below the mean to show the distribution and tendency towards extreme values.

Analysis and treatment of missing data

Respondents with a high proportion (over 60%) of responses were deemed to have high quality data for further quantitative analysis. Firstly, we looked at the patterns of missingness, to determine if there were patterns of missing data that could influence the findings, for example, consistently missing out the weekends but answering during the week could suggest that weekend drinking at elevated levels was being missed in the data set. Next, we considered duration of missing data, someone who missed one

or two days in a row provides a better picture of trends over time than someone who misses twenty days in a row.

The autocorrelation of missingness suggested there was a high autocorrelation at a 1-day lag, and in most cases, no significant autocorrelation at longer lags for those respondents with high data quality. This meant that missing one day was highly predicted by missing the day before, but not predicted by the week before, this gave us confidence that using the data in analysis would not be overly biased by missing key time periods.

The duration of missingness was low, predominantly missing for only one or two days at a time, with single occasions of missing up to 11 days for some respondents, and one participant missing 28 days. This is a key shortcoming of the analysis, as we cannot ascertain whether there were major differences in behaviour during the missing occasions, such as a lapse into heavy drinking for those who had reported no drinking or controlled drinking on other days. The participant with an occasion of 28 days missing also had long missing occasions of 17, 14 and 8 days, and a significant autocorrelation at lag 7, suggesting weekly trends.

To account for missing data, we used the “Amelia 2” procedure (Honaker et al., 2011) to impute missing data in the time series for those respondents that took part. Imputation models were conducted separately for each participant, with lag and lead at one day for all variables used in the imputation models. In effect, this approach imputes missing observations to fill in the trend line between two observations, while also accounting for the influence of other variables to increase or decrease the trend over time. This approach cannot account for the fact that drinking patterns may have been higher on the missing days, and this could introduce bias in the results and reduce the power to detect relationships between variables. We conducted imputation only for those providing moderate (over 50% completion) or good (over 60% completion) quality data.

Visual analysis

We produced plots of the responses over calendar time for each variable, this provides a useful description of the temporal trends in responses that cannot be easily represented in summary statistics. The visual plots appear in the appendix.

Influence of MUP on outcomes

In conventional multiple regression models the observations are assumed to be independent of each other. In a N of 1 study, subjects are observed over a varied length of time and as a result the assumption of independence would not be valid, a survey response on one day may be dependent on what the participant reported the previous day. The linear mixed effect models (LME) are commonly used for longitudinal observations which considers the grouping of each subject's observations. The LME models reported here estimate reported alcohol units, drug use (yes or no on the reported day) and seeking help or treatment (yes or no), and how these variables relate to other variables answered in the survey. Observations on each day are considered level 1, and respondent at level 2. The LME models account for between-respondent variability in the outcomes. An additional binary variable indicating the introduction of MUP was added to the independent variables. The coefficient of this variable shows the effect of MUP on the outcome variables.

Social network analysis

We calculated quantitative measures from the egonet diagrams, and we assessed the extent to which these varied according to baseline drinking status. We used t-tests to determine if drinking and non-drinking samples varied according to:

- Number of alters (people they reported being in contact with during the study)
- Proportion of positive alters
- Proportion of alters drinking a lot
- Proportion of alters using drugs
- Total alter closeness (how many alters, weighted by perceived closeness)
- Ego constraint (extent of potentially limiting social contact due to alter-alter ties)
- Index of qualitative variation by segment (diversity of type of alters mentioned)

We had planned to conduct an exploratory analysis to assess if there were any associations between the connectedness of factors in the EMA daily surveys, and the level of connectedness in the egonets, but there was too little overlap in respondents providing good quality EMA data and also completing the egonet interview, so this analysis is not reported.

Data prompted interview

The initial interview plan involved a data prompted interview component. Respondents would be presented with a summary of the preliminary analysis of their quantitative data and their opinions about this would be discussed as part of the interview. The interview prompts were: a visual network of variables, with significant partial correlations depicted as connecting lines; and a text summary of the significant correlations. After the initial training session, the peer research team were not

confident in interpreting the visual or the text summaries of data analysis, so these were not used during the interviews.

Qualitative data management and analysis

All interviews were audio recorded and transcribed verbatim by professional transcribers, interviews had a mean duration of 34 minutes, varying between 20 and 62 minutes. All respondents were given numbers and pseudonyms to ensure their anonymity. We used Nvivo software (QSR International Pty Ltd.) to facilitate data storage retrieval, coding and analysis.

During the process of data familiarisation, initial thoughts were noted focusing mainly on what respondents said about their alcohol use; how they described their social networks. Each transcript was read repeatedly by the coding team (AOG, MMcC and MA) and the main themes identified deductively (based on the research objectives) and inductively (based on themes that emerged during analyses). Meaning we used our pre-defined framework and allowed for framework flexibility as new themes emerged. We followed the main steps of framework approach in data analysis: familiarisation, identifying a thematic framework, indexing, charting, mapping and interpretation (Gale et al., 2013). All three coders met to read a sample of transcripts to verify key overarching themes: maintenance motives, self-regulation, psychological resources, temptation and habit, environmental and social influences, and MUP and the cost of alcohol. Additional themes emerged relating to peer and service support, family, the experience and impact of stress, motivations, coping strategies. Codes were agreed and entered into NVivo. All coders coded a sample of the transcripts and outputs from these broad codes were read and discussed by all coders. AOG coded the remaining transcripts.

Once the transcripts were coded in line with the aforementioned themes, the content within each theme was analysed by AOG and emerging themes across and within cases noted - see overall thematic analysis below. Nvivo software was used to import the content within each theme into framework matrices to review each theme in each participant and to review themes separately. Raw data in the form of direct quotations were highlighted in the matrices to review the context. This iterative process enabled inspection of the data and identification of consistencies across the themes and individuals. We were also able to inspect any atypical cases that were inconsistent with the accounts given by the majority of respondents in each of the themes. We were able to interrogate data across each of the themes referring back to the original transcripts. Following 'mapping and interpretation' phase, we interpreted the data in relation to the wider theoretical themes. As all respondents reported seeking to stop/control their drinking we were unable to make systematic comparisons between the accounts of respondents who were drinking versus those who were not drinking in relation to each theme. The study reporting adhered to the Consolidated Criteria for Reporting Qualitative Research guidelines (Tong et al., 2007).

Results

Descriptive statistics

In total 25 respondents took part in the study across three 12-week waves; 11 in the 1st wave (pre-implementation, but two participants chose to continue for longer than 12 weeks), 11 in the 2nd wave (pre and post implementation) and 3 in the 3rd wave (post implementation).

On average each participant was in the Ecological Momentary Assessment (EMA) study for 64 days ($SD=42$; $Median=59$); and on average each participant provided responses on 27 days ($SD=26$; $Median=21$); the total response rate for the full participating sample of 48%¹ ($SD=23$; $Median=51$). All study respondents were sent the same questionnaire daily that asked about their experiences in the last 24 hours, and an open text question for respondents to report any other information.

¹ *Nb. The mean of the average participation rate for each participant (48%) differs from the total response rate for the whole sample (44%). The response rate of someone taking part for 60 days affects the sample response rate more than that of someone taking part for 10 days.

Table 4: Characteristics of respondents at baseline recruitment

<i>ID</i>	<i>Gender</i>	<i>Age</i>	<i>Other substances</i>	<i>Stopped or controlling alcohol use</i>	<i>Employment status</i>	<i>Accommodation status (Independent, supported, homeless)</i>	<i>Living alone</i>	<i>Recent social contact</i>	<i>Social Outcomes Index</i>
1002	Male	46-50	Co-codamol	Yes	Not working	Independent	Yes	No	3
1003	Male	46-50			Employed	Independent		Yes	5
1004	Female	55-60		Yes	Employed	Independent			4
1005	Female	50-55	Cannabis		Not working	Independent	Yes	Yes	4
1006	Male	36-40		Yes	Employed	Independent	Yes	Yes	6
1007	Female	40-45	Cannabis	Yes	Not working	Independent	Yes	Yes	4
1008	Female	55-59	Alcohol	Yes	Not working	Independent	Yes		3
1009	Other	50-55	Alcohol	Yes	Not working	Independent	Yes	Yes	4
1011	Male	40-45	Alcohol	Yes	Not working	Independent	Yes	Yes	4
1012	Female	46-50	Alcohol	Yes	Volunteer	Independent	Yes		4
1013	Male	50-55	Alcohol	Yes	Volunteer	Independent	Yes	Yes	5
2001	Male	56-60			Not working	Homeless	Yes	Yes	2
2003	Female	60-65	Alcohol	Yes	Not working	Independent		Yes	3
2004	Male	66-70			Not working	Independent		Yes	3
2005	Male	36-40		Yes	Employed	Independent	Yes	Yes	6
2006	Male	50-55		Yes	Employed	Independent	Yes	Yes	6
2007	Male	60-65		Yes	Not working	Independent	Yes	Yes	4
2008	Female	40-45	Valium		Not working	Independent		Yes	3
2009	Male	36-40	Heroin		Not working	Independent			2
2010	Male	25-30			Not working	Homeless	Yes	Yes	2
2011	Male	60-65	Dihydrocodeine	Yes	Not working	Independent	Yes	Yes	4
2017	Female	40-45		Yes	Not working	Independent	Yes	Yes	4
3003	Male	30-35		Yes	Not working	Independent	Yes	Yes	4
3006	Male	30-35			Not working	Independent		Yes	3
3007	Male	16-20			Not working	Independent		Yes	3

Table 5 summarises means and standard deviations for the outcome measures assessed in the EMA surveys. For the respondents with low response rates the numbers should be treated with caution and as indicative only, because they are averaged across relatively low number of assessment points. Descriptive tables for other variables appear in the appendix.

Table 5: Number of responses and descriptive statistics for daily survey measures part 4: Outcome measures

ID	N	Alcohol units Mean*	Alcohol units sd	Alcohol units Median	Alcohol units %missing	Taking drugs %missing	% days taking drugs	Seeking help %missing	% of times Seeking help	Drinking %missing	% of days drinking
1002	109	1	7	0	0	0	99	11	33	0	1
1003	4	8	10	6	0	0	25	25	0	0	50
1004	45	0	3	0	0	2	0	9	29	0	2
1005	36	2	6	0	0	3	100	17	13	0	28
1006	22	7	10	0	0	0	0	5	0	0	36
1007	21	5	6	0	0	0	33	0	10	0	38
1008	2	5	7	5	0	0	0	0	0	0	50
1009	25	18	14	19	0	4	8	16	19	0	68
1011	3	8	14	0	0	0	100	33	0	0	33
1012	39	22	8	20	0	0	0	3	18	0	100
1013	8	42	22	36	0	0	12	12	29	0	100
2001	58	5	10	0	0	0	0	5	0	0	22
2003	3	6	6	10	0	33	50	33	0	0	67
2004	43	14	13	15	0	2	0	16	0	0	70
2005	33	14	10	20	0	0	48	3	0	0	70
2006	80	0	3	0	0	1	0	18	24	0	2
2007	7	5	6	0	0	14	0	14	33	0	43
2008	4	0	0	0	0	0	25	0	0	0	0
2009	6	2	4	0	0	0	0	17	0	0	17
2010	6	12	18	0	0	0	0	17	0	0	33
2011	15	23	7	24	0	0	80	33	50	0	100
2017	28	10	10	10	0	4	0	7	8	0	89
3003	21	3	8	0	0	5	85	19	18	0	14
3006	43	8	10	0	0	0	19	12	0	0	37
3007	7	45	53	15	0	0	57	14	0	0	71

*Mean units per drinking day

Missing data

The number of days in the study and relative response rate to the surveys varied between respondents (see Table 6). Considering missing data in the study, only some of the respondents were deemed suitable for further quantitative N of 1 analysis (time series analysis and cross-correlations of predictors and outcomes).

We coded each respondent's data patterns into one of four categories according to suitability for statistical analysis: not suitable (too few responses to apply statistical measures), low quality (enough responses to apply statistical approaches, but missing data which could lead to a high risk of bias), potentially suitable (enough responses to be suitable for statistical analysis, but with some risk of bias due to missing data i.e. 50% or above), and suitable for analysis (sufficient number of responses and high response rate i.e. 60% or above).

From the 1st wave, respondents considered not suitable for quantitative analysis were: 1003, 1008, and 1011 due to not having enough days in the study and 1013 due to not providing enough responses. Participant 1007 had low quality data, with sufficient days in the study but a low response rate. Respondents considered potentially suitable were 1005, 1012 (high days in the study and acceptable response rate) and 1006, 1009 (acceptable number of days in the study and acceptable response rate) and respondents considered suitable were respondents 1002 and 1004 with a high number of the participation study days and good response rates.

From the 2nd wave, respondents considered not suitable for quantitative analysis were: 2003, 2007, 2008, 2009, and 2010 due to not having enough days in the study and/or responses. Participant 2001 had poor quality data, with an appropriate number of study participation days but a low response rate. Participant considered potentially suitable was 2004 (high number of days in the study and acceptable response rate) and 2005, 2017 (acceptable number of days in the study and acceptable response rate) and respondents considered suitable were respondents 2001, 2006 with a high number of the participation study days and good response rate.

Table 6: Colour-coded data quality, response rate, interview and analysis outcome

Study ID	Days in study	Number of days completed	Response rate (%)	Drinking days (%)	Mean units of alcohol	Follow up interview	Statistical Analysis
Wave 1							
1002	166	128	77.11	0.78	0.6		Yes
1003	9	4	44.44	50	8		
1004	100	67	67.00	6.0	0.86		Yes
1005	161	47	29.19	17.0	2.3		Yes
1006	60	31	51.67	29.03	5.36		Yes
1007	72	22	30.56	36.36	4.36		
1008	3	3	100	33.33	3.2		
1009	56	31	55.36	67.74	18.27	Yes	
1011	6	4	66.67	50	9		
1012	101	53	52.48	100	22		Yes
1013	60	8	13.33	100	42.25		
Wave 2							
2001	103	79	76.7	22.78	5.16		Yes
2003*	65	53	81.54	3.77	6.4	Yes	
2004	90	46	51.11	67.39	13.4	Yes	Yes
2005	51	36	70.59	69.44	14.11		Yes
2006	144	98	68.06	2.04	0.34		Yes
2007*	138	75	54.35	4.00	5.14	Yes	
2008	11	5	45.45	0	0		
2009	33	7	21.21	14.29	1.54		
2010	14	6	42.86	33.33	11.5		
2011*	84	27	32.14	66.67	21.77	Yes	Yes
2017	46	31	67.39	64.52	9.08		Yes
Wave 3							
3003	57	23	40.35	13.04	2.43		
3006	83	43	51.81	37.21	7.63		Yes
3007	65	8	12.31	75.00	40.98	Yes	

Colour code: **not suitable**; **low quality**, potentially suitable and suitable for quantitative analysis.

* partially completed on paper with missing data on drinking variables

From the 3rd wave, participant 3007 was not suitable for quantitative analysis due to low number of responses. Respondent 3003 had an appropriate number of study participation days a low response rate; and participant 3006 was considered potentially suitable with high number of study participation days and better response rate.

Analysis and treatment of missing data

We imputed data for 12 respondents with moderate or high-quality response rates: 1002, 1004, 1005, 1006, 1007, 2001, 2004, 2005, 2006, 2007, 2011, 2017, 3003 and 3006. The imputation procedure incorporated 'lag' and 'lead' predictors, meaning that a missing value would be imputed based on the values observed on previous and subsequent days.

The final analytical dataset was created using a one day lag. Rather than using the original values reported for each variable by the respondents, the analytical dataset was based on a 'change from yesterday' variable. This approach accounts for 'autocorrelation', the tendency for days close together to be more similar than days far apart. We also considered a seven day lag – the tendency for each weekday to be more similar than other weekdays (e.g. a correlation between Saturdays), but preliminary analysis suggested that there wasn't a strong 'weekend effect' for alcohol use or for the other variables. The analytical dataset contained the residuals from a linear regression of the current day's variable value on the previous day's value.

Correlation networks

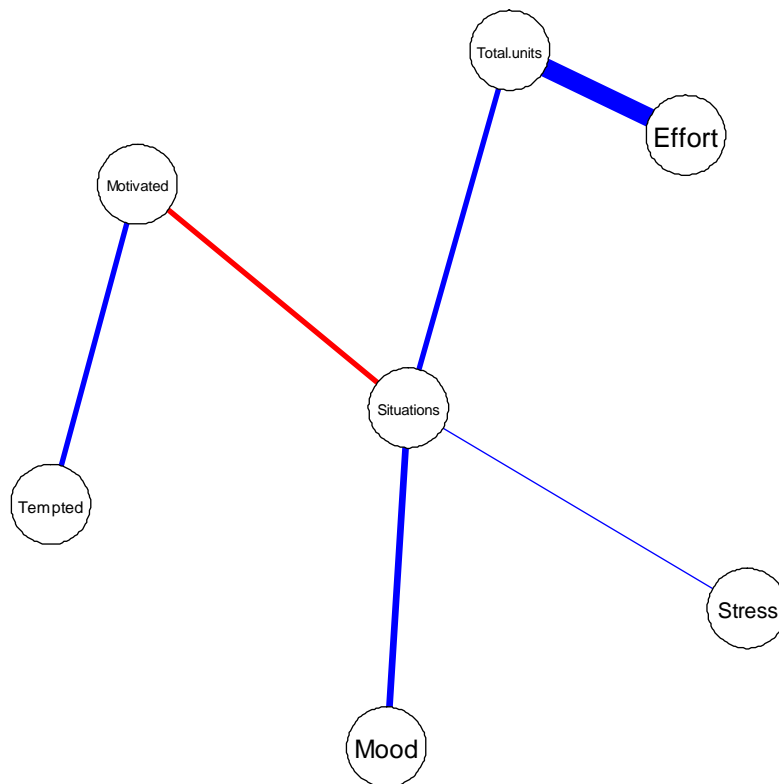
The partial correlations of the lagged imputed variables are shown in the following graphs, plotted using R's qgraph programme, to show the relationships between these psychometric, social, and behavioural variables (Epskamp et al., 2012, Kim, 2015). The variables used in the partial correlations were: Mood, Motivated, Tempted, Effort, Stress, Situations and Total units. The graphs were drawn with a spring layout algorithm (which places connected factors closer together and more heavily connected factors in the centre), and the "gimme" theme (which avoids colour blindness confusion). The guide to interpreting the graph is as follows:

- The red lines are positive correlations
- The blue lines are negative correlations
- The width of the line is the strength of correlation
- Absent connections suggest no correlation (at $p > 0.05$)

Only the significant ($p < 0.05$) correlations are shown in the graphs. The correlation matrices for the subjects with partial correlations are shown in the appendix (Kim, 2015).

Our analysis identified three types of response patterns, based on the structure of the correlations among variables. Below we present the correlation plots and their interpretation for three respondents for each of the response patterns. Data for the remaining respondents appears in the appendix.

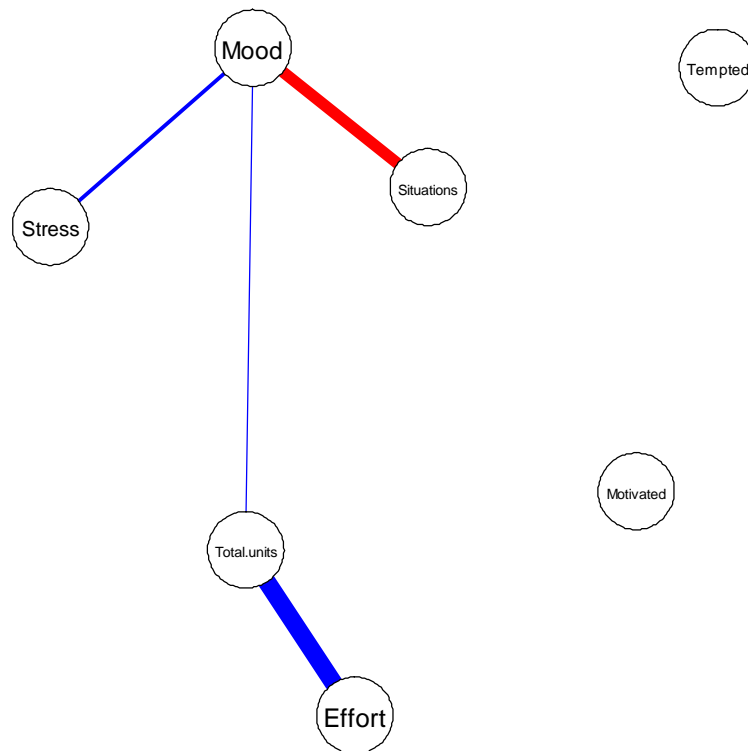
Figure 5: Partial correlation plot for ID 1002, centralised structure



Participant 1002 reported alcohol use on only one day of the study, the first day. He reported maximum effort (100%) on all of his non-drinking days, and motivation around 75% on the single day where he had one drink. Given their low level of drinking, we cannot over-interpret the correlation of the variables with alcohol units; but we can observe how social and psychological factors influenced each other. The positive correlations between situations and mood, and situations and stress suggest that on days where 1002 spent a greater proportion of time where alcohol was available, he reported a worse mood, but also slightly lower stress (the thin line suggests a marginal association). This suggests social situations where alcohol was available were not a source of emotional support, but were linked to lower stress to some extent. When in situations where alcohol was available, 1002's motivation was higher, higher motivation was itself predictive of being less tempted.

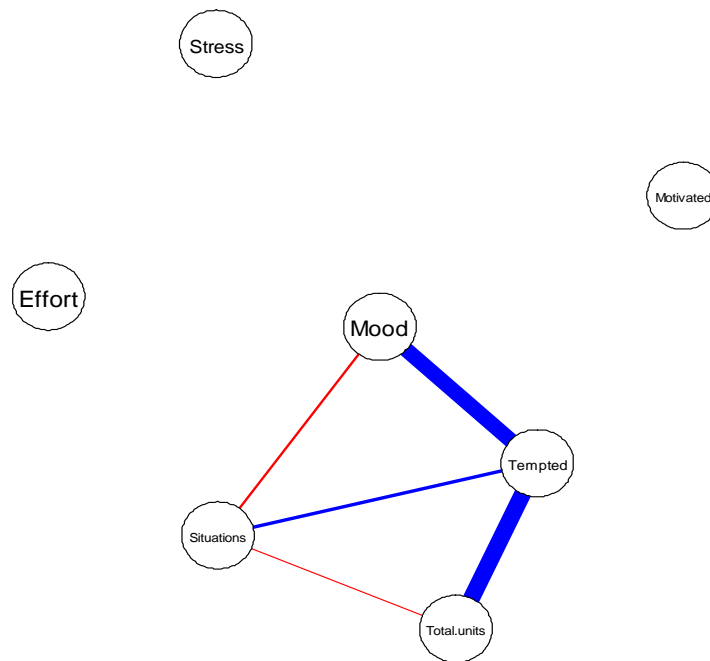
Thinking in terms of the network structure, the most central factor in 1002's network was social situations, connecting to four other factors while other factors had only one or two connections. The overall pattern was centralised around social situations: other factors were disconnected from each other, but all were indirectly connected though social situations. Hence, social situations was the key intermediary factor relating to all other psychosocial characteristics.

Figure 6: Partial correlation plot for ID 1004, disconnected structure



Participant 1004 reported drinking on around 7% of her surveyed days. Her effort was near 100% on most days of the study, but not on the days where the lapses occurred; this appears as the strong negative correlation between effort and consumption. Her mood was often low, but was slightly higher on the days where she reported drinking. For 1004, motivation and temptation were not associated with drinking, or other factors, but both varied over the course of the study. Participant 1004 reported higher mood on days where she was more often in situations where alcohol was available. Higher mood, in turn, was associated with lower levels of stress. This suggests that the social situations were a positive influence, without the negative social interactions that appeared for 1002. For 1004, mood was the most central factor. The overall structure was disconnected, with some factors not related to any others (motivation and temptation).

Figure 7: Partial correlation plot for 2005, clustered structure



Participant 2005 provided moderate quality data, answering on around 70% of days, and reported drinking on 69% of those days. He reported drinking cans of beer every day at the maximum amount in the survey of ten or more. On some days he also drank cider or spirits, but the variability in alcohol units is primarily a comparison of drinking days versus non-drinking days.

Temptation was the most central factor related to alcohol consumption. When he reported higher temptation, he drank less. The key determinant of temptation was mood, when 2005 reported low mood, he felt more tempted to drink. Being in situations where alcohol was available was very weakly associated with lower temptation, higher mood and higher units.

The pathway of lower mood leading to higher temptation, and higher temptation to subsequent lower consumption suggests that drinking is perceived negatively; while the positive association between situational availability being associated with better mood and higher consumption suggests a positive social dimension to consumption. The negative correlation between temptation and consumption is quite counterintuitive, which could reflect noise in the data due to moderate quality response rate, or potentially indicates the complexity of external factors not captured in the data that are related to consumption, temptation and mood. The free text responses to the daily survey contained references to football team wins and weekend socialising, but also offering explanations for not drinking of being busy or having other commitments. The overall structure was disconnected, with very few factors relating to the decision to drink besides temptation. This suggests there are few preventive psychosocial factors acting to limit alcohol consumption, but incentivising factors to drink.

Table 7: Summary of network structure for participant correlation plots

<i>ID</i>	<i>Most central factor (or tied factors)</i>	<i>Degree centrality</i>	<i>Network structure</i>
1002	Situations	4	Centralised
1004	Mood	3	Disconnected
1005	Mood	6	Clustered
1006	Situations	2	Disconnected
1007	Effort; tempted	4; 4	Clustered
2001	Effort; stress	2; 2	Disconnected
2004	Motivation	4	Centralised
2005	Tempted; situations	3; 3	Disconnected
2006	Effort; stress	4; 4	Clustered
2011	Situations; stress; tempted	3; 3; 3	Disconnected
2017	Stress	3	Disconnected
3003	Motivated, situations, effort, tempted	3;3;3;3	Clustered
3006	Motivated; situations	3; 3	Disconnected

NB. Degree centrality is the number of connections each factor has to others in the graph

Table 7 gives an overview of the structural features of the correlation graphs. Firstly, the most central factor – with the most links to other factors – was considered. This varied from participant to participant, but situational availability of alcohol appeared for around half the respondents. Secondly, we consider the structure of the graphs as falling into one of three types: disconnected – where some factors were not related to any others; clustered – where many factors were inter-related in tight knit structures, and centralised, where all factors were connected in ‘chains of causation’, but without the tightly clustered patterns of co-occurrence that appeared in the clustered graphs.

These graphs are based on partial correlations, which as a method to reduce indirect effects of one variable on the others and provides the potential to consider potential causal paths. The fact that high levels of clustering even in partial correlation graphs suggests that there may be further issues to consider. For instance, this may be due to data limitations, such as bias due to missing information, a low number of data points leading to random variation and ‘noise’ in the data, or low variability in the way the questions were answered. Alternatively, if the clustering is not due to data limitations: it is possible that clustered graphs may relate to confounding factors, unobserved factors that cause three or more variables to co-vary would produce these

clustered correlations even after partialling out the indirect relationships between the variables.

Influence of MUP on outcomes

Some subjects had observations both before and after MUP. The following table shows the numbers in each case. The chi-square statistic for the number of observations by ID and pre- post MUP status was statistically significant and $P < 0.0001$, indicating that number of completed data points was not independent of periods before and after MUP.

Some of the wave 1 respondents continued in the study past MUP implementation as they re-consented to continue in wave 2. None of the wave three respondents began before implementation and hence did not feature in the pre-post analysis. The following table shows the percentage of missing values before and after MUP for the binary variables, “taking drugs”, “seeking help” and “drinking” together with their proportions. In addition, the mean value for total alcohol consumption in units before and after MUP are also shown. The binary variable “drinking yes/no” had no missing values.

Table 8: Outcome measures before and after MUP implementation for each participant

ID	NUMBER OF RESPONSES		% OF OCCASIONS DRINKING		MEAN ALCOHOL UNITS		% OF OCCASIONS TAKING DRUGS		% OF OCCASIONS SEEKING HELP		DRUG TAKING % MISSING		SEEKING HELP % MISSING	
	Before MUP	After MUP	Before MUP	After MUP	Before MUP	After MUP	Before MUP	After MUP	Before MUP	After MUP	Before MUP	After MUP	Before MUP	After MUP
1002	72	37	1	0	1	0	99	100	36	11	0	0	11	11
1005	29	7	21	57	2	6	100	100	16	29	0	14	14	29
1012	38	1	100	100	22	27	0	0	16	0	0	0	3	0
2001	20	38	30	18	6	4	0	0	0	8	0	0	0	8
2003	2	1	100	0	10	0	100	0	0	0	50	0	50	0
2004	23	20	70	70	14	14	0	0	0	15	0	5	17	15
2005	18	15	78	60	16	12	22	80	0	0	0	0	6	0
2006	21	59	0	3	0	1	0	0	25	15	0	2	24	15
2007	5	2	60	0	7	0	0	0	40	50	0	50	0	50
2009	4	2	25	0	3	0	0	0	0	0	0	0	25	0
2011	2	13	100	100	24	22	100	77	100	38	0	0	0	38
2017	14	14	86	93	13	6	0	0	15	7	0	7	7	7

The changes over time in consumed total units of alcohol (the primary outcome) with the secondary outcome variables, stress, tempted, motivated, effort, mood, drink-feeling and number of contacts as independent variables were described by multilevel multiple regression, also known as Linear Mixed Effect model (Bates et al., 2015). The possible effect of MUP is represented as a categorical variable, with 1 before 1st May 2018 and 2 afterward. Multiple observations for each subject are nested within each subject.

$$Total\text{-}alcohol\text{-}units_{ij} = (\beta_0 + u_{0i}) + (\beta_1 + u_{1i}) time_{ij} + \beta_2 x_{ij} \dots$$

Where i is the subject and j is the occasion (time). The u_i is the random variance accounting for differences in individual estimate for β_1 . The generated variable “post MUP” was also included in the regression model. The estimated coefficient of this variable is an indication for the interrupted time series method of analysis (Bernal et al., 2017). In this analysis a coefficient not different from zero (a statistically not significant result) shows the similarity of result pre and post MUP. The dataset for this analysis was restricted to subjects with observation in both pre and post MUP, the analysis for all respondents appears in the appendix. The interpretation of the models didn't vary whether or not the data was restricted to those providing data at both time points, although the effect sizes were less pronounced.

Table 9: Linear mixed effects models with alcohol units as the outcome, for 15 respondents

<i>Ten models showing adjusted beta coefficients for the association between survey responses, time point and daily units of alcohol</i>										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
time	-0.038 (0.026)	-0.047 (0.040)	-0.010 (0.019)	-0.022 (0.026)	-0.037 (0.069)	-0.037 (0.028)	-0.010 (0.028)	-0.119 (0.096)	-0.038 (0.027)	0.012 (0.015)
Post MUP	-0.518 (1.497)	-0.959 (1.648)	-0.373 (1.474)	0.209 (1.561)	-1.905 (1.533)	-0.836 (1.641)	-1.133 (1.499)	-0.063 (2.361)	-0.571 (1.521)	
Stress		0.027 (0.020)								
Tempted			0.094*** (0.016)							0.042** (0.019)
Motivated				-0.119*** (0.018)						0.029 (0.022)
Effort					-0.189*** (0.017)					-0.176*** (0.023)
Mood						-0.008 (0.021)				
Situations							0.132*** (0.022)			0.042 (0.026)
Drink feeling								-0.076** (0.034)		
Number of contacts									0.251 (0.380)	
Constant	12.799*** (3.837)	10.625*** (3.775)	5.462* (2.969)	18.672*** (3.661)	25.248*** (4.263)	13.638*** (4.063)	5.388 (3.845)	27.686*** (6.600)	12.307*** (4.009)	14.502*** (3.373)
Observations	528	464	458	457	465	465	460	187	520	278
Log Likelihood	-	-	-	-	-	-	-	-724.537	-	-980.657
Akaike Inf. Crit.	3,993.328	3,500.004	3,387.778	3,432.954	3,425.051	3,545.951	3,422.228	1,465.075	3,932.327	1,981.313
Bayesian Inf. Crit.	4,023.211	3,533.123	3,420.793	3,465.952	3,458.187	3,579.088	3,455.278	1,490.924	3,966.358	2,017.590

Note: *p<0.1, **p<0.05, ***p<0.01

The secondary outcome variables “drug use”, “seeking help”, and a binary measure of drinking (yes/no) each day were also used as outcome variables in a logistic mixed effects model. The results are shown in Table 10 and Table 11.

Table 10: Multilevel logistic regression model of drug use (yes or no). Restricted to 15 respondents with observations before and after MUP

<i>Ten models showing adjusted odds ratios between survey responses, time point, and daily drug use</i>										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
time	1.003 (0.984, 1.022)	0.984 (0.959, 1.009)	0.985*** (0.978, 0.992)	0.993 (0.966, 1.020)	0.991 (0.967, 1.016)	0.977 (0.948, 1.006)	0.987 (0.960, 1.014)	0.987 (0.960, 1.014)	0.987 (0.963, 1.012)	0.985 (0.960, 1.010)
Post MUP		8.249*** (1.836, 37.053)	7.957*** (7.903, 8.012)	2.058** (1.477, 41.468)	1.481* (0.942, 20.541)	9.235*** (1.803, 47.307)	9.646*** (1.829, 50.881)	9.646*** (1.829, 50.881)	8.414*** (1.871, 37.844)	7.718*** (1.709, 34.852)
Stress			0.981*** (0.974, 0.987)							
Tempted				-0.003 (0.982, 1.013)						
Motivated					-0.009 (0.978, 1.005)					
Effort						0.991 (0.979, 1.003)				
Mood							1.019* (0.999, 1.039)			
Situations								1.019* (0.999, 1.039)		
Total alcohol units									1.032* (0.995, 1.069)	
Number of contacts										1.075 (0.682, 1.693)
Constant	0.045 (0.001, 2.229)	0.002** (0.00002, 0.307)	0.018*** (0.018, 0.018)	0.004** (0.00003, 0.493)	0.013* (0.0002, 1.041)	0.005* (0.00003, 1.092)	0.0004*** (0.00000, 0.089)	0.0004*** (0.00000, 0.089)	0.002*** (0.00002, 0.174)	0.003** (0.00003, 0.263)
Observations	521	521	463	457	456	464	465	459	521	520
Log Likelihood	-96.037	-91.895	-83.157	-83.910	-85.766	-80.286	-79.663	-82.792	-90.153	-91.778
Akaike Inf. Crit.	198.075	191.790	176.315	177.820	181.533	170.572	169.326	175.583	190.306	193.555
Bayesian Inf. Crit.	210.842	208.813	197.003	198.444	202.145	191.271	190.036	196.229	211.585	214.824

Note:

*p<0.1, **p<0.05, ***p<0.01

Table 11: Multilevel logistic regression model with seeking help from services as the dependent variable. Restricted to 15 respondents with observations before and after MUP

<i>Ten models showing adjusted odds ratios between survey responses, time point, and daily support from services</i>										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Time	1.002 (0.995, 1.010)	1.015*** (1.004, 1.027)	1.017** (1.004, 1.030)	1.017*** (1.005, 1.029)	1.016** (1.003, 1.029)	1.018*** (1.006, 1.030)	1.012* (1.000, 1.025)	1.016*** (1.004, 1.027)	1.024*** (1.012, 1.036)	1.024*** (1.011, 1.036)
Post MUP		0.220*** (0.081, 0.599)	0.243** (0.082, 0.718)	0.213*** (0.077, 0.583)	0.190*** (0.065, 0.559)	0.182*** (0.064, 0.519)	0.233*** (0.082, 0.665)	0.220*** (0.081, 0.599)	0.119*** (0.044, 0.325)	0.098*** (0.033, 0.288)
Stress			1.000 (0.987, 1.013)							
Tempted				0.993 (0.983, 1.003)						
Motivated					1.010 (0.997, 1.023)					
Effort						1.024*** (1.006, 1.042)				1.021** (1.003, 1.039)
Mood							1.009 (0.996, 1.022)			
Total alcohol units								1.002 (0.967, 1.037)		
Number of contacts									2.015*** (1.571, 2.585)	2.012*** (1.533, 2.641)
Constant	0.061*** (0.018, 0.209)	0.376 (0.082, 1.725)	0.302 (0.047, 1.946)	0.755 (0.157, 3.622)	0.238* (0.045, 1.254)	0.097** (0.013, 0.708)	0.279 (0.053, 1.462)	0.371 (0.078, 1.765)	0.116*** (0.029, 0.458)	0.037*** (0.005, 0.260)
Observations	464	464	406	400	399	407	409	464	463	406
Log Likelihood	-173.865	-169.358	-145.475	-154.802	-140.418	-145.211	-153.560	-169.355	-152.011	-129.807
Akaike Inf. Crit.	353.729	346.717	300.950	319.603	290.836	300.423	317.120	348.709	314.021	271.614
Bayesian Inf. Crit.	366.149	363.276	320.982	339.561	310.781	320.467	337.189	369.409	334.710	295.652

Note: *p<0.1, **p<0.05, ***p<0.01

Table 12: Multilevel logistic regression model with drinking (Yes/No) as the dependent variable. Restricted to 15 respondents with observations before and after MUP

Ten models showing adjusted odds ratios between survey responses, time point, and daily alcohol use

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Time	0.999 (0.989, 1.009)	1.002 (0.989, 1.015)	1.002 (0.988, 1.017)	0.999 (0.984, 1.013)	1.004 (0.989, 1.019)	1.011 (0.993, 1.028)	1.002 (0.988, 1.016)	1.009 (0.993, 1.024)	0.976 (0.931, 1.023)	1.001 (0.987, 1.015)	1.012 (0.992, 1.032)
Post MUP		0.734 (0.316, 1.705)	0.674 (0.268, 1.696)	0.952 (0.369, 2.455)	0.691 (0.267, 1.791)	0.440 (0.146, 1.322)	0.661 (0.269, 1.629)	0.785 (0.308, 2.004)	14.557 (0.582, 364.068)	0.726 (0.310, 1.703)	0.713 (0.198, 2.573)
Stress			1.009 (0.997, 1.021)								
Tempted				1.044*** (1.029, 1.060)							1.032*** (1.012, 1.052)
Motivated					0.963*** (0.950, 0.976)						1.000 (0.978, 1.022)
Effort						0.934*** (0.916, 0.953)					0.954*** (0.933, 0.976)
Mood							0.995 (0.984, 1.008)				
Situations								1.039*** (1.024, 1.054)			1.030*** (1.010, 1.050)
Number of contacts										0.968 (0.757, 1.238)	
Constant	1.001 (0.25, 3.98)	1.429 (0.27, 7.71)	0.914 (0.14, 5.98)	0.065*** (0.01, 0.45)	16.895*** (2.29, 124.84)	234.168*** (21.34, 2,569.06)	1.883 (0.29, 12.09)	0.101** (0.02, 0.58)	0.00000*** (0.00, 0.01)	1.555 (0.254, 9.524)	0.504 (0.024, 10.733)
Observations	528	528	464	458	457	465	465	460	528	520	278
Log Likelihood	-201.895	-201.637	-174.873	-154.840	-157.799	-127.649	-176.506	-155.074	-24.959	-198.046	-72.912
Akaike Inf. Crit.	409.790	411.273	359.745	319.679	325.598	265.298	363.011	320.148	59.918	406.092	161.823
Bayesian Inf. Crit.	422.597	428.349	380.445	340.313	346.221	286.008	383.721	340.805	81.263	427.361	190.844

Note: *p<0.1, **p<0.05, ***p<0.01

Social network analysis

The following sections reports on the analysis of the egonets completed as part of the follow up interviews for six respondents. There was one member of the local community who did not participate in the baseline recruitment survey or smartphone survey, but did take part in an egonet interview at the time the peer team was undertaking the interview fieldwork. This respondent's information was not used in analysis.

During the interviews, some respondents did not wish to disclose information about their substance using friends. The interviewers handled this by discussing some social groups of friends, in some cases this was accompanied by a rough number of friends within the group, but in others it was not. When the network data was transcribed into Vennmaker, the specified number of friends was encoded for those alters, and where it was not specified, three alters were used, hence reflecting a potential underestimate of network size. The three alters were assigned characteristics according to how they were described in the qualitative recording (e.g., all currently drinking a lot, a mixture of men and women etc).

Table 13: Social network measures by drinking status at recruitment

Network measure	Currently drinking mean (SD)	Stopped drinking mean (SD)	Overall mean (SD)	t-test (p value)
<i>Number of alters</i>	12.5 (2.12)	10 (0.82)	10.8 (1.72)	1.6 (0.33)
<i>Proportion of alters: Rated positively</i>	0.5 (0.71)	0.5 (0.46)	0.5 (0.47)	-0.1 (0.95)
<i>Drinking a lot</i>	0.2 (0.25)	0.1 (0.06)	0.1 (0.14)	0.7 (0.60)
<i>Using drugs</i>	0.4 (0.56)	0.2 (0.18)	0.3 (0.3)	0.5 (0.72)
<i>Total closeness score</i>	45 (5.66)	30.8 (6.85)	35.5 (9.42)	2.7 (0.09)
<i>Network constraint</i>	0.29 (0.08)	0.25 (0.07)	0.3 (0.07)	0.6 (0.61)
<i>Diversity of alter types (Index of Qualitative Variation)</i>	0.5 (0.2)	0.8 (0.1)	0.7 (0.19)	-1.9 (0.26)
Respondents	2	4	6	~~~

Table 13 shows the mean scores for measures calculated from the social network graphs from the six interview respondents, and a t-test for differences between those who were currently drinking, and those who had stopped or were cutting down at the time of their interview. Respondents named 10.8 social contacts on average, and rated about half of their networks as positive supports. Around 10% of each respondents' networks were perceived as 'drinking a lot', as opposed to drinking a little or not at all. There was a higher proportion of drinkers in the networks of the currently drinking sample, but no evidence of a statistically detectable difference in this small sample. There was a similar trend for higher drug use among the currently drinking sample. The drinking sample had evidence of a slightly higher closeness score, meaning that they had a greater number of people in their networks that they rated as close.

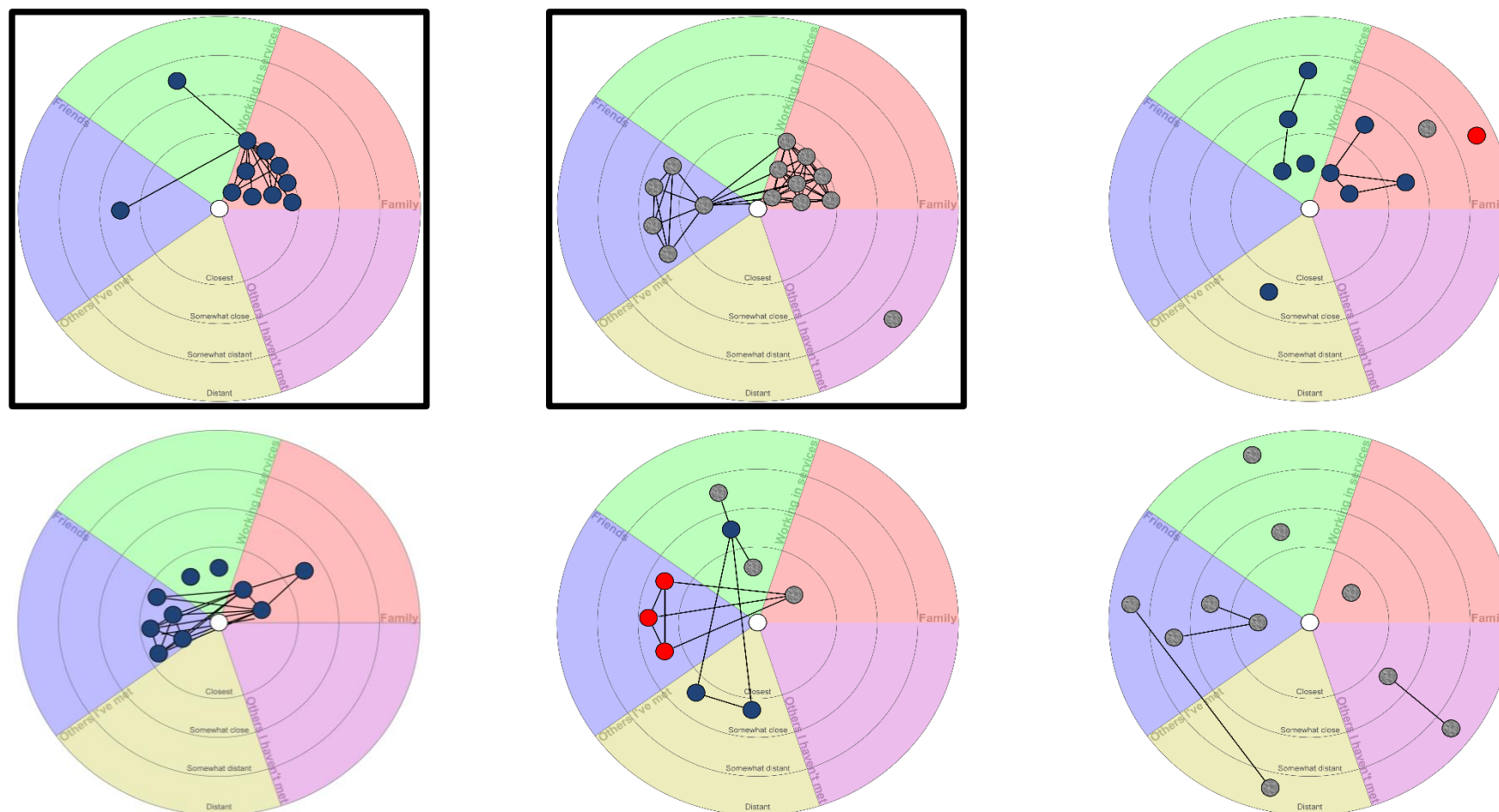
The constraint measure did not vary greatly between groups, and the value of 0.3 suggests that respondents had a reasonable diversity of social connections, and connected to several groups that were independent of each other. The Index of Qualitative Variation was slightly higher for the stopped drinking sample than the drinking group, but with no evidence of a statistical trend in this small sample. This measures how many categories of individuals (family, friends, professionals etc) were present in the social networks.

The small sample size limits the quantitative analysis that can be conducted on this data. Qualitatively, there were important dimensions of social relationships that underpinned the networks. Some respondents spoke about the high levels of relational strain in the past, which meant that some family members were not present in the networks. This historical context thus had an important role in structuring the diversity of contacts in the network, this point will be picked up in the qualitative section.

Figure 8 shows digitised and anonymised versions of the egonets completed by the six interview respondents. Images are ordered in reading order (from left to right, then left to right on second row) according to increasing index of qualitative variation for segment. Those who placed alters in more segments of the egonet diagram – and thus had more variation in their social network) appear towards the bottom right.

The “current drinkers” sample - respondents who were not stopping or reducing their alcohol at the time of baseline recruitment - are highlighted with a square border. These two respondents had the least diverse social networks, with a predominance of family contacts, or family and friends only. In both cases, they perceived their family or friend clusters of social contacts as being close to them, and all members of these clusters as being similarly close. This pattern of perceived close clusters appeared for one of the “stopping drinking” sample, while the remaining three showed greater diversity in placing alters in terms of closeness. This may reflect greater diversity of social interactions, and but also some evidence of social strain, such as the family member perceived as a negative influence, and placed at a distance for the top right panel (ID 2007).

Figure 8: Anonymised egonets for six respondents



Top row IDs 2004, 3007, 2007; bottom row 2003, 2011, 1009. “Current drinker” sample highlighted in square frame. Blue denotes a positive alter, grey denotes neutral, and red denotes a negative alter. Egonet segments denote, clockwise from North: professional in health/social care services (green), family (pink); others that I have not met (purple); others I have met (yellow); friends (blue)

Alters tended to be viewed as having positive influences on people's wellbeing and alcohol use, with only two respondents mentioning negative connections. In one case, this was a strained family relationship (top right; 2007), and in the other case related to a cluster of friends who had negative influences in relation to drinking (bottom middle, 2011).

Thematic analysis of interview data

The inductive thematic analysis of the interview data identified key issues for the respondents from the peer-led research interviews. In this section, the interview excerpts demonstrated the rich supplementary data that qualitative interviews add to our understanding of behavioural change around alcohol. The key themes explored here were: peer and family networks; the experience and impact of stress; motivation; coping strategies and the impact of MUP.

Peer and service support

The positive role played by support networks of peers from local alcohol/drug service and mutual aid groups was a recurring theme in the respondents' accounts of maintaining behavioural change. Having someone to talk to who had experience of controlling their alcohol use and with whom they could discuss how to develop tools and coping mechanisms was valued by the respondents. For example, Gayle reported that her local service, "keeps me grounded to what I am doing ... when I come here I'm totally honest about what I drink."

Neil described how he found these groups helpful: *'they gave us tools ... I've met a lot of people that made me realise, I'm not on my own.'* Similarly, Dave commented, *"I see them [peer group] every two weeks ... it's like somebody to talk to."*

The availability and geographical proximity of these support networks appears important. Jackie reported frustration of seeking but not being able to access the support she wished, this in turn had an unanticipated outcome on her social life. She related that, *"I don't go out as much now because I feel that I haven't got the social contact I had before."*

The role of mutual aid support services in providing companionship and filling the vacuum in respondents' social life as they sought to transition to a reduced or non-drinker was important for a number of respondents as they found they had drifted away from former drinking companions. Dave explained the rationale for this: *'we'd end up getting into trouble. I very rarely see [friend] but when I did used to see him it used to be through a few drinks ... we went our separate ways'.*

Ken was adamant that their social network did not influence his alcohol use, but this was a unique response. Throughout the interviews, the respondents' narratives outlined the challenges of seeking to change behaviours in their existing environment and social networks. For example, Iain's story demonstrates the negative aspects of

social networks as he reported a relapse during the heavy snowfalls that had occurred during the study. In his case he had stopped drinking completely but after a stay in hospital with a broken ankle returned home and resumed drinking as was unable to leave the house and his friends brought alcohol when visiting him. He continues to drink with his friendship network and relates an ability to maintain his change in drinking behaviour despite their higher patterns of alcohol use:

“Most of them have a drink at night. Not so much during the day as I do ... well, they drink stronger stuff ... they’ll drink Super and things I just do X all the time. They all seem to drink the stronger stuff at night ... I don’t drink the same as them. I wouldn’t ask them for a cut of their stuff because I just drink my own stuff all the time. I just like sticking to the same drink.”

Family Networks

Family relations were a recurring theme in the interviews and ranged from supportive to non-supportive.

Bob has a close family network and derives strong social support from his family in particular his mother and aunt, ‘they make things easier’. He has a good relationship with his children who he visits every fortnight. Neil also derives strong support from his extended family, who, for example, have alcohol-free family gatherings to help support him:

“I’ve got a strong support. I’m lucky, I’ve got a strong family that support me, and don’t turn their backs on me. Even when I do relapse, they’re there to give me a kick up the backside, they’re honest with me. And I really appreciate that.”

He relates a story of his sister’s support at a family gathering:

“One of the family who didn’t know about my, distant family that was there, actually had put a drink down in front of me. My sister quickly got it out the way.”

He has more strained relationships with some family members and his children, though this does not appear to affect his drinking. Iain’s familial networks - a large extended and blended family – were mainly negative and he maintained also that this had little impact on his drinking, ‘I never see them. Out of sight, out of mind, kind of thing’. In contrast, Dave’s relationships with his wife and son had broken down and impacted heavily on his ability to maintain behavioural change and control his drinking.

Experience and impact of stress

The respondents’ narratives depicted high level of historic and current stress derived from their own or family members’ ill health, conflict with family and/or friends, and trauma. Their accounts demonstrated many successes in coping with these situations

but illustrated the challenges they faced both during the survey period and over their life course and its impact on their alcohol consumption.

For example, Gayle sought to manage everyday stress so that it would not affect her alcohol intake. Her coping strategy was to 'set a limit of what I drink. I buy that set limit and that's it'. However, during the survey she was experiencing high levels of stress due to sister's illness which did impacted on her drinking:

"My last two days have been horrendous ... my alcohol consumption has gone up in the last two days ...I wandered round the Co-op about nine o'clock last night to get a bottle of wine on top of what I already drink."

Previously, an extremely stressful social situation with her former partner had also affected her alcohol intake:

"My ex-husband was there, the one that used to beat me up and everything, so I was already anxious and I lost track of what I was drinking."

The extent of stress within the group of respondents interviewed, and its impact on their alcohol use was marked. For some, coping with stress was an ongoing struggle. For example, Neil used alcohol to cope with the stress and trauma he experienced from this service in the army:

"Because of things I had seen, and done, in the army, in they tours that I done ... And, basically, I pushed all the bad feelings to the back. And the drink was just to block them, and to stop them coming forward again ... the stress I was under and it just came to a head ... I've had relapses, that there is times I feel, what's the point. The constant struggle, I find it hard, it's a constant."

For others, such as Dave, 'bad news' impacted on his levels of alcohol use:

"On odd occasions when I've had bad news, I've hit the drink ... Just over a few days. As I say my wife asked for a divorce two or three weeks ago. On that day my drinking went up and up and up and up. The next day I started early in the morning and then by the next day I was just back to what I normally had."

He relates how:

"It doesn't really affect me on a day-to-day basis, my son not talking to me, because I try to put it at the back of my mind. It's just when I see him, and he just doesn't talk to me it cracks me up and I just want to drink more although it doesn't help. It helps at the time, but it doesn't help in the morning because the problem is still there."

Motivations

Amid such stress, staying motivated was an ongoing challenge for the interview respondents. Health was a key motivator for a number of respondents. As Jackie related:

“I wasn’t able to do what I want to do ... I was sick of being sick. I was sick of having the shits. I was sick of being thin and scrawny. I was sick of not enjoying my food.”

For Iain health was a key motivation also as he sought to reduce his alcohol intake and manage the withdrawal symptoms and the associated shakes and tremors he experienced. To do this, he initially switched the type of alcohol he drank from white cider (7.5% ABV) to a regular cider (5% ABV).

Dave reported that positive outcomes from reducing his drinking such as losing weight and being told he looked better as a result have helped him sustain his motivation. While, for Neil, ‘pride’ and not wishing ‘to let his family down’ were important factors for motivating him to both stop alcohol use and withstand the temptation to drink at trigger events such as football matches and at a family funeral. Practical issues such as sleeping better provided motivation for change also.

“I’ve done quite a bit of damage to myself, and if I keep going, it’s only going to make it worse, to the point I won’t recover, health wise. ... I’ve realised that I have to do it. And the second one, pride, pride in myself ... [at a family gathering] I found it, not easy, but I was able to control myself, and drink orange juice, all day. I was proud of that fact, and so was my sister. She was really proud of me, she told me that a few weeks after, that I managed, and kept away from the alcohol.”

Coping strategies

Respondents’ narratives indicated a wide range of coping strategies they had developed to maintain their change and reduce and/or stop their alcohol use. These strategies were sometimes referred to as ‘the tools’ [a term used by self-help and mutual aid groups] and included distraction methods such as going for a walk, playing a game of golf. For example, Bob played golf with his brothers; Gayle treated herself to a fish supper as a treat after attending her self-help group. Neil described a range of coping strategies he employed such as keeping himself active; busy; cooking; and deferring alcohol use until later in the day:

“Cooking is one of the tools I use. If I’m feeling borderline, shall we say, and I’m thinking about drink, cooking is a means. It takes a long time to cook something from fresh ... and making something, allocating time to make

something. Well, you're talking about two or three hours out of your day, spent doing that one task ... it takes your mind completely off it. And I find, the way I cope, is if I have a task for during the day."

Neil derived a high level of satisfaction from being able to control his drinking and this helped him to sustain his behavioural change. Over the duration of the survey, Neil had started and then stopped drinking, he recounted how he had achieved this:

"Like the first time [they had stopped drinking during survey] I started using the tools. And I went, right, if I can reduce it, start later in the morning, and reduce it for the evening, until I eventually, over time, they met, and I stopped drinking ... I tend to use family a lot. ... And if they're not available, then I tend to go out ... just jump on a bus and go somewhere that I know I can stay away from the alcohol."

Dave also distracted himself by leaving the house [where alcohol is available] – *'I'm usually out the house for about nine o'clock. I meet my pal about ten o'clock.'* And, Iain also described reducing their alcohol use gradually over time, they hoped this would alleviate the withdrawals they had experienced previously. Jackie put in place strategies to cope including seeking support from peers and friends and walking her dog. She relates, that she now has *'my wee dog and I've got, you know, a wee social life there. I think that helps'*.

MUP and the cost of alcohol

The cost of alcohol, including the MUP related rise in cost, did not appear to have much influence over patterns of alcohol consumption among those who were interviewed. Depending on their choice of alcohol, some, like Bob, found no difference in the price and that *'nothing's changed'*.

Both Neil and Iain related that they had found alternative supplies for the white cider they preferred to drink at the old price suggesting that some outlets did not pass on the price increase:

"I was getting it in different ways ... There was always a way to get the reduced price ... And to be honest, it's quite surprising how easy it is, to find these outlets."

Both respondents had stopped drinking for health reasons. However, Neil related that he would cut back on food or bills to drink their choice of cider:

"It would either be a bill, or even, food. ... it doesn't matter where we find the money from ... We don't worry about what consequences, what happens ... it does is actually make matters worse. Because I'm having to find the money

from elsewhere. And the only place to find it is either food, or not paying bills. And that comes back and bites you. But you don't worry about that, you hide from it, as long as you get that bottle.”

In contrast, Dave's alcohol consumption had changed due to the MUP. Price was an issue for him, he related borrowing money so he could continue drinking. He is the only participant who reported that his type of alcohol consumption had changed due to the MUP and he had switched from cider to lagers which were cheaper post MUP implementation.

“.....went up to four [pounds] forty for a four pack. I was getting eight for the price of that plus change or I was getting a bottle. That's went up to five pounds, so I'll treat myself now and again to a bottle but it's usually just lagers I drink now.”

Dave also borrowed money so he could continue drinking:

“I'll go to see my pal X. I'll borrow money off of him ... Because he knows what it's like. As I say he's just been off the drink 10 months now, but he still realises that it is a hard thing. So, I'll get a loan of money off of him.”

For Jackie, money had a negligible influence on the amount of alcohol she drank and very seldom influenced the type of alcohol. She reports being in debt and reckons, *“I'm already in debt so what does any more matter.”*

Framework Analysis

In addition to the inductive thematic approach, a framework analysis was conducted based on a deductive approach to the interview data. This approach focussed on exploring pre-defined theoretically based themes associated with behavioural change which formed the basis for a framework matrix, though this allowed for flexibility and new themes to emerge from data also. The key themes in the framework analysis were: maintenance motives; self-regulation and coping behaviours; psychological resources; temptation and habit; and environmental and social influences. These were examined on both a case and theme approach to inform the overall analysis.

As the interviews were unique to each participant (i.e., not all were asked the same questions) the shape and content of the matrices reflect the issues important to each participant. Observing the matrix as a whole, provided a visualisation of the issues most important for each participant; data which can be used to identify and target person specific interventions to support behavioural change. In addition, patterns can be observed as to the relevance of each theme across all respondents. Here we examine the key themes emerging from the Framework Analysis. Though, we note a level of overlap across the themes, for example, between maintenance of motivation and coping strategies, and psychological resources and temptation, and the influence of environmental factors across all themes.

Maintenance motives

Respondents noted their struggles in seeking to maintain motivation and avoid temptation. They expressed feelings of satisfaction and pride when they maintained their goals and a profound guilt when they slipped and relapsed. Their efforts to keep motivated included engaging in new pastimes from playing golf, to cooking, to walking their dog to fill the time they would have previously spent drinking. We could see also instances of respondents working on, and struggling with, developing their identity as a non-drinker. This varied across the respondents with some choosing to move away from the pastimes and networks associated with drinking, such as watching the football in the pub with friends, while others continued their existing routines and networks but did so as a non-drinker or with pre-set limits to their drinking. In almost all cases the motivation for change was intrinsic – a desire to improve their health and to feel better both physically and mentally. In one case, the motivation was extrinsic arising from their contact with the criminal justice system and a requirement to demonstrate behavioural change.

Self-regulation and coping behaviours

Seeking to self-regulate their drinking and adopt coping mechanisms were key for all respondents. A clear commitment to their goals to reduce and stop drinking was evident across all cases. Though, clear goal conflicts could be seen when stressful experiences disrupted their goals and they relapsed to the temptation of old patterns of drinking behaviour as a coping mechanism. Successful coping strategies and tools included deferring their drinking until later in the day, switching to a lower strength alcohol, and setting and keeping to a fixed amount of alcohol. As Iain described:

“I’m trying to just cut down. I’ve stopped drinking bottles, I’m drinking cans so I’m drinking less, drinking my eight cans than drinking two bottles. You know what I mean? Then cut down on the cans, you know. Maybe a can a week kind of thing. Cut down a can a week then a can the next week and a can the next week. Eventually I’ll be able to do it.”

Psychological resources

Stress was a key factor for almost all respondents. Extremely difficult life circumstances weighed heavily on the capacity of the respondents to cope with stress. Anxiety about their own poor health, and the ill health of family and friends, were key recurring themes across the cases and coping with especially bad news (e.g. a sister’s cancer diagnosis, a friend’s death, reminders of past trauma) impacted on their capacity to maintain behavioural change in the face of goal conflicts. As Neil, recounted:

“I was trying to juggle my groups, and my responsibilities to my mother, and they were often clashing. And I think, I just ended up getting depressed, slightly. Because I wasn’t showing my feelings to the family, and the stress I was under,

and then it just came... And it just came to a head. And I just turned to my old habit of self-medicine ... and the more guilty I felt, it seemed to be a domino effect, it got worse and worse."

Temptation and habit

The temptation to respond to embedded automatic cues to resume drinking was clearly linked to experiences of stress. When emotional, tired or stressed cue behaviour associations were activated to resume the negative drinking habits they had prior to alcohol reduction. As Dave described:

"I get emotional. The more I drink, the more I think about things. I'll not tell lies, I've burst out crying. Then I sit, more drink, more drink until I can't take it and then I go to my bed."

Environmental and social influences

Environmental and social influences were the strongest theme emerging from the interviews in terms of their importance for maintaining behavioural change, as this was a focus of the egonet task. Key in this regard was the role played by support networks of peers from local alcohol/drug service and mutual aid groups, as well as family networks.

The availability of alcohol in their homes and in social situations was pervasive. However, most respondents demonstrated developing coping strategies to deal with this. For example, respondents with partners who drank alcohol found strategies to cope with this temptation as Neil related:

"As time went on, I got used to it, and it didn't bother me. It didn't cross my mind, I just got on, either made myself something to eat, and a cup of tea or coffee. And I still chatted away, even though there was a glass of wine sitting in front of me, the partner's, it didn't bother me, after a while. Because I got used to that, and I used the tools I had learned, to block that from bothering me ... Because I knew, if I let that bother me, then I'm on that downward spiral again. I had to keep myself busy."

Others spent time with peers who had successfully controlled their drinking and this helped to moderate their own behaviour, as Dave described:

"Well, it's made me cut down quite a bit because I used to drink maybe three or four times as much as I did when sitting in the house with him. Whereas now I'll maybe only have the two tins sitting in front of him and I could be sitting there for five or five hours. So, two tins in that space of time is quite good because... I don't like drinking in front of him. I don't want him to feel awkward."

The need for social support systems to help maintain behavioural change varied across the cases. Some respondents found family and peer support a great resource others expressed a desire to cope on their own and though this meant increased levels of isolation. As Jackie explained:

“I keep myself to myself because it’s safer... I don’t really have much to do anybody else.”

Social networks were seen to have both positive and negative influences. Conflict with family and friends could spark a change in drinking habits. As Ken related: ‘sometimes when I’d been arguing I obviously did kind of go out and drink more’.

Free text phone data

The final tranche of qualitative data collected in this study were the free text data from the phone surveys. At the end of each phone survey, respondents were provided with the opportunity to add qualitative comments with a maximum character length of 2,000 to describe any special circumstance of that day. Respondents took this opportunity to record supplementary data to varying degrees. The data collected offers an interesting insight into the state of mind at that particular time and space. In some cases, the direct influence of MUP on their alcohol use and mood, such as the following quote from 1007, which was provided in early April, around three weeks before MUP was implemented. *“I went to the shop for a bottle of frosty and they have stopped selling it coz of the price rise so I’m pissed off”*.

The data contained observations on the influences they experienced in their everyday life and its impact on their current levels of motivation and alcohol use. For example, respondents flagged the influence of being busy, being bored, having money, having no money, feeling stressed, feeling tempted, and feeling guilty for drinking or feeling strong for withstanding temptation. These feelings and thoughts could change day by day reflecting the fluctuating levels of need for people seeking to change their alcohol consumption patterns. As an example, one respondent (1009) texted early in the survey that, *‘I am sick of drinking alcohol and want to be better’* and two weeks later wondered *‘Why stop drinking when you are dying anyway’*.

For some respondents, the extreme levels of stress they experienced on a day to day basis was clearly evident. Free text messages relayed the intensity and immediacy of their situation and the fluctuating levels of stress, anxiety, loneliness, frustrations, challenges, mood, motivation, and temptation that they struggled with day by day.

“Now I am drained I need a drink I can’t cope with the horrible feeling it leaves me. I don’t think that is the way to live. I have been in high spirits excited about the future and BOOM my brain or something won’t let me move on. This is why tonight I am having a drink and Tomorrow is another day.” (1005)

Overall, the challenges they faced in seeking to change their alcohol use is perhaps best summed up by one respondent (1005) who texted: *“Sometimes recovery is very frustrating and unfair and tiring.”*

Discussion

Summary of findings

This study used an N of 1 design to explore the extent to which the policy environment, social environment, and psychosocial factors were associated with within-person change in alcohol use and related behaviours. In relation to alcohol consumption, levels of temptation and of effort appeared as the key risk and protective factors for this sample; and some evidence that situational availability and motivation were also important, potentially as precursors to effort and temptation (RQ1).

When analysed collectively, there was a slight trend towards lower alcohol consumption after MUP but little statistical evidence to suggest this was a robust finding. This may be due to the level of variability in the data. The trend downwards after MUP is small relative to the daily up-down trends from day to day. A longer time series might have had more power to detect the downward shift. There was some evidence that drug use became more frequent after MUP, this association was driven by responses from a respondent who was already using drugs before MUP. There was no clear evidence that the frequency seeking help from treatment services changed after MUP implementation. For other drug use, stress showed the strongest association, this may reflect the self-medicating effect of drug use to reduce stress. For seeking help, higher effort was the strongest predictor, but there was also a time trend, respondents reported more often being in contact with services as their time in the study progressed (RQ2). It is worth re-iterating that this study focusses on studying the variability in behaviour patterns at the individual level, rather than assessing overall trends before and after MUP which are the focus of other MUP evaluation studies.

When considering response patterns on a case by case basis, there was evidence of large variability between respondents in terms of their health behaviours before and after MUP, and in terms of the environmental and psychosocial predictors of behaviour. Effort was associated with reduced drinking for five out of 12 respondents, while higher temptation was associated with lower drinking for three, and higher drinking for two respondents.

From the social network and interview data, established family and social circumstances were key factors relating to alcohol use. Respondents either implemented strategies to support behaviour change that drew upon these social resources; while others experienced social strain and poor mental wellbeing - in the absence of supportive strategies – which placed individuals at risk of increased alcohol or other drug use.

Feasibility of the study design

The design used in this study was innovative in terms of technology supported frequent assessment, all but two respondents responded to mobile phone delivered EMA surveys (two respondents opted for pen-and-paper questionnaires due to hand shaking related to alcohol use). Around half of the recruits (12 out of 25) provided sufficient daily survey data to undertake quantitative analysis, which is not dissimilar

to the proportions participating in N of 1 studies in other populations (e.g., weight loss or mental health). Only five respondents completed the follow up social network interview, and not all of these respondents provided sufficient quantitative data, limiting the ability to fully explore the relationship between social networks, perceived important factors and the observed trends in quantitative data.

Another limitation was the method through which respondent were identified. Rather than implementing a threshold in terms of units of alcohol consumed, or appearance at treatment services, we used an approach based on the peer research team asking people who considered themselves as being current or former “heavy drinkers”. As such, there was greater variability in consumption rates than would be expected using a clinical sample.

The response rate was variable with some respondents providing high quality data despite ongoing alcohol consumption (e.g., 128 responses out of 166, i.e., 77.11%) which is comparable or often even higher than the response rate in general population participating in EMA studies (Kwasnicka et al., 2019). However, the response rates were variable between the respondents and that is also typical shortcoming of the EMA method which is suitable for some but not for all individuals.

Several crisis events occurred during the study which affected participation: respondents experienced mugging, knife attacks, imprisonment on remand, and bereavement during the course of the study. These events illustrate some of the challenges faced by marginalised populations, but is also a demonstration of the ability of the peer research team to engage with groups that would be unlikely to participate in research otherwise. The fact that such a rich, high quality quantitative and qualitative data was gathered for some of the respondents can be attributed to the engagement skills of the SDF research team and the importance of participatory approaches to research.

Some of the study components proved unsuitable for the application in this study population, namely EMA-data prompted interviews (Kwasnicka et al., 2015) including quantitative data summaries which were meant to be presented to and discussed with the respondents. Peer researchers felt that that this part of the study was too difficult for them to deliver effectively, given the limited time frame for fieldwork, and it was not possible to redesign the data prompted interview materials, or to conduct further training with the peer team in data interpretation. Our lesson learned for future research is to provide a set of verbal questions, based on analysis of the data but which do not require interpretation of data summaries by the peer research team themselves. For example, “you seem to drink less when your stress levels are low” with specific data-driven suggestions for questions, e.g., “could you tell me a bit more about how stressed you were during the study and consider if stress had any impact on your drinking?”.

N of 1 design and recent technology developments have great potential to advance our understanding of human behaviour and to apply interventions tailored to current patterns of predictor and outcome variables (Davidson et al., 2014a). In this study we have explored predictors of drinking and substance use looking at MUP influence on time-specific data patterns. Future research could explore the potential of providing personalised interventions that address person-specific predictors of drinking and

substance use. For instance, for people who drink most when stressed, specific interventions should address not only drinking behaviour but also coping strategies for dealing with stressful situations. For people who are most prone to problematic drinking when in the presence of specific individuals, their awareness of this co-occurrence, may help them limit time spent together or discuss with the person how they could collaboratively work on limiting drinking. Through EMA we have successfully gathered personal data that can inform future interventions aimed at limiting alcohol and substance use.

N of 1 is a recommended method for testing behavioural theory within individuals through repeated measures (Johnston and Johnston, 2013). Our study showed how N of 1 can be conducted in community settings with alcohol dependent groups. Behavioural sciences lack a long-standing tradition of N of 1 studies, and this design has been underused in the field (McDonald et al., 2017).

N of 1 design in alcohol research has limitations such as potential for measurement reactivity, acceptability and compliance with the study protocol and consequently missing data (Wray et al., 2014). The issue of measurement reactivity is unresolved in the literature with some authors claiming high reactivity as a response to repetitive assessment and other claiming that the reactivity is small and if it present, the effect wears off quickly. The finding of a time trend towards more frequently contacting services could be a reactivity effect, in that study participation encouraged reflection on alcohol use and subsequent increase in service contact.

Study acceptability was high and that may be due to peer researchers' involvement. Study compliance was variable and that was explained through the prism of personal characteristics, preferences and individual differences. Missing data was appropriately dealt with and imputed for some but not for all respondents and we emphasized the results that should be interpreted with caution due to small sample size. We have measured the predictors of drinking and substance use; however, we have not explored the consequences of drinking (Piasecki et al., 2014). Future research could also look at individual level consequences such as physiological states, psycho-social consequences (violence, impact on the relationships) and environmental consequences (employment, housing).

The social network information collected during interview showed a high level of variation in degree of social support, strain and connectedness. These factors can all influence health and wellbeing (Berkman et al., 2000), and in relation to dependent alcohol use they are key features of the social environment which are potentially modifiable, and which may act to mitigate the influence of psychosocial factors, for example to reduce stress or offer alternative spaces for social interaction where situational availability of alcohol is lower. The EMA design was able to characterise variability in social contact over time, and evidenced high variability in social contact patterns, from regular daily contact with a range of family, friends, and professionals, through to less frequent, but regular, contact with others, through to near complete social isolation. Particularly for those living alone, regular social contact, even if infrequent, may provide an important social routine that confers psychological benefits, even if the frequency of contact is much lower than those who have co-resident family or frequent peer interactions. A limitation of this study was the low overlap between the qualitative egonet data and the EMA social contact data to explore the perception

of peer relationships and the dynamic patterns of social interaction. Further research would be necessary to explore the dynamic patterning of social interactions and appropriate methods to analyse daily changes in social contacts.

In this study, we demonstrated how idiographic methods can be used to study drinking patterns over time and their relationship with complex dynamic predictors such as cravings/temptations, stress, mood, motivations and social and environmental influences. EMA methods are useful in this type of research as they help avoiding retrospective bias to recall alcohol use and to feedback on momentary states. They are also useful in assessing drinking episodes as the occasions of alcohol use are often organised into discrete events/episodes that may have a typical pattern of associated predictors such as drinking when stressed and tired or drinking when in the presence of a specific person. We showed that EMA is useful to study trajectories of change for alcohol and other substance use as well as changes in other momentary variables, e.g., mood, motivation.

The theory of change for Minimum Unit Pricing implementation

The second overarching question for the MUP evaluation is “Are some people and businesses more affected (positively or negatively) than others?” The findings of our study suggest that there may be certain subgroups of the alcohol dependent population who may be less affected by MUP implementation at the current price of 50p per unit. Those who have fewer coping strategies in place may place themselves in debt or greater financial strain to obtain alcohol, while those with better coping strategies may utilise price, and improved health, as motivators to change drink type, or to reduce the amount of alcohol consumed.

The study uncovered three patterns of psychosocial factors related to alcohol use, in terms of the structure of correlation networks. Two respondents had a centralised structure, indicating a single central factor playing a greater role than the others. These respondents stopped or limited their drinking during the study participation.

Seven respondents showed a disconnected structure, several factors that did not relate to any others. Based on the theories of behaviour change and domain expertise that informed the choice of questions; we would expect that these factors should be related, at least at the population level. That fact that some are disconnected may provide insight into the individual circumstances which place people at higher risk. Some. For example, some of the disconnected patterns highlighted the potential absence of positive coping strategies (e.g. motivation or higher effort), while stressful risk factors are present. On the other hand – disconnection between factors may be caused by external variables that are masking the association, such as time constraints that were mentioned qualitatively by one individual in the study.

Besides the emergence of different ‘risk structures’; there was also variation in the factors driving alcohol consumption and related psychosocial factors. For two individuals, mood was the key factor, for three it was motivation, while for six it was situational availability. While all three factors would be considered important risk factors for alcohol use at the population level, our analysis suggest the role of these and other theorised factors may differ from person to person.

Such differences may be an indication of the sources of different responses to MUP, and potentially responses to other alcohol policies and interventions. Other studies in the MUP evaluation portfolio – particularly those collecting qualitative data - may be able to shed light on the extent to which the factors such as situational availability, mood, motivation, or other factors may relate to differential responses to MUP.

The within-person variability in responses to MUP and other potential influences on substance use may provide a mechanism through which health inequalities emerge. If those whose social circumstances elicit resistance to behaviour change following MUP are those experiencing the highest level of deprivation, then overall health inequalities may reduce, but relative inequalities persist and are felt most sharply by the most disadvantaged. Our analysis did not find any clear patterning according to social outcomes index, although all respondents would be considered as low socioeconomic status and most were experiencing high levels of deprivation.

The study found a trend, but no clear statistical evidence for a reduction in alcohol consumption after MUP, some evidence of increases use of other drugs, and no clear evidence around a change in contacting treatment services. There were noticeable differences in the psychosocial factors related to alcohol consumption, suggesting that the mechanism through which MUP leads to reduced drinking may differ according to the environmental, social, and psychological resources individuals have to draw upon, and the risk and stressors that may prevent them adopting healthier drinking levels.

At the time of writing, the overall level of alcohol sales has dropped in the year of MUP implementation, suggesting that the one element of the theory of change for MUP has some support. Having observed change at the population level, N of 1 studies can help contextualise the circumstances that may lead to different levels of change. The findings from this small scale study suggest that mood, motivation, situational availability, and stressful social contexts in people's daily lives may be key factors to explore further, as these may determine what additional interventions and policies beyond MUP may act to further reduce alcohol harm.

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Appendices

Appendix 1: Delphi method for developing survey questions

Delphi advisors

We invited a range of experts to provide feedback on our questions; first, by e-mailing the initial question set, and second, by attending a delphi workshop. We invited participants with a range of backgrounds and expertise, and the final set of advisors (N = 10) had backgrounds in: quantitative and qualitative alcohol research, substance treatment policy, policy evaluation research, addiction treatment, public health, N of 1 study design, Scottish Government policy, and peer research.

Developing the initial question set

The research team developed a set of initial questions for inclusion in the study based on A.) a systematic review of the theoretical mechanisms underpinning behaviour change (Kwasnicka et al., 2016), B.) the theory of change for how MUP may affect alcohol and other drug use, and seeking treatment, and C.) interpersonal social factors affecting behaviour. From the behaviour change theory review, we developed questions around: maintenance motives; self-regulation; resources; habit; and environmental and social influence. From the MUP logic model, we included questions about alcohol and other drug use, use of services, and financial strain/displacement of spending. The process led to a set of 25 questions for consideration by delphi participants and peer advisors.

E-mail survey consultation

The initial set of questions was e-mailed to those invited to the delphi workshop. Some invitees and all workshop attendees provided feedback on the questions; and one respondent collated feedback from alcohol treatment service users and peer researchers. In the e-mail, we gave the following guidance:

- The questions are based on theories of **behaviour change maintenance, social support, and alcohol price**. Please tell us if we have missed something important.
- We are looking at things that could change a lot from one day to the next, so we can study change over 12 weeks.
- We will not ask things that do not change a lot over 12 weeks, even though they might be important (for example, living alone).
- We want the questions to be easy to understand, so people can answer the questions quickly every day.

- It is more important for us to find out about **change** in individual level of alcohol and drug use, rather than measuring how much people use.
- We want the survey to be as short as possible, so **we will remove some questions**, please tell us which questions we should not include.
- We will send a text asking participants to answer the questions around 7pm each day.
- The questions will appear in a random order each day.

For each question, we presented the survey item as it would appear in the online survey, along with three questions.

Figure 9: Example question from the delphi process email consultation

How would you describe your overall feelings?

Very down Very happy

0 10 20 30 40 50 60 70 80 90 100

Mood

Should this question be included in the study? Yes / No

Should the words of this question stay the same? Yes / No

If no: how should the words change? Write any comments in the space below

The responses from the survey were collated and then formed the discussion format for the delphi workshop. If feedback was unanimous to retain a question unchanged, or to delete it, then the question would be retained or removed as appropriate. This did not occur, as all question had some variation or suggestion for a modification of the terms.

Based on the collated feedback, the wording of questions was changed, and additional questions added. A question around withdrawal symptoms were missed from the theoretical review but identified by service user representatives as important, and several rephrasing of original questions were made.

Delphi workshop

At the delphi workshop on the 11th January 2018 (N=10), the participants were

presented with 29 slides, with new wording for previous questions and additional questions. Participants then voted anonymously using radio voting buttons for the inclusion of each question, or for its change. After voting was completed, the results of the voting were counted, and the outcome discussed. Unanimous inclusions were retained in the final survey, and all other questions were discussed among the group. Peter Craig chaired the discussions while Mark McCann kept notes and proposed modified wording for questions and the addition of new questions. After discussion, a further round of voting took place, with unanimous decisions carried forward. There was one final round of discussions on the wording for remaining questions – all of which were unanimously agreed apart from one question. This question related to the degree to which individuals reported making efforts to control their drinking. The delphi group put forward five variations on the question and agreed that the final decision would be made based on a service user feedback (see Table 14).

Table 14: Example of the evolution of survey items through the delphi process

Initial question	How much have you tried to control your drinking?
Delphi suggestions	How much have you been controlling your drinking? How much were you making an effort to reduce or stop drinking, or stay stopped? How much have you done to reduce or stop drinking, or stay stopped? How much have you used strategies to reduce or stop drinking, or stay stopped? How much have you tried to reduce or stop drinking, or stay stopped?
Final wording	How much have you tried to reduce or stop drinking, or stay stopped?

The discussions at the delphi workshop covered a range of topics, which are summarised below.

- **N of 1 question scales:** Information on categorical or binary issues were collected with a Yes/No answer followed up with a continuous scale question e.g. rating their intensity of drug use, or the positive/negative nature of interactions with people they had met
- **Understandability:** simplifying language where possible
- **Negative interpretations:** changing phrasing to avoid blaming, stigmatising or dramatizing language (e.g., around temptation, self-control)
- **Policy-neutral questions:** Framing questions that would a.) relate to MUP's influence on alcohol affordability, b.) that would be applicable before and after MUP implementation, and c.) that weren't "leading questions" that invited respondents to make an attribution of their behaviour to MUP.

Appendix 2: Respondent partial correlation matrices

The partial correlation coefficients matrices (lower triangle) for subjects with imputed data are shown in the following tables. These matrices correspond to the graphs presented in the main results.

Subject 1002

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	-0.001	1					
Tempted	0.128	-0.368	1				
Effort	-0.084	-0.1	0.006	1			
Stress	0.073	-0.016	0.055	-0.035	1		
Total units	0.03	0.083	-0.002	-0.938	0.025	1	
Situations	-0.4	0.356	-0.044	-0.138	-0.173	-0.354	1

Subject 1004

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	-0.068	1					
Tempted	0.072	-0.117	1				
Effort	0.045	0.046	0.037	1			
Stress	-0.32	-0.122	0.04	0.069	1		
Total units	-0.259	0.213	0.037	-0.739	0.021	1	
Situations	0.534	-0.228	-0.116	0.19	-0.188	-0.028	1

Subject 1005

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	0.566	1					
Tempted	0.3	0.008	1				
Effort	0.29	0.031	-0.131	1			
Stress	-0.239	-0.079	-0.033	-0.068	1		
Total units	0.167	0.366	0.348	-0.052	0.121	1	
Situations	0.243	-0.011	0.203	-0.018	0.134	0.132	1

Subject 1006

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	-0.211	1					
Tempted	0.02	-0.216	1				
Effort	-0.083	0.195	-0.25	1			
Stress	0.22	-0.259	0.041	-0.164	1		
Total units	0.187	0.296	-0.146	0.222	-0.171	1	
Situations	0.338	-0.119	0.033	-0.3	0.058	-0.19	1

Subject 1007

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	0.096	1					
Tempted	0.267	0.429	1				
Effort	0.363	-0.208	0.428	1			
Stress	-0.178	-0.048	-0.382	0.214	1		
Total units	0.041	0.226	-0.211	0.339	-0.314	1	
Situations	0.041	-0.324	0.084	-0.598	0.217	0.395	1

Subject 2001

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	0.028	1					
Tempted	-0.013	0.016	1				
Effort	0.014	0.519	0.173	1			
Stress	0.014	-0.333	0.006	0.206	1		
Total units	-0.18	-0.121	-0.118	-0.491	-0.633	1	
Situations	0.209	-0.104	-0.047	0.046	-0.069	0.073	1

Subject 2004

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	-0.539	1					
Tempted	-0.095	-0.156	1				
Effort	0.105	-0.234	-0.045	1			
Stress	0.058	0.083	-0.037	-0.388	1		

Total.units	-0.178	0.445	-0.226	-0.151	-0.054	1	
Situations	-0.067	0.33	0.062	-0.144	-0.036	-0.053	1

Subject 2005

	Mood	Motivated	Tempted	Effort	Stress	Total.units	Situations
Mood	1						
Motivated	0.278	1					
Tempted	-0.46	-0.235	1				
Effort	0.291	0.025	0.085	1			
Stress	0.151	-0.1	0.062	-0.234	1		
Total.units	-0.23	0.075	-0.474	0.107	0.071	1	
Situations	0.316	0.043	-0.336	-0.227	-0.059	0.302	1

Subject 2006

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	-0.191	1					
Tempted	0.023	-0.254	1				
Effort	0.212	-0.179	0	1			
Stress	-0.235	0.047	0.18	-0.196	1		
Total units	0.345	0.135	0.492	-0.751	-0.533	1	
Situations	0.001	0.162	0.158	0.117	0.127	0.079	1

Subject 2011

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	-0.022	1					
Tempted	-0.086	-0.329	1				
Effort	-0.099	0.133	-0.167	1			
Stress	0.062	0.077	0.417	0.269	1		
Total units	-0.004	0.141	-0.031	-0.128	-0.024	1	
Situations	0.098	-0.067	-0.299	-0.108	-0.66	0.178	1

Subject 2017

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						

Motivated	0.104	1					
Tempted	-0.105	0.265	1				
Effort	0.037	0.136	-0.062	1			
Stress	0.364	0.204	-0.103	-0.078	1		
Total units	0.083	-0.097	-0.013	-0.441	0.487	1	
Situations	0.148	-0.288	0.088	0.121	0.463	0.225	1

Subject 3003

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	0.018	1					
Tempted	0.311	0.158	1				
Effort	-0.057	-0.511	0.389	1			
Stress	0.22	-0.123	0.068	-0.09	1		
Total units	0.129	0.527	-0.499	0.058	-0.281	1	
Situations	0.065	-0.405	-0.028	-0.498	-0.371	0.215	1

Subject 3006

	Mood	Motivated	Tempted	Effort	Stress	Total units	Situations
Mood	1						
Motivated	0.009	1					
Tempted	0.17	-0.336	1				
Effort	-0.074	-0.638	0.078	1			
Stress	-0.081	-0.06	0.078	0.037	1		
Total units	-0.108	0.461	0.18	0.003	-0.041	1	
Situations	0.255	0.01	0.39	0.345	-0.145	-0.129	1

Table 15: Multilevel linear regression model with alcohol units as outcome for 25 respondents

	<i>Dependent variable : Total alcohol units</i>									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
time	-0.042 (0.027)	-0.063 (0.038)	-0.017 (0.020)	-0.030 (0.032)	-0.015 (0.050)	-0.043 (0.029)	-0.020 (0.034)	-0.100 (0.067)	-0.046* (0.027)	0.021 (0.038)
Post MUP	-0.483 (1.459)	-0.770 (1.588)	-0.554 (1.440)	0.387 (1.507)	-1.543 (1.427)	-0.689 (1.578)	-1.708 (1.384)	-0.639 (2.306)	-0.404 (1.482)	
Stress		0.034** (0.017)								0.006 (0.021)
Tempted			0.103*** (0.014)							0.054*** (0.018)
Motivated				-0.126*** (0.015)						0.046** (0.022)
Effort					-0.180*** (0.015)					-0.168*** (0.023)
Mood						-0.018 (0.019)				
Situations							0.149*** (0.018)			0.075*** (0.022)
Drink feeling								-0.037 (0.032)		
Number of contacts									0.139 (0.342)	
Constant	12.240*** (3.069)	10.280*** (3.171)	6.044** (2.807)	17.589*** (2.972)	22.346*** (3.281)	13.343*** (3.280)	5.016 (3.098)	26.532*** (4.869)	11.983*** (3.212)	8.099*** (3.108)
Observations	668	587	575	581	574	589	581	235	657	263
Log Likelihood	-2,524.483	-2,214.294	-2,127.440	-2,168.758	-2,113.765	-2,237.466	-2,157.977	-913.320	-2,481.348	-911.290
Akaike Inf. Crit.	5,062.965	4,444.589	4,270.880	4,353.515	4,243.530	4,490.931	4,331.954	1,842.641	4,978.696	1,844.580
Bayesian Inf. Crit.	5,094.495	4,479.589	4,305.715	4,388.433	4,278.351	4,525.959	4,366.872	1,870.317	5,014.598	1,883.874

Note:

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Multilevel logistic regression model with taking drugs as dependent variable. All data are used in this analysis rather than restricting the dataset to subjects with both pre and post MUP observations. There are twenty five subjects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
time	0.999 (0.992, 1.007)	1.007 (0.997, 1.018)	1.007 (0.996, 1.019)	1.010* (0.999, 1.021)	1.007 (0.996, 1.019)	1.009* (0.998, 1.020)	1.005 (0.993, 1.016)	1.007 (0.996, 1.018)	1.008 (0.997, 1.018)	1.013** (1.002, 1.023)	1.012** (1.001, 1.023)
Post MUP		0.385** (0.155, 0.955)	0.446 (0.168, 1.180)	0.355** (0.141, 0.890)	0.354** (0.134, 0.940)	0.323** (0.128, 0.811)	0.396* (0.153, 1.028)	0.473 (0.180, 1.242)	0.379** (0.152, 0.941)	0.251*** (0.103, 0.613)	0.221*** (0.088, 0.554)
Stress			1.005 (0.994, 1.015)								
Tempted				0.992* (0.984, 1.001)							
Motivated					1.005 (0.995, 1.015)						
Effort						1.013** (1.001, 1.025)					1.010 (0.998, 1.022)
Mood							1.006 (0.994, 1.017)				
Situations								0.998 (0.987, 1.011)			
Total alcohol units									1.009 (0.984, 1.034)		
Number of contacts										1.859***	1.801***

Constant	0.075*** (0.030, 0.187)	0.222** (0.062, 0.796)	0.139** (0.030, 0.649)	0.457 (0.123, 1.699)	0.185** (0.046, 0.741)	0.147*** (0.035, 0.619)	0.187** (0.046, 0.763)	0.191** (0.042, 0.874)	0.204** (0.055, 0.752)	(1.505, 2.296)	(1.440, 2.253)
Observations	591	591	520	506	512	507	522	512	591	589	505
Log Likelihood	-228.070	-225.962	-198.711	-203.409	-190.016	-196.852	-201.865	-198.941	-225.736	-207.143	-181.157
Akaike Inf. Crit.	462.140	459.924	407.421	416.818	390.033	403.704	413.729	407.882	461.473	424.286	374.314
Bayesian Inf. Crit.	475.286	477.451	428.690	437.951	411.224	424.847	435.018	429.074	483.382	446.178	399.661

Note: *p<0.1, **p<0.05, ***p<0.01

Table 17: Multilevel logistic regression model with seeking help as dependent variable. All data are used in this analysis rather than restricting the dataset to subjects with both pre and post MUP observations. There are 25 subjects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
time	0.999 (0.992, 1.007)	1.007 (0.997, 1.018)	1.007 (0.996, 1.019)	1.010* (0.999, 1.021)	1.007 (0.996, 1.019)	1.009* (0.998, 1.020)	1.005 (0.993, 1.016)	1.007 (0.996, 1.018)	1.008 (0.997, 1.018)	1.013** (1.002, 1.023)	1.012** (1.001, 1.023)
Post MUP		0.385** (0.155, 0.955)	0.446 (0.168, 1.180)	0.355** (0.141, 0.890)	0.354** (0.134, 0.940)	0.323** (0.128, 0.811)	0.396* (0.153, 1.028)	0.473 (0.180, 1.242)	0.379** (0.152, 0.941)	0.251*** (0.103, 0.613)	0.221*** (0.088, 0.554)
Stress			1.005 (0.994, 1.015)								
Tempted				0.992* (0.984, 1.001)							
Motivated					1.005 (0.995, 1.015)						
Effort						1.013** (1.001, 1.025)					1.010 (0.998, 1.022)
Mood							1.006 (0.994, 1.017)				
Situations								0.998 (0.987, 1.011)			
Total alcohol units									1.009 (0.984, 1.034)		
Number of contacts										1.859*** (1.505, 2.296)	1.801*** (1.440, 2.253)

Constant	0.075*** (0.030, 0.187)	0.222** (0.062, 0.796)	0.139** (0.030, 0.649)	0.457 (0.123, 1.699)	0.185** (0.046, 0.741)	0.147*** (0.035, 0.619)	0.187** (0.046, 0.763)	0.191** (0.042, 0.874)	0.204** (0.055, 0.752)	0.069*** (0.020, 0.241)	0.057*** (0.013, 0.243)
Observations	591	591	520	506	512	507	522	512	591	589	505
Log Likelihood	-228.070	-225.962	-198.711	-203.409	-190.016	-196.852	-201.865	-198.941	-225.736	-207.143	-181.157
Akaike Inf. Crit.	462.140	459.924	407.421	416.818	390.033	403.704	413.729	407.882	461.473	424.286	374.314
Bayesian Inf. Crit.	475.286	477.451	428.690	437.951	411.224	424.847	435.018	429.074	483.382	446.178	399.661

Note: *p<0.1,**p<0.05,***p<0.01

Table 18: Multilevel logistic regression model with drinking as dependent variable. All data are used in this analysis rather than restricting the dataset to subjects with both pre and post MUP observations. There are 25 subjects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
time	0.998 (0.988, 1.007)	0.999 (0.987, 1.011)	0.998 (0.986, 1.011)	0.996 (0.983, 1.010)	1.001 (0.987, 1.014)	1.006 (0.991, 1.021)	0.999 (0.987, 1.012)	1.005 (0.992, 1.019)	0.970 (0.923, 1.020)	0.998 (0.986, 1.010)	1.017 (0.993, 1.040)
Post MUP		0.855 (0.390, 1.877)	0.818 (0.348, 1.925)	1.072 (0.439, 2.621)	0.874 (0.357, 2.140)	0.620 (0.227, 1.691)	0.759 (0.326, 1.769)	0.899 (0.379, 2.134)	23.118* (726.791)	0.855 (0.386, 1.896)	0.325 (0.071, 1.500)
Stress			1.015*** (1.004, 1.025)								0.978 (0.949, 1.008)
Tempted				1.045*** (1.032, 1.058)							1.053*** (1.023, 1.083)
Motivated					0.964*** (0.954, 0.974)						1.026* (0.998, 1.055)
Effort						0.949*** (0.937, 0.961)					0.951*** (0.921, 0.981)
Mood							0.989** (0.979, 0.999)				0.968** (0.940, 0.997)
Situations								1.038*** (1.026, 1.050)			1.043*** (1.019, 1.067)
Total alcohol units									109,820.400 (0.000, Inf.000)		
Number of contacts										0.928 (0.752, 1.144)	
Constant	0.826	0.976	0.477	0.050***	7.514***	22.345***	1.878	0.098***	0.00000**	1.194	0.480

	(0.311, 2.195)	(0.269, 3.536)	(0.114, 1.999)	(0.011, 0.232)	(1.633, 34.585)	(3.979, 125.470)	(0.444, 7.944)	(0.025, 0.390)	(0.000, 0.058)	(0.296, 4.818)	(0.018, 13.017)
Observations	668	668	587	575	581	574	589	581	668	657	192
Log Likelihood	-274.258	-274.182	-238.202	-204.253	-213.324	-179.365	-239.438	-211.699	-25.943	-268.567	-46.748
Akaike Inf. Crit.	554.516	556.364	486.403	418.506	436.648	368.730	488.875	433.398	61.886	547.135	113.496
Bayesian Inf. Crit.	568.029	574.382	508.279	440.277	458.471	390.493	510.768	455.221	84.407	569.573	146.071

Note: *p<0.1, **p<0.05, ***p<0.01

Table A4: Colour coded data for respondents' compliance with EMA protocol – excluding observations from paper participation

Respondents ID number	Days in the study	Total of the EMA surveys answered	Response rate (%)	Drinking days	Mean of units consumed	Follow up interview
Wave 1						
1002	166	128	77.11	0.78	0.6	
1003	9	4	44.44	50	8	
1004	100	67	67.00	6.0	0.86	
1005	161	47	29.19	17.0	2.3	
1006	60	31	51.67	29.03	5.36	
1007	72	22	30.56	36.36	4.36	
1008	3	3	100	33.33	3.2	
1009	56	31	55.36	67.74	18.27	Yes
1011	6	4	66.67	50	9	
1012	101	53	52.48	100	22	
1013	60	8	13.33	100	42.25	
Wave 2						
2001	103	79	76.7	22.78	5.16	
2003	15	3	20.00	66.67	6.4	Yes
2004	90	46	51.11	67.39	13.4	Yes
2005	51	36	70.59	69.44	14.11	
2006	144	98	68.06	2.04	0.34	
2007	70	7	10.00	42.86	5.14	Yes
2008	11	5	45.45	0	0	
2009	33	7	21.21	14.29	1.54	
2010	14	6	42.86	33.33	11.5	
2011	77	20	25.97	90	21.77	Yes
2017	46	31	67.39	64.52	9.08	
Wave 3						
3003	57	23	40.35	13.04	2.43	
3006	83	43	51.81	37.21	7.63	
3007	65	8	12.31	75.00	40.98	Yes

Note. Colour code: not suitable; potentially suitable and suitable for quantitative analysis.

Table 19: Number of responses and descriptive statistics for daily survey measures part 1

ID	Response days	Tempted mean	Tempted sd	Tempted median	Tempted %missing	Stress mean	Stress sd	Stress median	Stress %missing	Effort mean	Effort sd	Effort median	Effort %missing
1002	109	21	28	11	10	61	22	67	17	100	3	100	10
1003	4	30	26	39	25	59	45	68	0	26	34	26	50
1004	45	33	27	26	18	53	25	50	16	98	12	100	16
1005	36	45	34	50	17	59	28	67	17	91	22	100	19
1006	22	48	25	61	23	54	16	60	9	54	28	62	27
1007	21	55	42	80	19	70	29	84	5	59	36	74	14
1008	2	20	6	20	0	16	19	16	0	0	NA	0	50
1009	25	82	27	96	4	75	21	80	20	26	37	4	32
1011	3	51	42	36	0	30	37	18	0	100	0	100	33
1012	39	87	17	90	15	88	14	88	5	19	25	14	13
1013	8	62	35	78	38	48	37	38	12	7	10	0	0
2001	58	66	8	65	22	64	7	64	7	54	12	57	10
2003	3	48	NA	48	67	50	71	50	33	45	64	45	33
2004	43	67	20	70	21	60	18	63	14	54	20	55	5
2005	33	90	18	100	9	68	23	75	21	59	44	75	9
2006	80	40	31	32	8	45	25	50	9	96	14	100	15
2007	7	58	45	70	14	35	41	20	29	93	12	100	14
2008	4	50	58	50	0	0	0	0	25	33	58	0	25
2009	6	30	45	0	17	17	41	0	0	80	45	100	17
2010	6	70	41	75	17	31	38	15	0	0	0	0	33
2011	15	99	1	100	7	82	16	86	0	92	8	91	13
2017	28	87	20	94	14	44	37	30	14	22	34	6	18
3003	21	15	24	0	14	48	34	50	10	85	22	100	10
3006	43	79	40	100	5	70	25	75	9	70	45	100	9
3007	7	57	35	61	29	13	32	0	14	24	36	12	14

Table 20: Number of responses and descriptive statistics for daily survey measures part 2

ID	Mood mean	Mood sd	Mood median	Mood % Missing	Motivated mean	Motivated sd	Motivated median	Motivated %missing	Drink feeling mean	Drink feeling sd	Drink feeling median	Drink feeling % missing
1002	67	22	73	8	87	24	100	12	50	NA	50	99
1003	38	31	38	0	58	42	64	0	74	34	74	50
1004	65	19	74	16	86	24	100	9	2	NA	2	98
1005	59	25	51	6	93	14	100	6	58	33	50	75
1006	58	13	63	5	61	21	65	14	45	20	44	64
1007	34	35	15	10	47	35	53	14	13	8	14	62
1008	23	NA	23	50	49	69	49	0	50	NA	50	50
1009	37	24	39	8	28	34	17	16	44	23	50	32
1011	63	9	60	0	74	32	84	0	10	NA	10	67
1012	7	9	2	8	30	35	18	28	10	20	0	0
1013	36	29	24	0	20	29	0	12	19	14	20	0
2001	46	13	45	17	47	11	46	10	45	9	46	78
2003	42	NA	42	67	24	35	24	33	32	26	32	33
2004	47	17	50	14	54	19	50	12	40	12	42	30
2005	50	22	50	9	64	37	71	15	43	29	50	30
2006	54	25	50	14	96	12	100	15	2	3	2	98
2007	53	35	56	43	68	41	70	29	40	17	50	57
2008	0	0	0	25	0	0	0	25	NA	NA	NA	100
2009	70	45	100	17	75	42	100	0	34	NA	34	83
2010	0	0	0	33	14	12	18	0	80	6	80	67
2011	30	20	24	7	86	27	94	7	19	25	15	0
2017	64	29	71	4	36	37	18	14	57	23	67	11
3003	49	32	50	14	87	18	100	29	51	19	50	86
3006	37	26	50	16	81	35	100	7	30	30	36	63
3007	78	35	100	14	41	35	50	0	53	35	50	29

Table 21: Number of responses and descriptive statistics for daily survey measures part 3

ID	Alcohol units mean	Alcohol units Sd	Alcohol units median	Alcohol units %missing	Situations mean	Situations sd	Situations median	Situations %missing	Period (days)
1002	1	7	0	0	3	4	1	8	146
1003	8	10	6	0	50	41	50	0	8
1004	0	3	0	0	42	22	50	18	77
1005	2	6	0	0	32	38	0	8	149
1006	7	10	0	0	69	4	68	9	50
1007	5	6	0	0	13	27	2	19	70
1008	5	7	5	0	4	5	4	0	1
1009	18	14	19	0	73	35	90	12	48
1011	8	14	0	0	80	28	80	33	4
1012	22	8	20	0	95	8	100	15	86
1013	42	22	36	0	86	11	84	12	59
2001	5	10	0	0	74	9	75	16	81
2003	6	6	10	0	60	57	60	33	59
2004	14	13	15	0	82	15	79	5	86
2005	14	10	20	0	51	27	50	15	47
2006	0	3	0	0	12	17	7	15	125
2007	5	6	0	0	69	40	86	29	69
2008	0	0	0	0	12	25	0	0	9
2009	2	4	0	0	12	22	0	17	31
2010	12	18	0	0	31	38	14	0	13
2011	23	7	24	0	94	18	100	7	134
2017	10	10	10	0	97	7	100	25	42
3003	3	8	0	0	8	16	0	10	54
3006	8	10	0	0	41	19	50	19	82
3007	45	53	15	0	72	26	75	0	63

Table 22: Proportion of outcomes more than one standard deviation from the mean

ID	Tempted	Stress	Effort	Mood	Motivation	Situations	Drink Feeling	Alcohol units
1002	0.17	0.2	0.02	0.23	0.1	0.1	0	0.01
1003	0.25	0.25	0	0.5	0.25	0.5	0	0.25
1004	0.24	0.24	0.02	0.18	0.16	0.2	0	0.02
1005	0.31	0.22	0.08	0.28	0.11	0.22	0.06	0.14
1006	0.18	0.23	0.18	0.27	0.18	0.36	0.14	0.32
1007	0.24	0.19	0.29	0.24	0.38	0.1	0.19	0.38
1008	0	0	0	0	0	0	0	0
1009	0.16	0.48	0.12	0.28	0.16	0.12	0.16	0.44
1011	0.33	0.33	0	0.33	0.33	0	0	0.33
1012	0.1	0.05	0.1	0.13	0.18	0.1	0.08	0.33
1013	0.12	0.38	0.25	0.38	0.12	0.5	0.38	0.25
2001	0.16	0.21	0.33	0.28	0.21	0.19	0.09	0.14
2003	0	0	0	0	0	0	0	0
2004	0.16	0.12	0.26	0.16	0.3	0.35	0.09	0.44
2005	0.12	0.21	0.27	0.39	0.18	0.21	0.24	0.33
2006	0.34	0.35	0.04	0.34	0.05	0.08	0	0.02
2007	0.29	0.14	0.14	0.29	0.14	0.14	0.14	0.43
2008	0	0	0.25	0	0	0.25	0	0
2009	0.17	0.17	0.17	0.17	0.17	0.17	0	0.17
2010	0.17	0.33	0	0	0.33	0.33	0	0.17
2011	0.07	0.13	0.13	0.2	0.13	0.07	0.07	0.2
2017	0.07	0.43	0.18	0.29	0.21	0.07	0.29	0.21

3003	0.19	0.33	0.24	0.29	0.1	0.14	0	0.1
3006	0.19	0.33	0.26	0.35	0.12	0.14	0.02	0.37
3007	0.29	0.14	0.14	0.14	0.43	0.43	0.29	0.29

Appendix 3: Visual plots of survey responses

The diagrams below present changes in respondents' responses to selected study variables over time. The variables presented below are the ones that were answered most fully by respondents; some respondents did not report alcohol or drug use, hence there were no responses for these individuals. Figure 10 shows the mood scores for respondents recruited in Wave 1. It is also clear that there are large between-person differences in the overall rating of mood, and its variability from day to day. 1002 and 1005 consented to continue the study into the following waves, while the other respondents had varying lengths of participation. The following figures show scores for mood, stress, motivation, temptations and effort.

Figure 10: Wave 1 Mood scores over calendar time

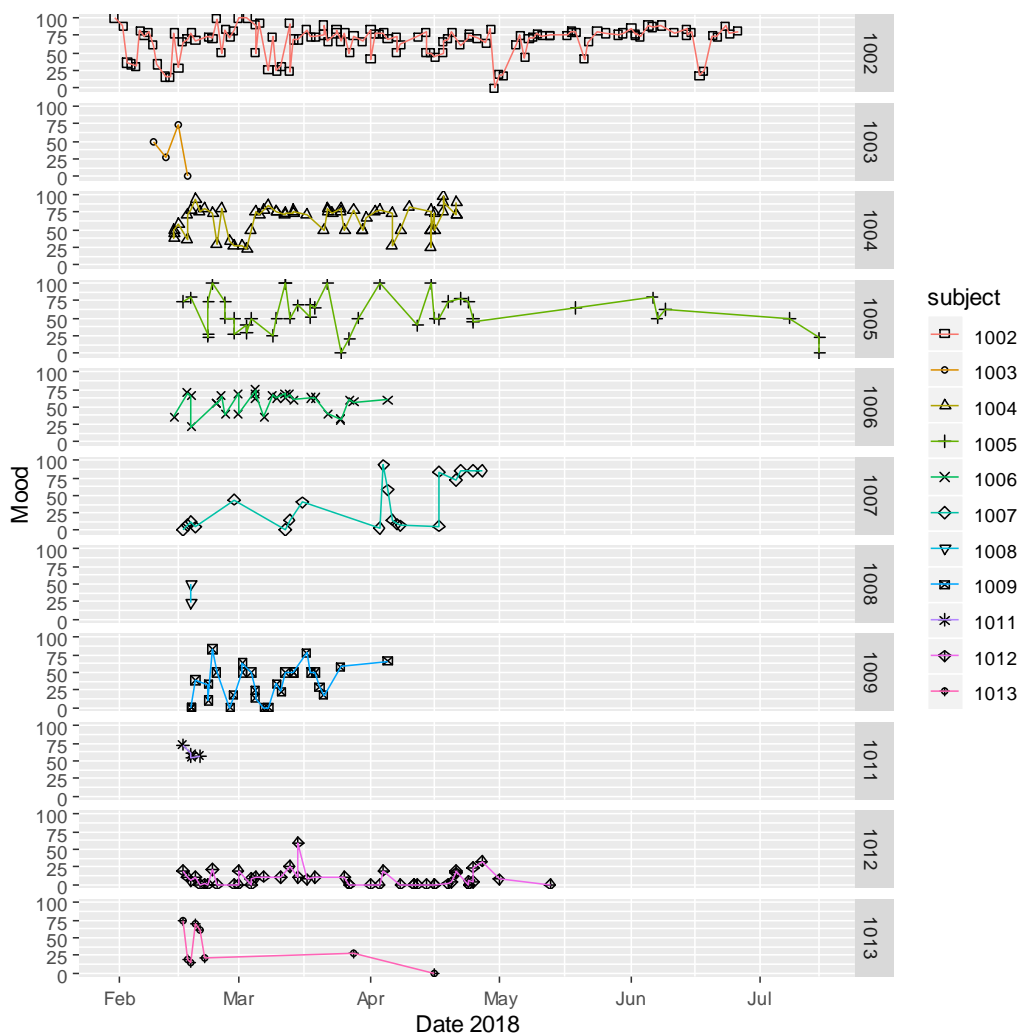


Figure 11: Wave 2 Mood scores over calendar time

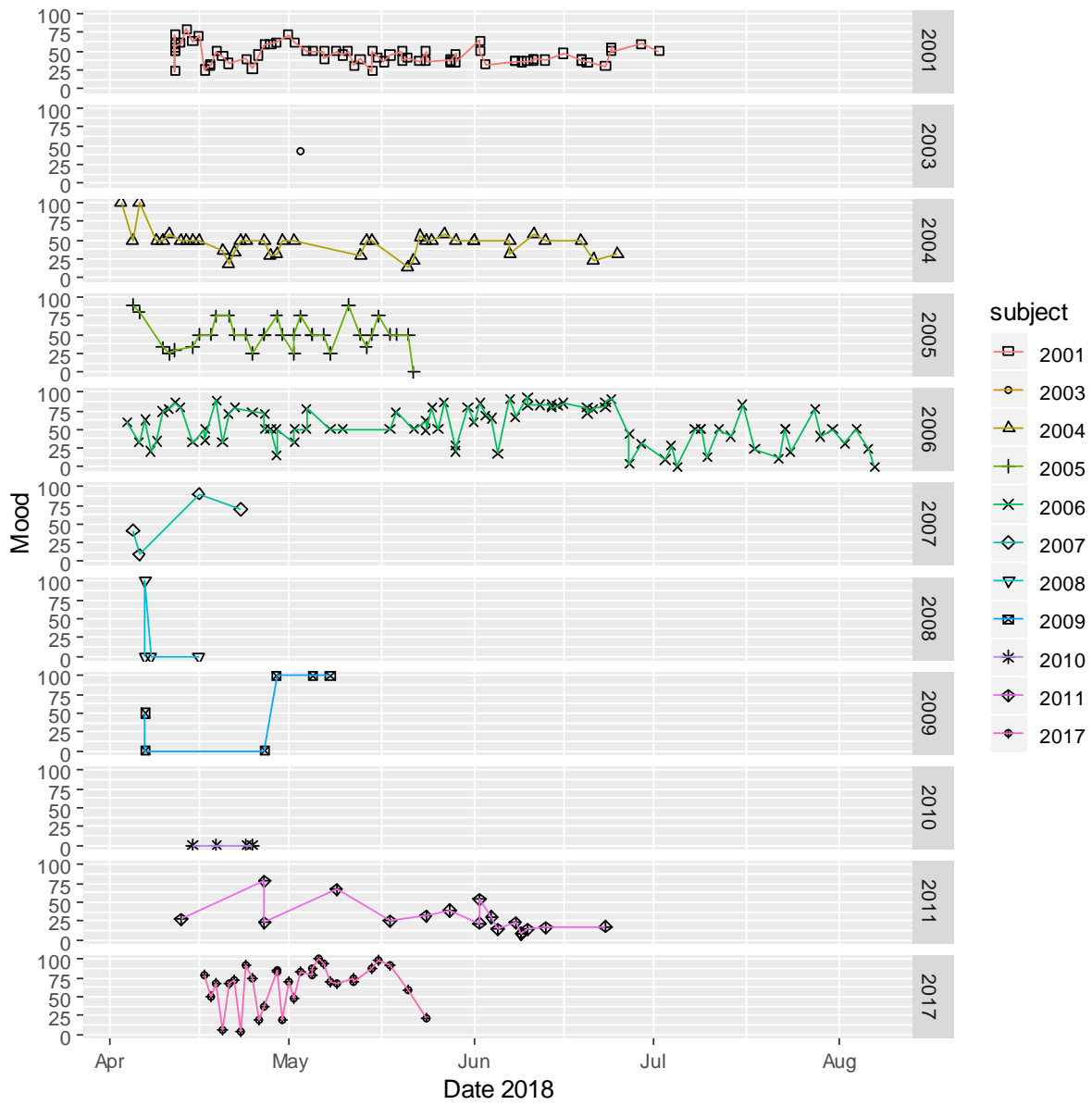


Figure 12: Wave 3 Mood scores over calendar time

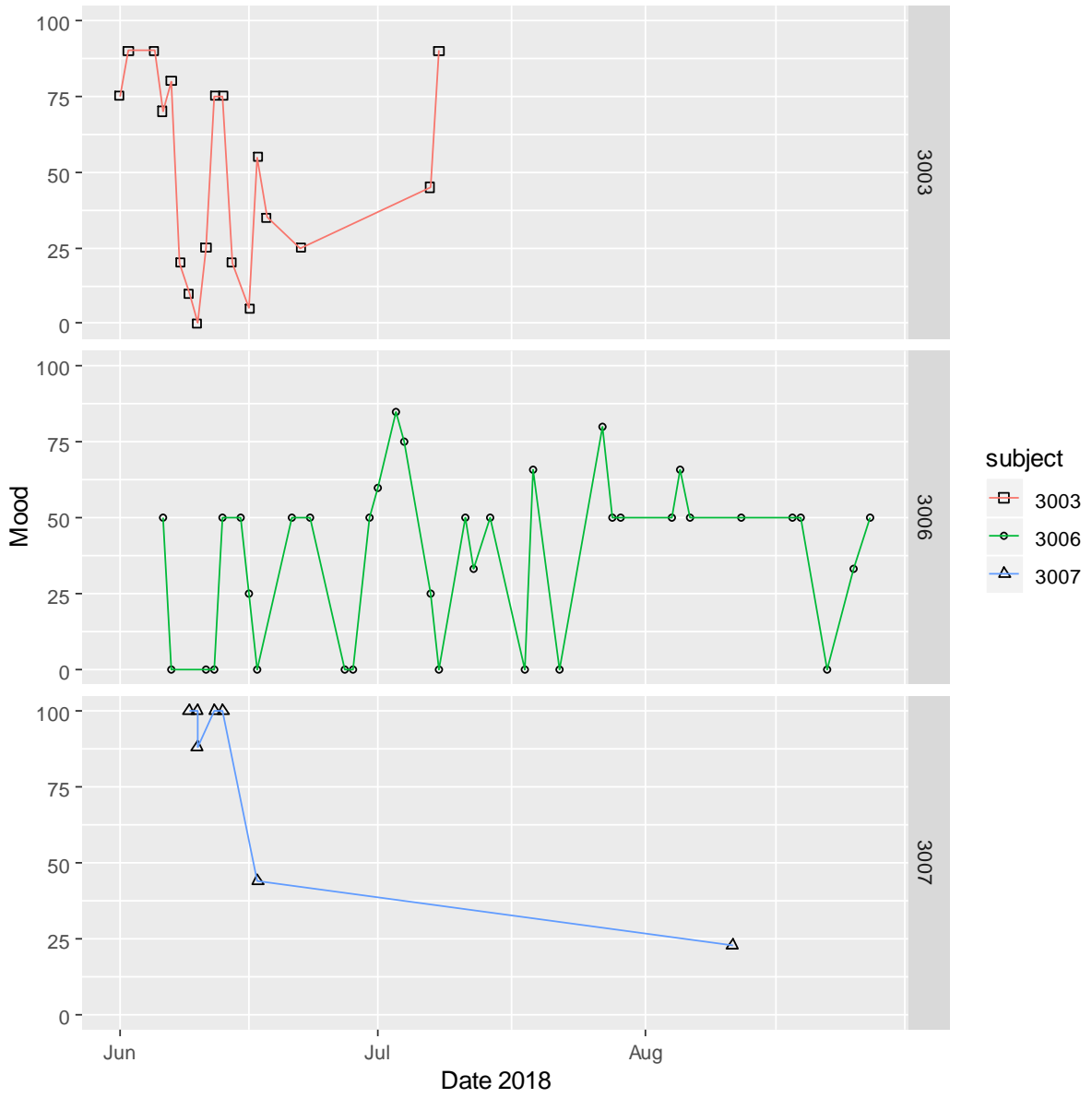


Figure 13: Wave 1: Stress scores over calendar time

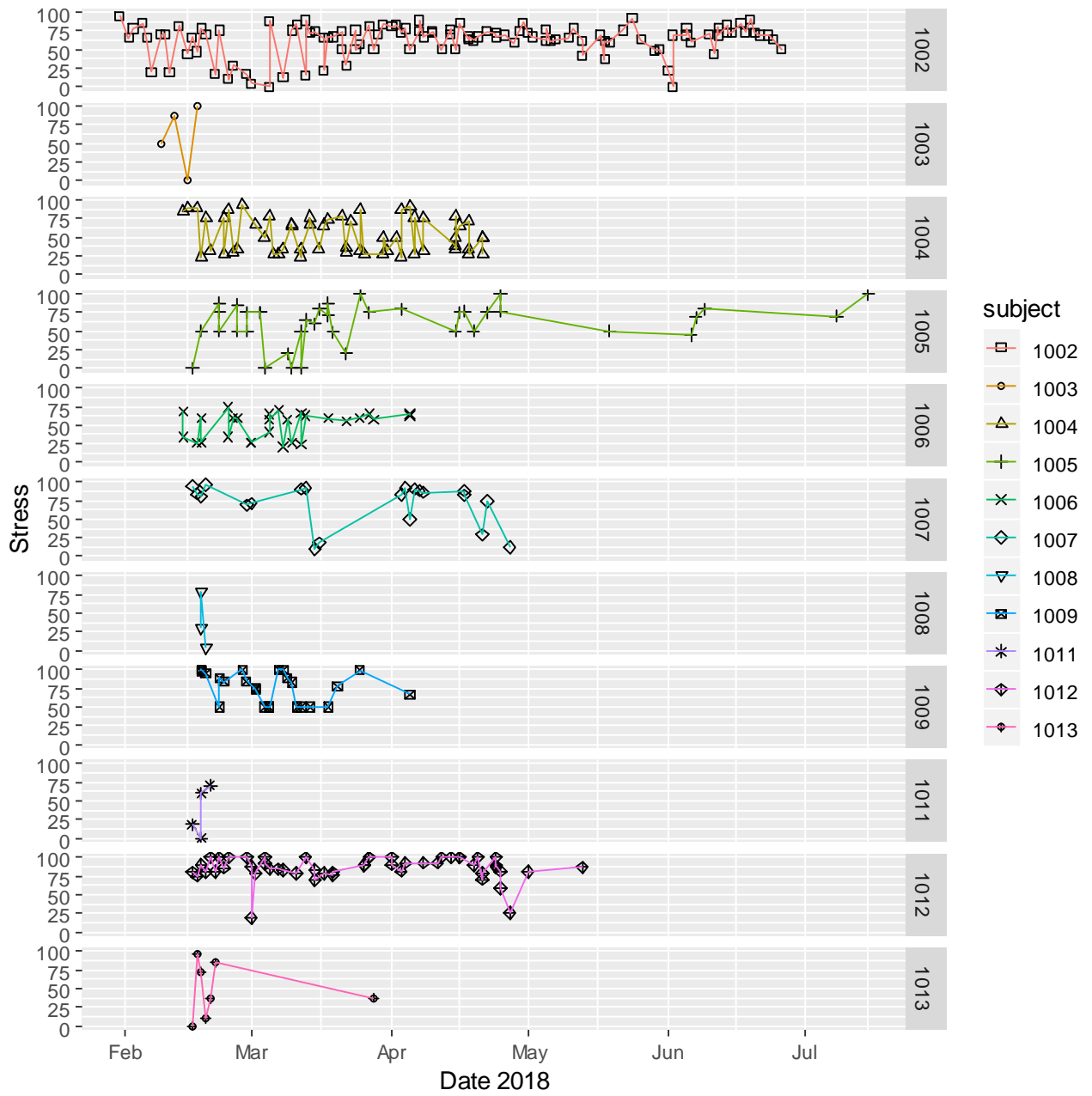


Figure 14: Wave 2 stress scores over calendar time

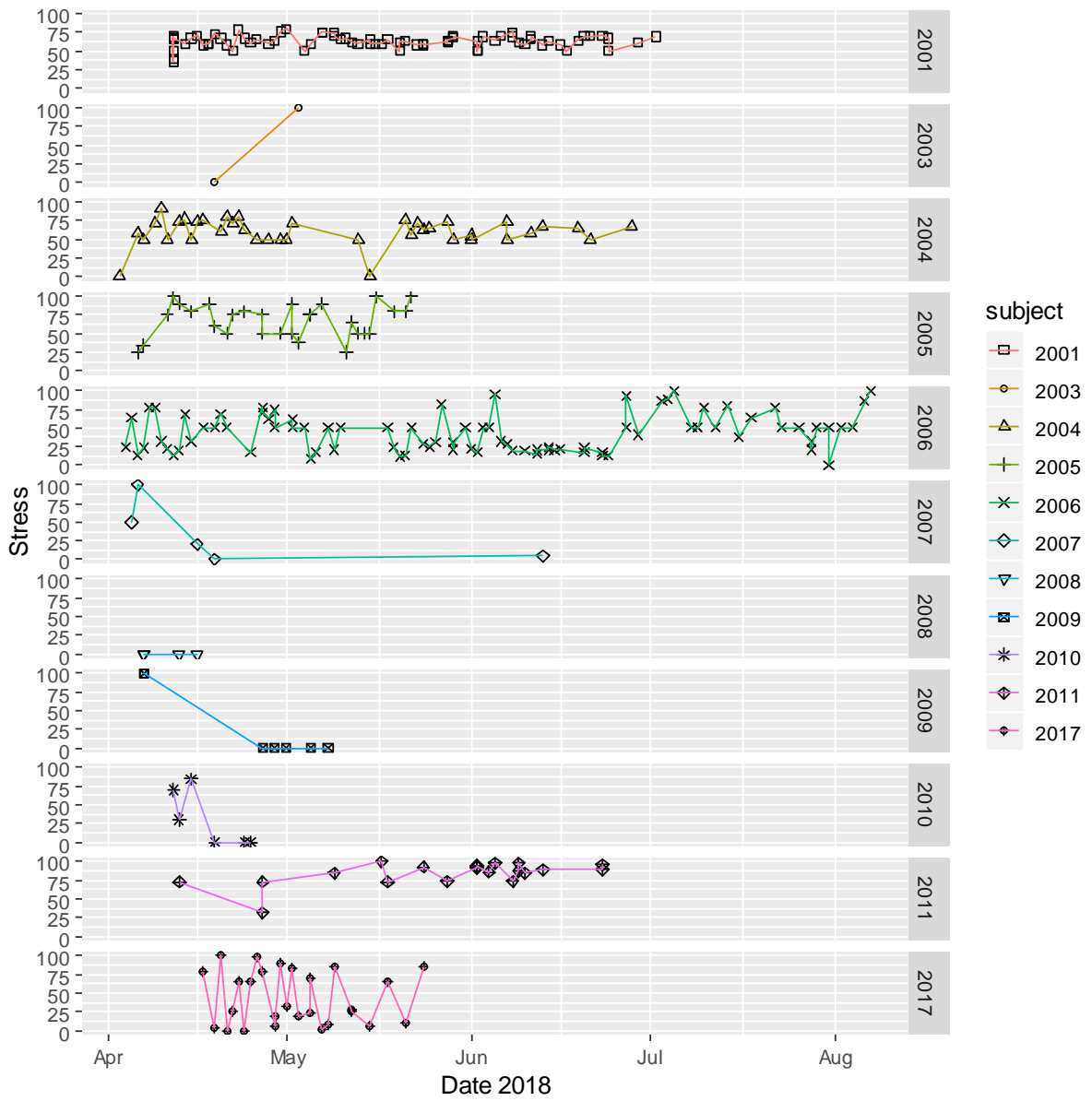


Figure 15: Wave 3 Stress scores over calendar time

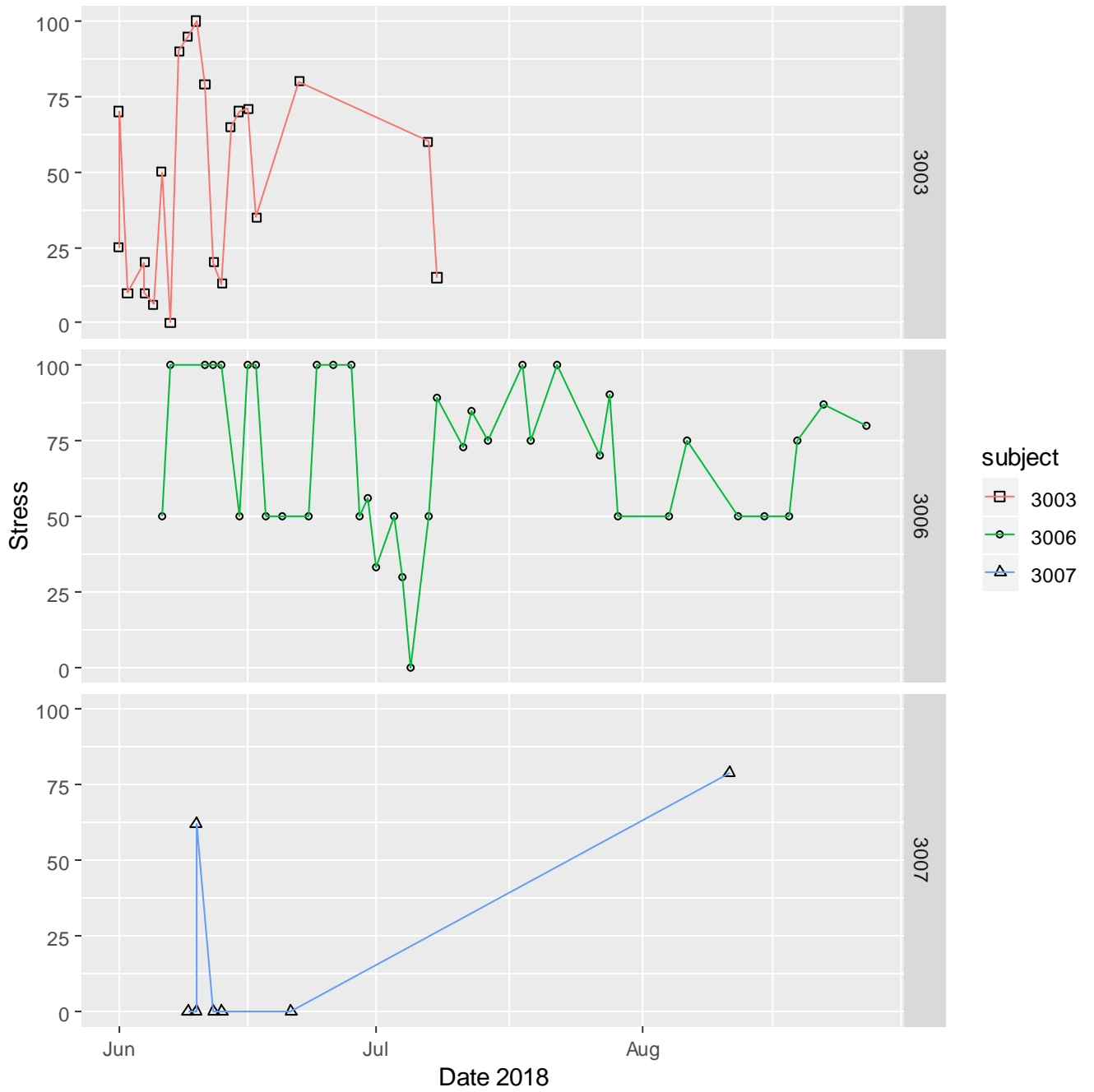


Figure 16: Wave 1 Motivation scores over calendar time

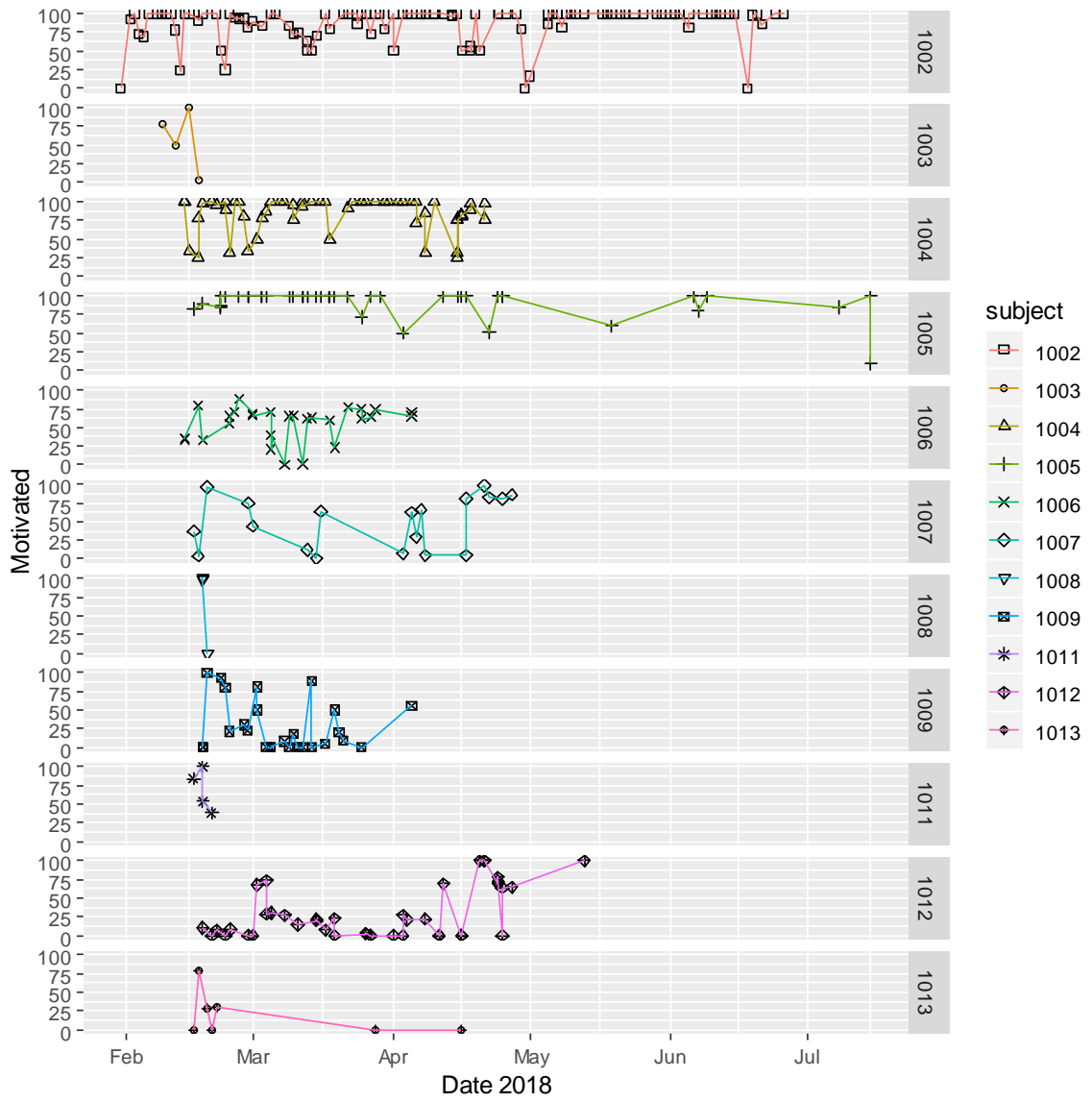


Figure 17: Wave 2 Motivation scores over calendar time

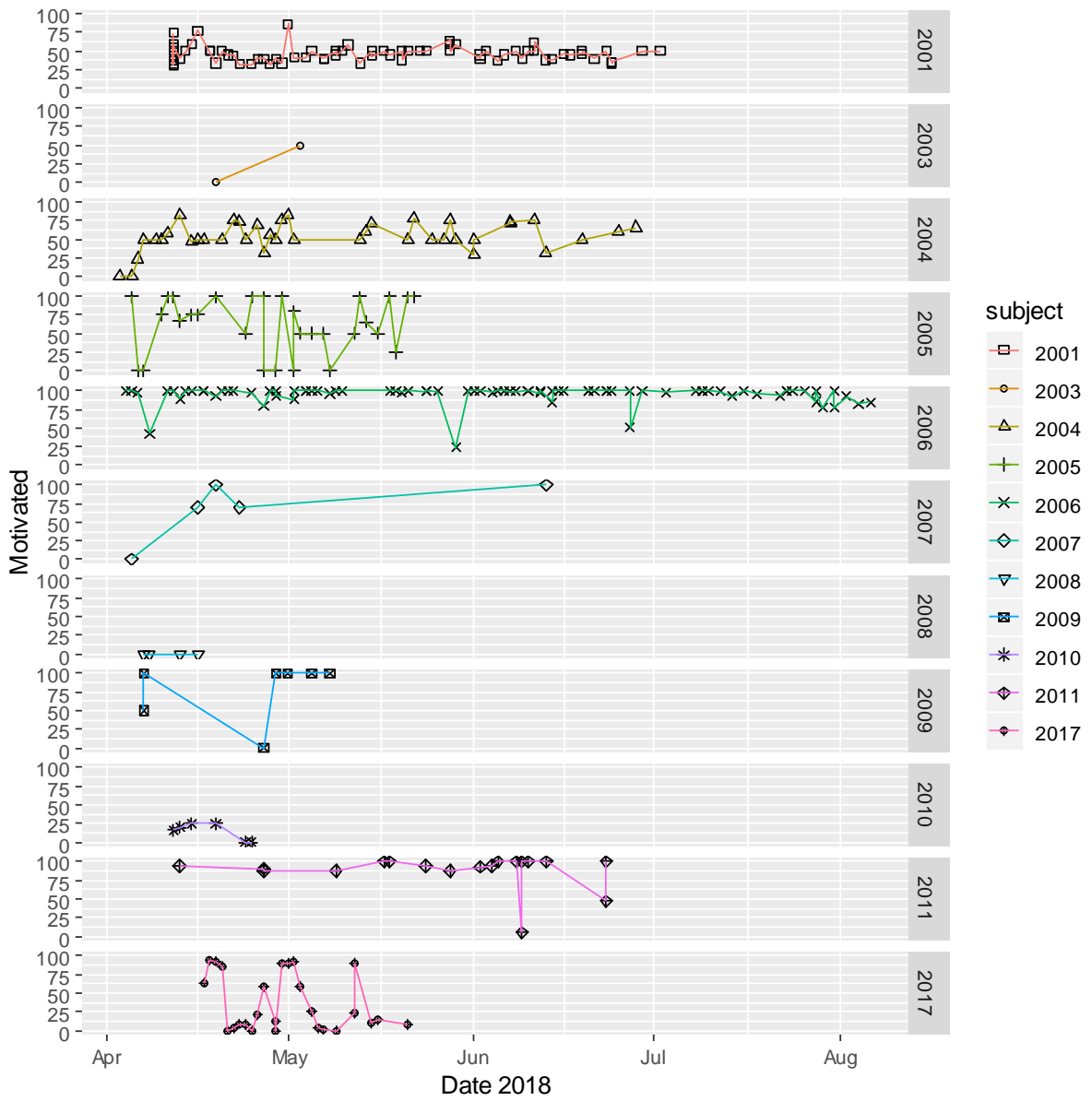


Figure 18: Wave 3: Motivation scores over calendar time

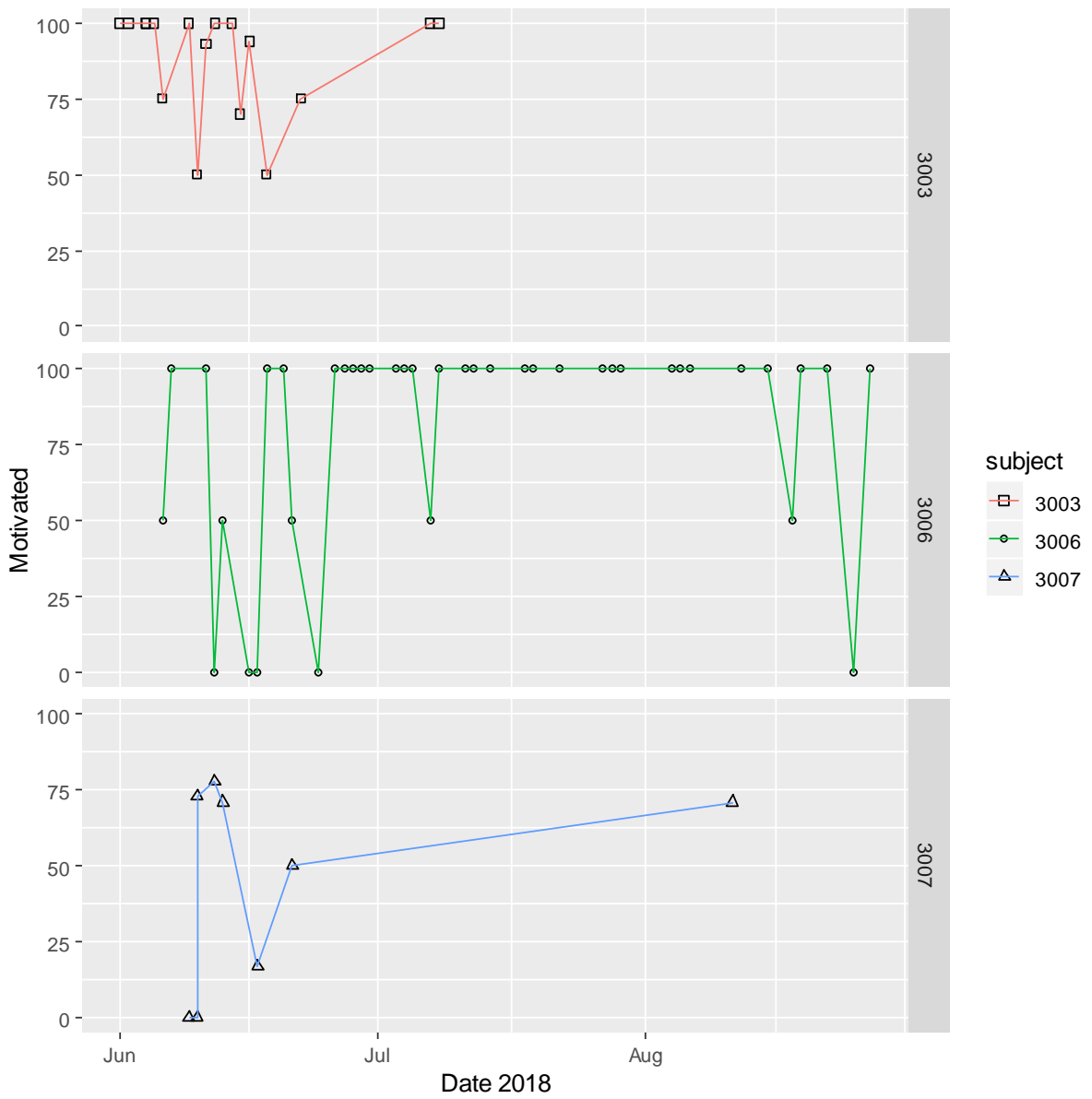


Figure 19: Wave 1 Tempted scores over calendar time

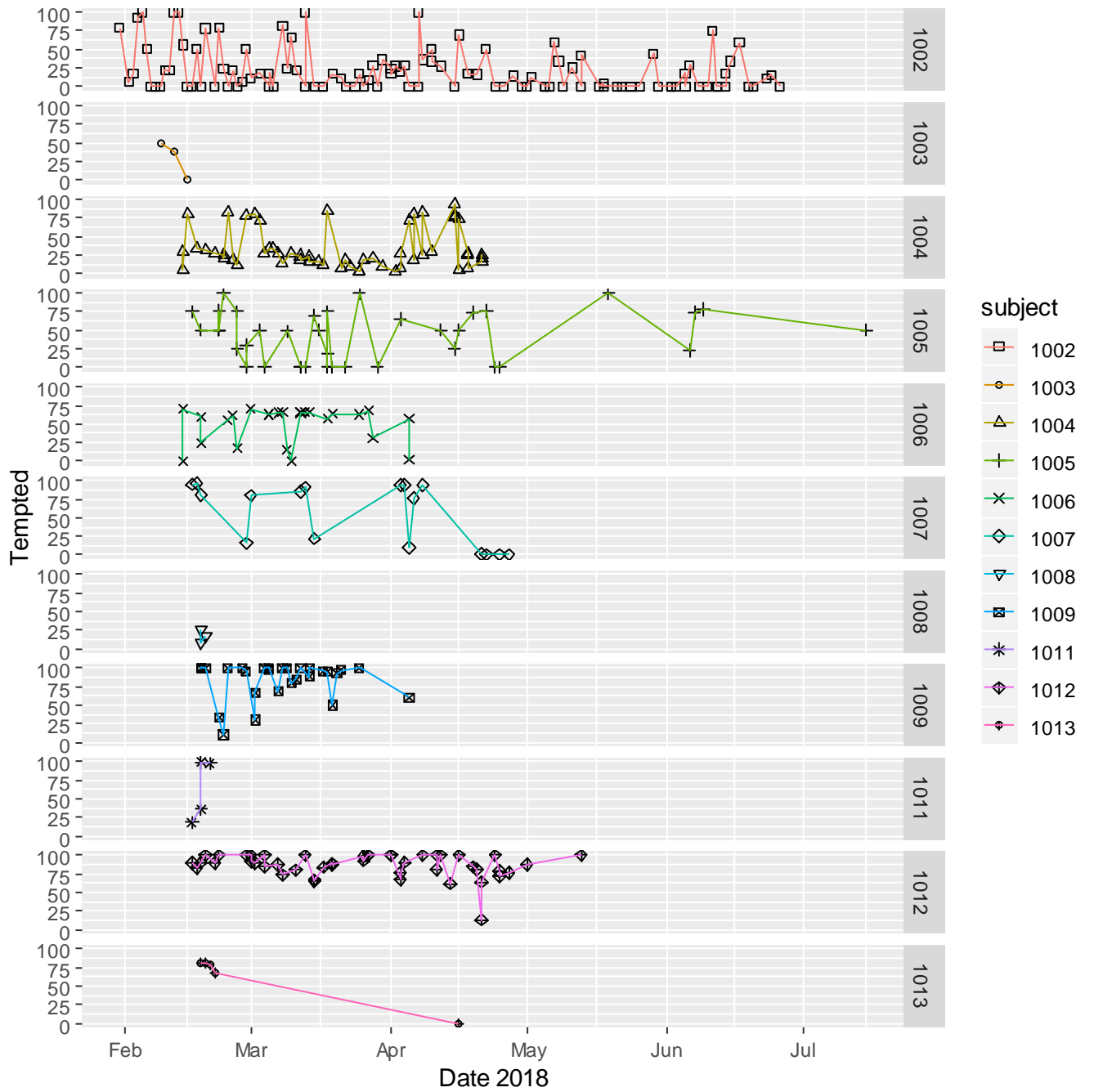


Figure 20: Wave 2 Tempted scores over calendar time

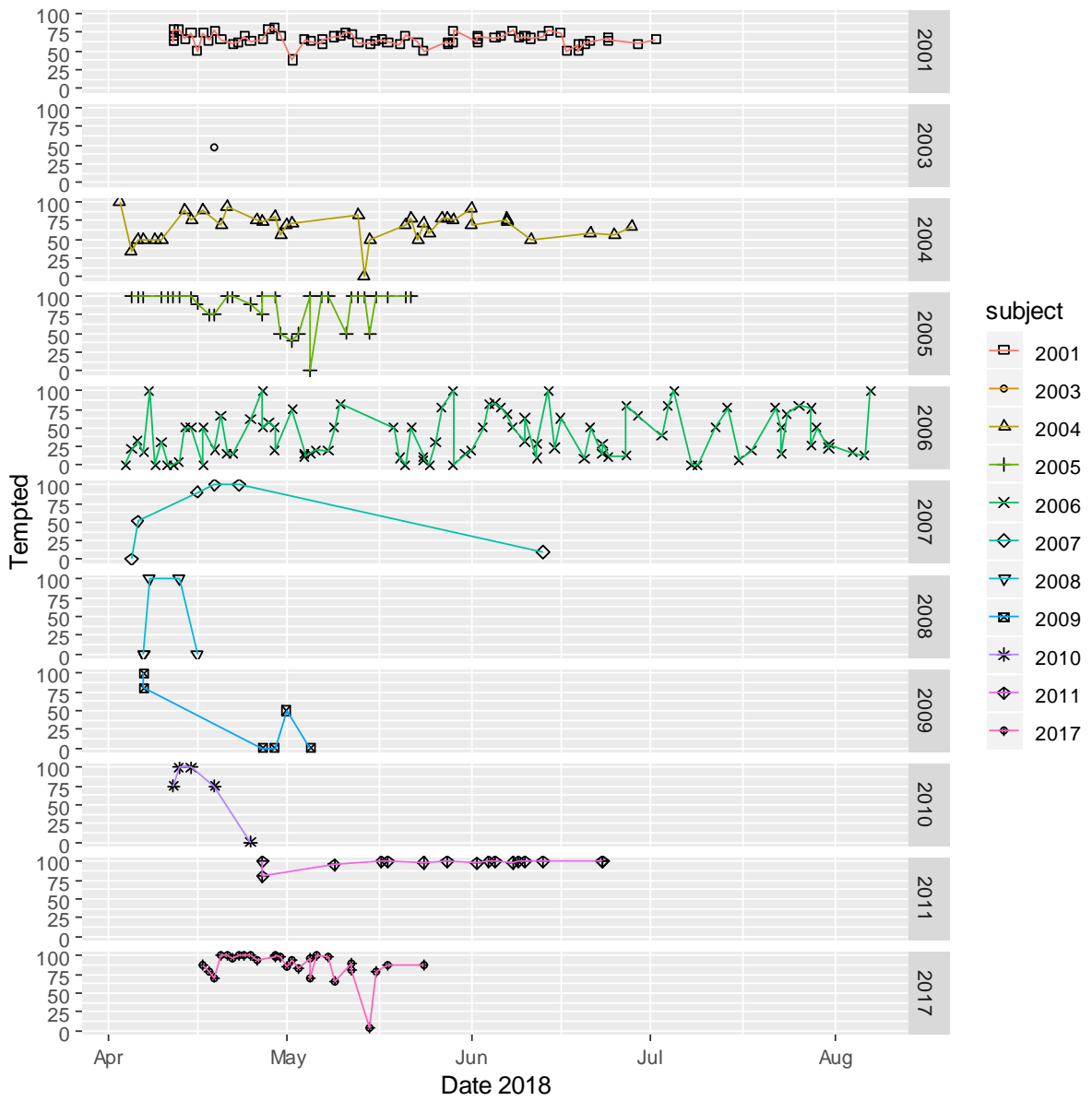


Figure 21: Wave 3: Tempted scores over calendar time

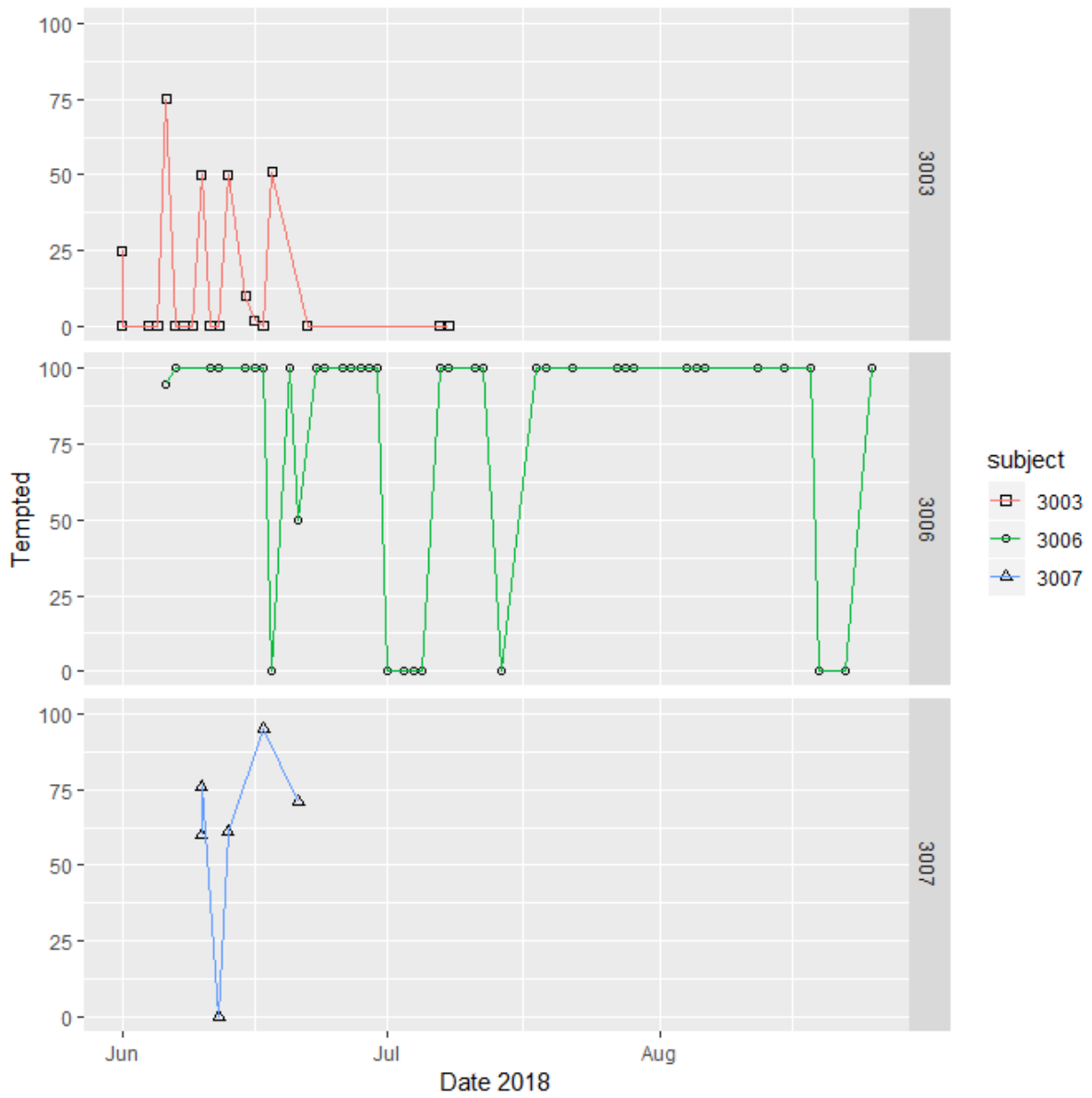


Figure 22: Wave 1 Effort scores over calendar time

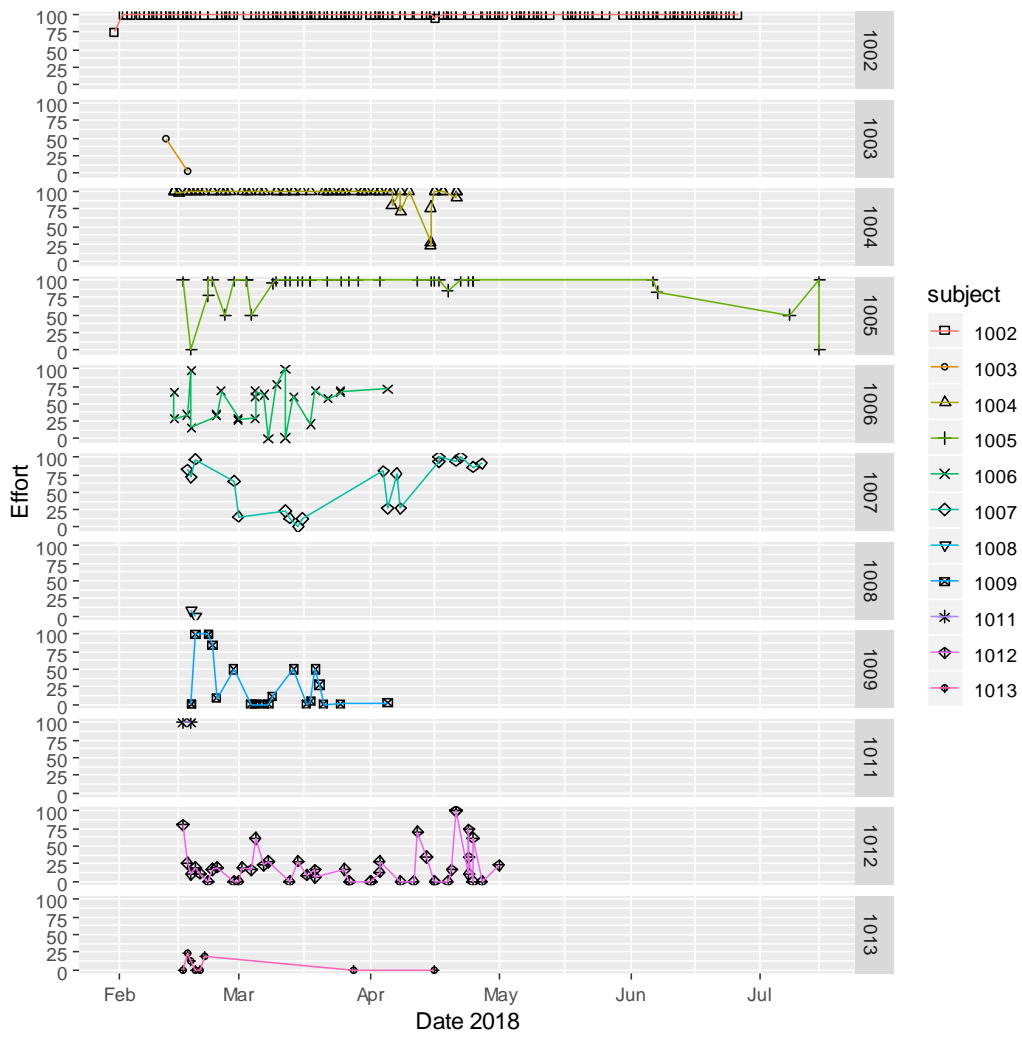


Figure 23: Wave 2 Effort scores over calendar time

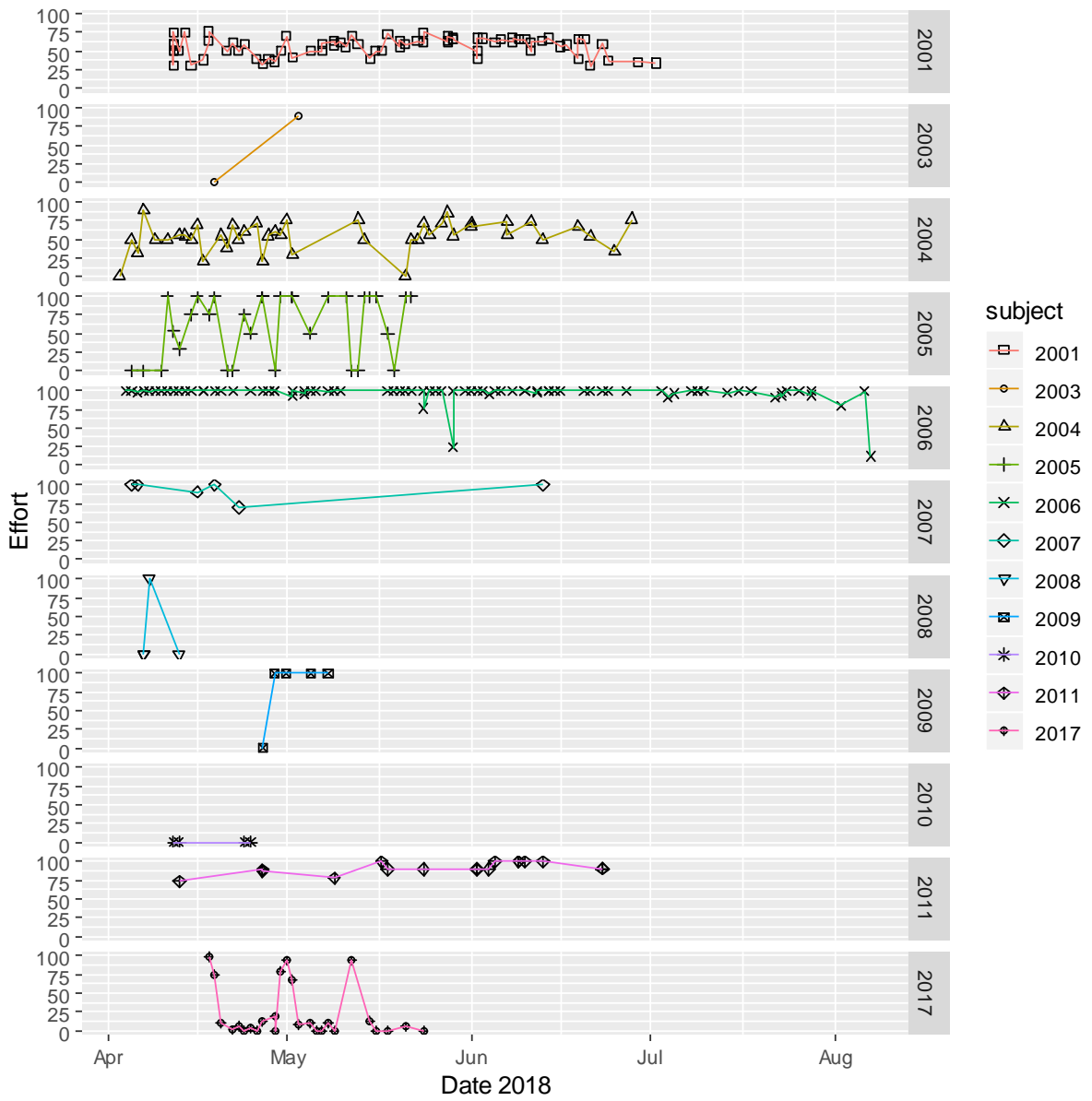
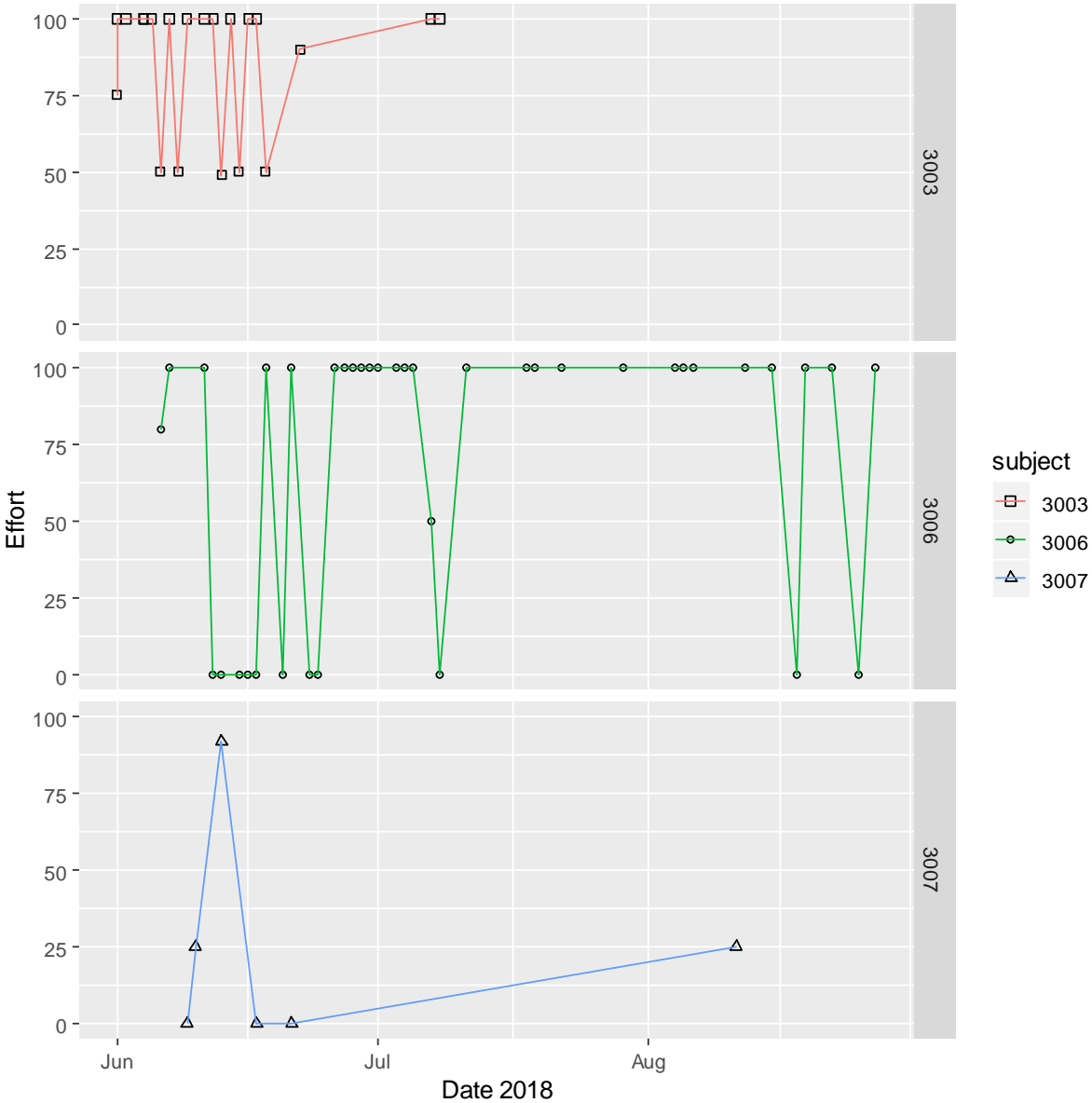


Figure 24: Wave 3: Effort scores over calendar time



Visual plots of social contact

The figures below show the extent of social contacts the respondents reported during the study. Time moves from left to right, and each horizontal row refers to each category of social contact the respondents answered about (family, friends, peers etc.). The coloured lines indicate that the respondent did meet this person on the day in question, while the dark grey background shows that they did not meet them. The light grey vertical lines show the days where the participant didn't complete the survey.

Figure 25 shows the social contacts for participant 1002. This participant was in the study for 166 days in total, and answered on 77% of days. The blue and purple rows show that they were in contact with professionals almost every day they completed the survey, and drug recovery peers on most days. They were much less frequently in contact with family, and less frequently with friends outside the recovery community.

Figure 25: Social contact over time - ID 1002

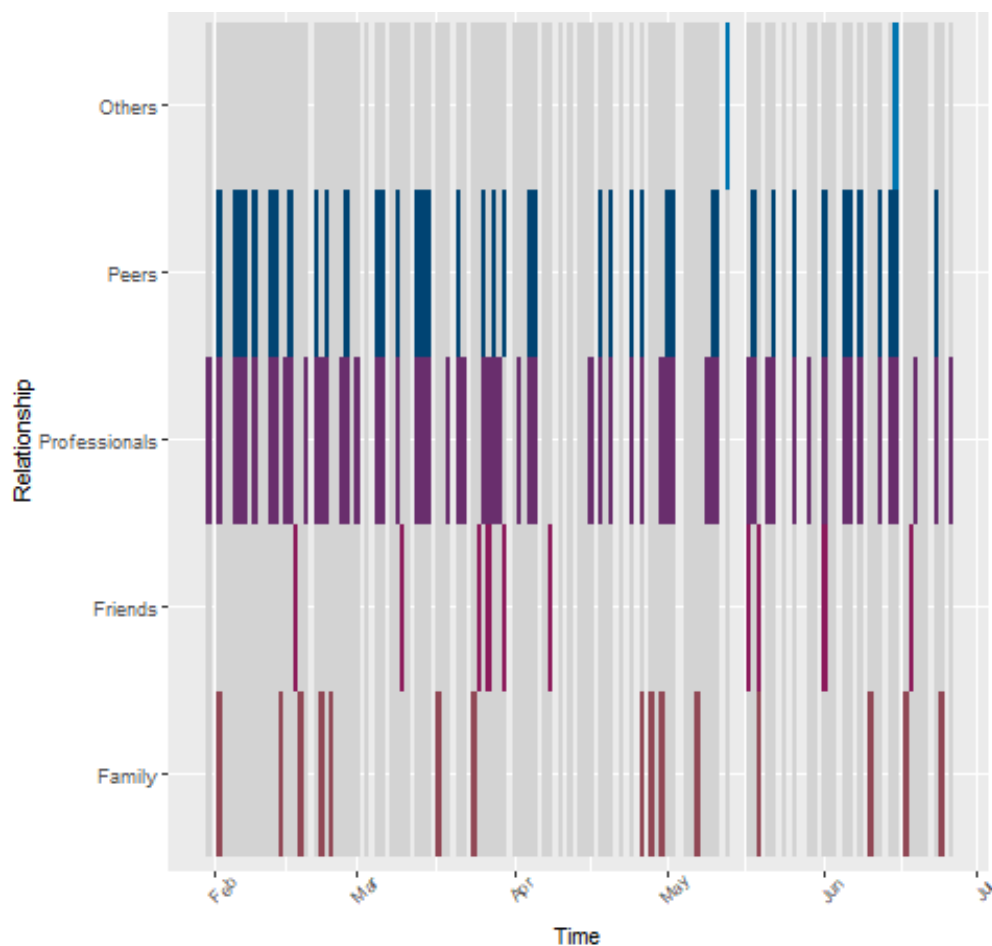
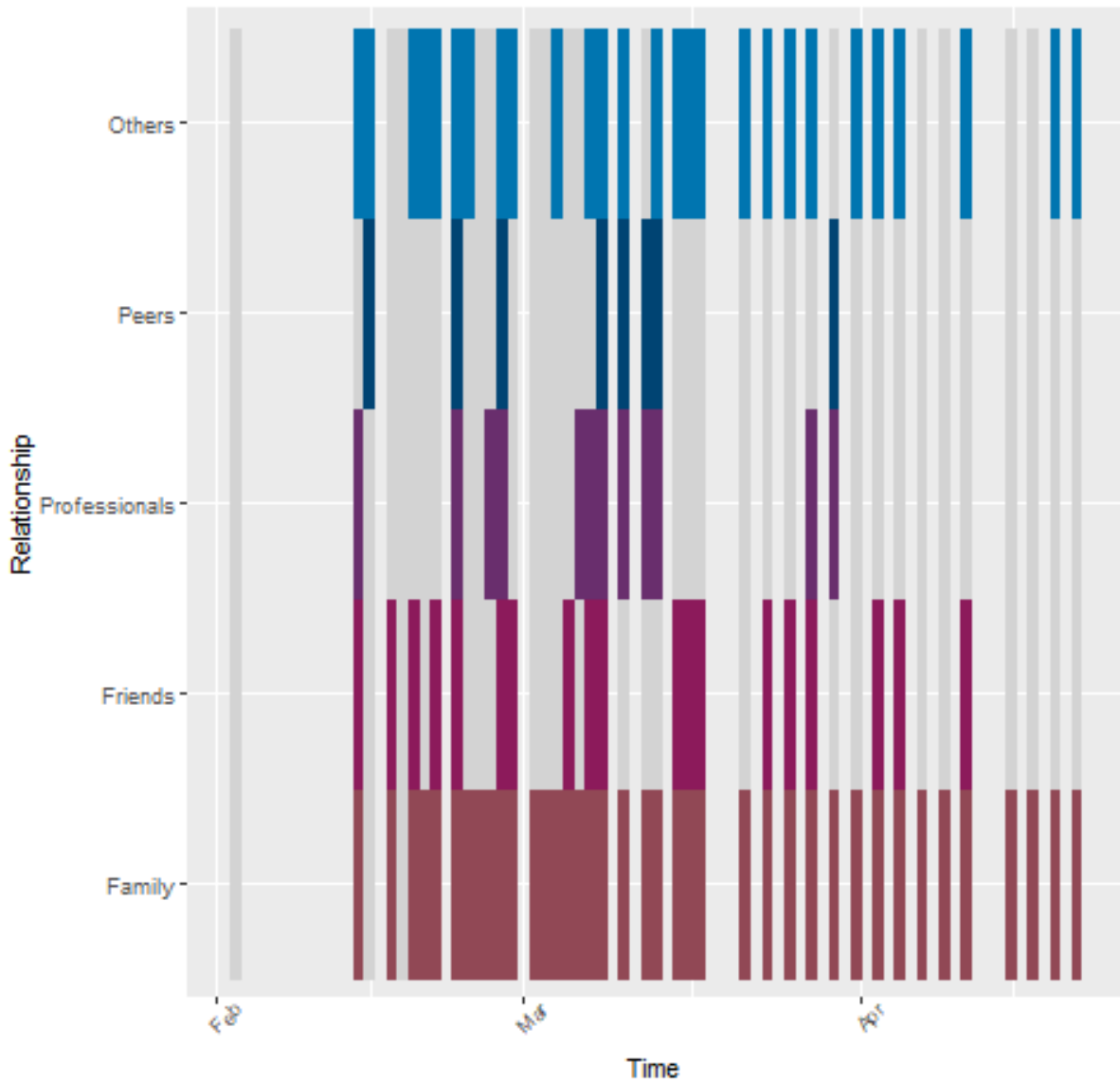


Figure 26 shows the same data for participant 1004. In contrast to 1002, this respondent was in contact with family almost every day, was in contact with professional and peers less regularly, much less frequently in April than in March, and was very frequently in contact with other non-family/friend/peer contacts.

Figure 26: Social contact over time: ID 1004



The remaining figures from Figure 27 to Figure 39 show the response patterns for those that provided moderate or good quality data – there is clear variation in the diversity and the frequency of social contact between the respondents. The remaining plots are presented in small multiples to facilitate visual comparison, with some supporting text for a subset of the charts to contextualise the comparisons.

Figure 27: Social contact over time: ID 1005

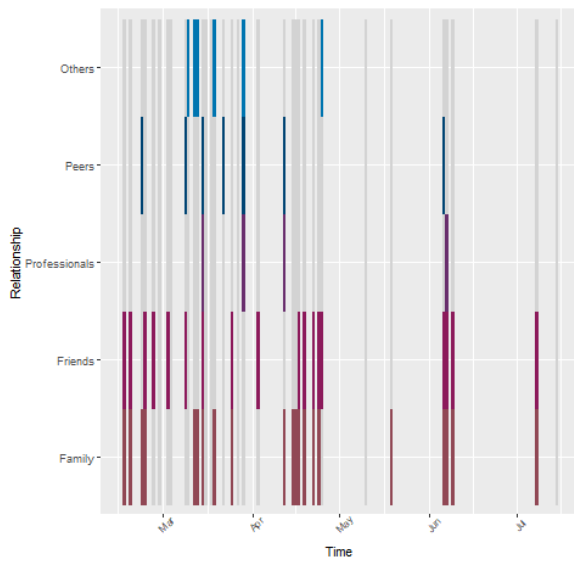


Figure 29: Social contact over time: ID 1007

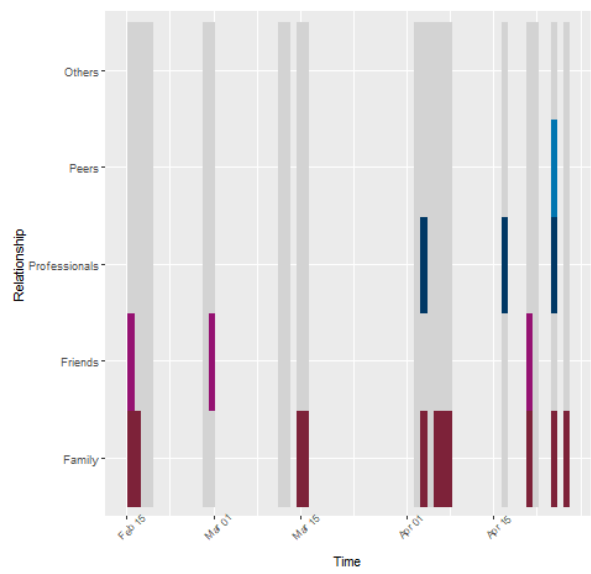


Figure 28: Social contact over time: ID 1006

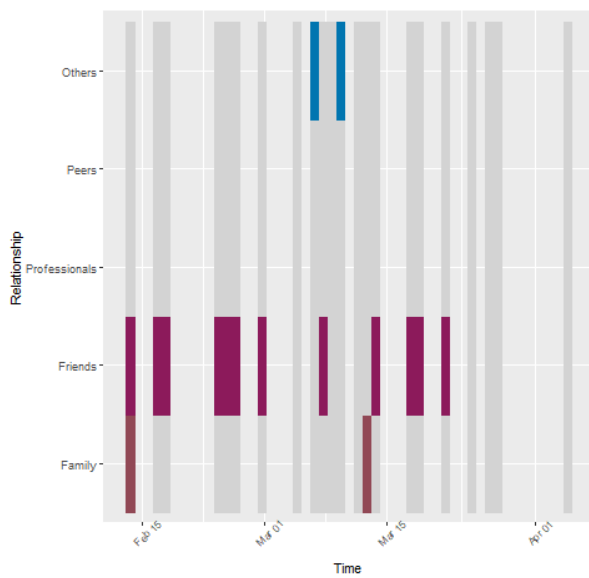
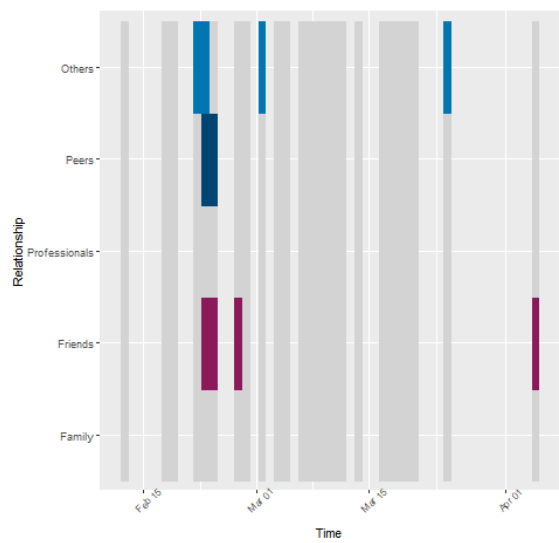
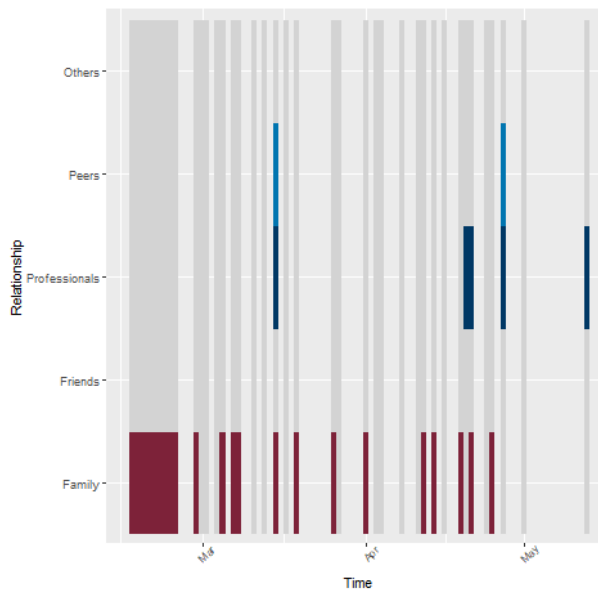


Figure 30: Social contact over time: ID 1009

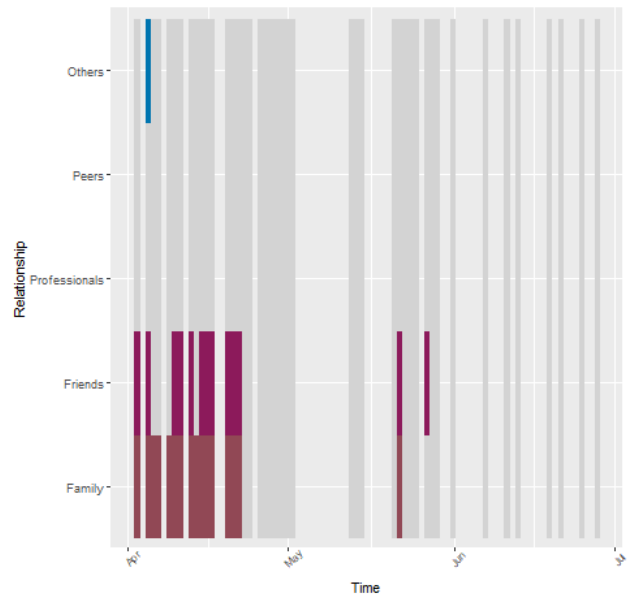


ID 1009 reported contacts on only a few days, and no family contact

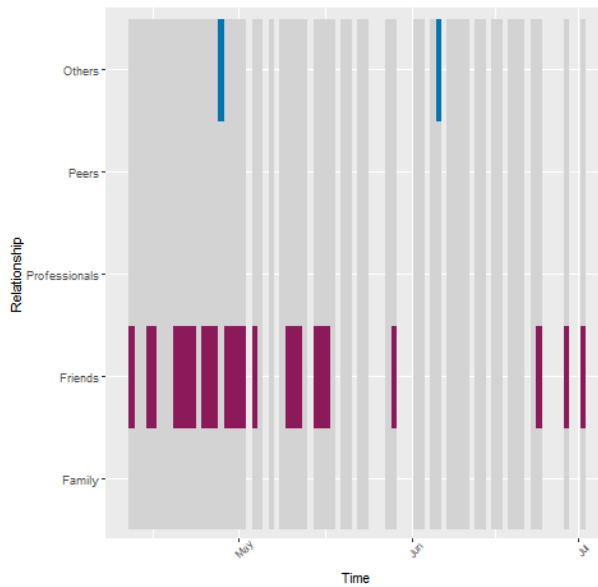
**Figure 31: Social contact over time:
ID 1012**



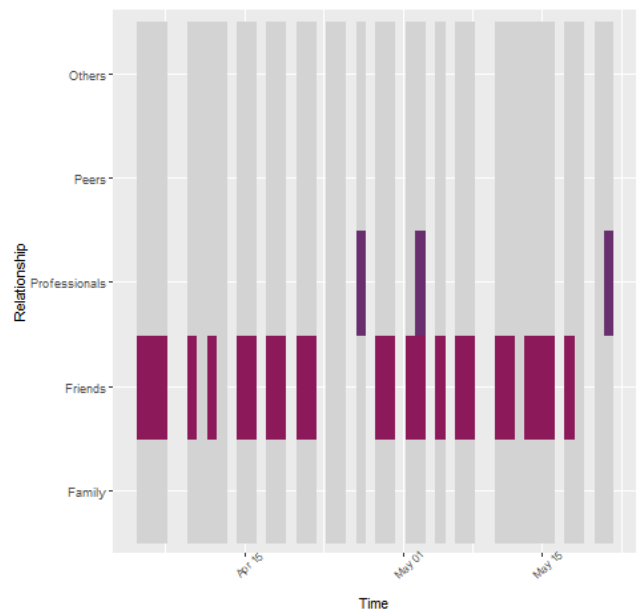
**Figure 33: Social contact over time:
ID 2004**



**Figure 32: Social contact over time:
ID 2001**

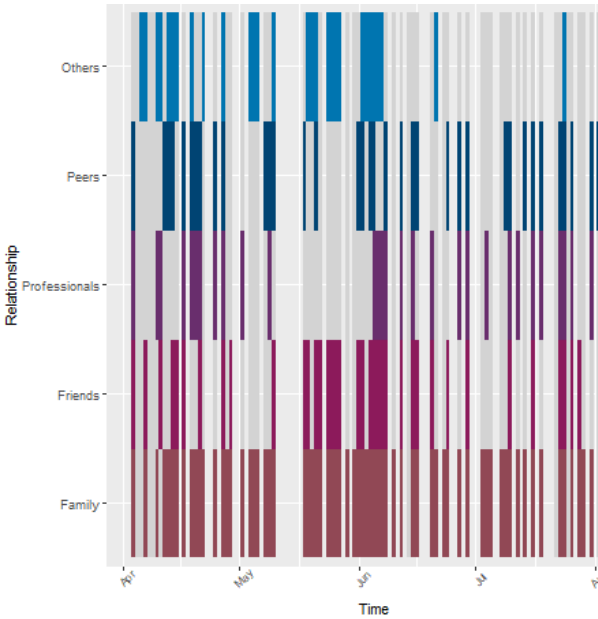


**Figure 34: Social contact over time:
ID 2005**

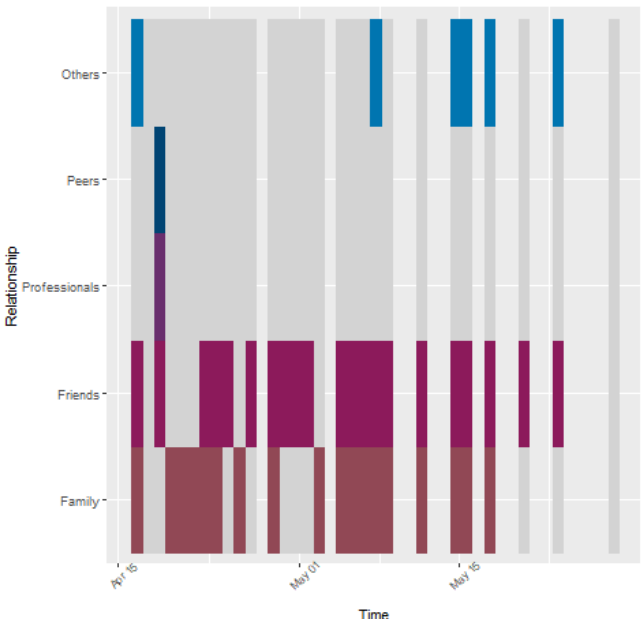


2001 and 2005 had no family contact, but regular contact with friends

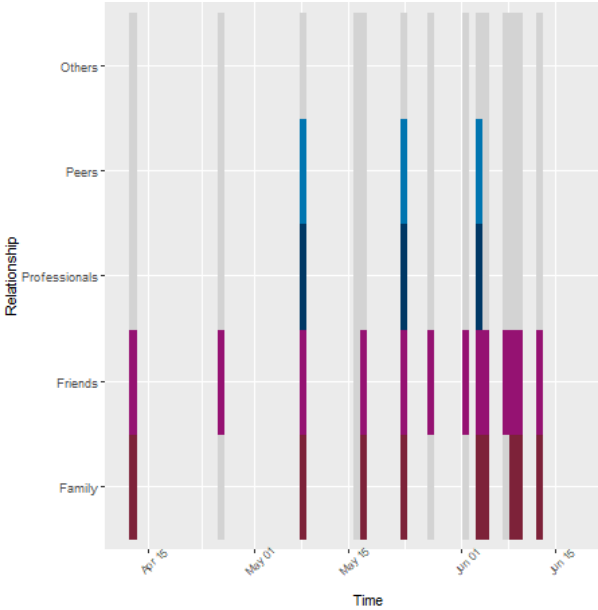
**Figure 35: Social contact over time:
ID 2006**



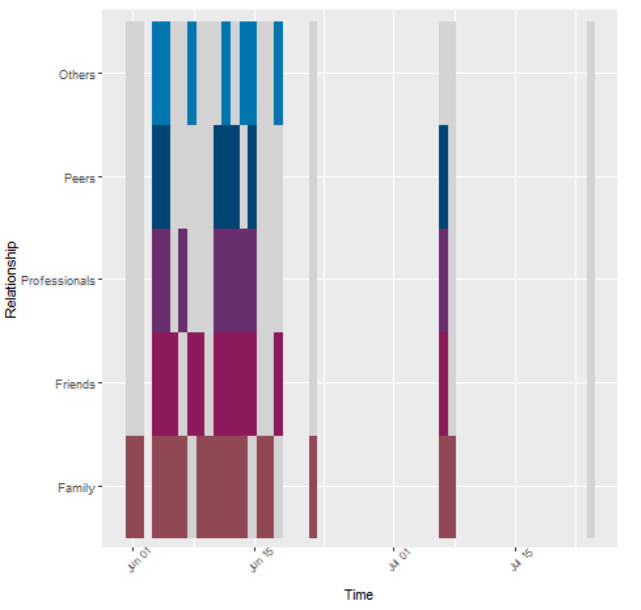
**Figure 37: Social contact over time:
ID 2017**



**Figure 36: Social contact over time:
ID:2011**

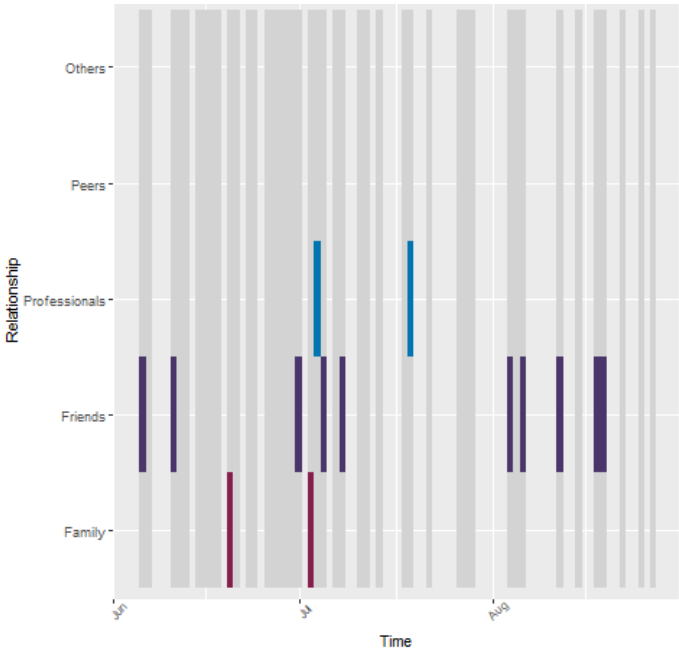


**Figure 38: Social contact over time:
ID 3003**



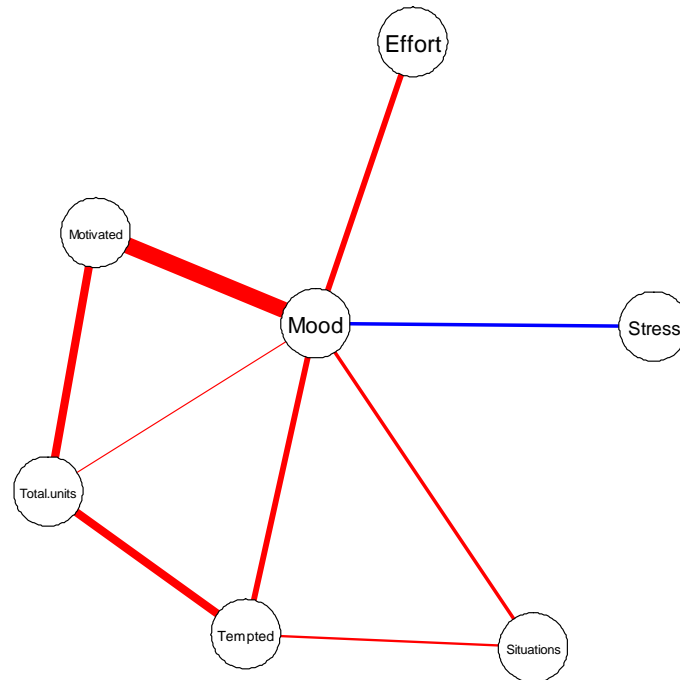
2006 and 3003 had frequent interactions with a diverse range of people

**Figure 39: Social contact over time:
ID 3006**



Correlation networks for participants

Figure 40: Partial correlation plot for ID 1005



Participant 1005 went for long periods without completing a survey. The high proportion of missing data means that her results may be prone to bias, as she may have been drinking differently on the periods where she did not complete the survey. The correlation map is much more densely connected and more complex to interpret, and must be interpreted with caution given the data quality issues. Before considering the correlations, and looking at the overall pattern of responses: 1005 reported drinking on 17% of the days she was in the survey, these were quite evenly spaced out across the study period. Her motivation and effort were consistently high, but temptation, stress and mood varied widely over the course of the study.

Better mood was associated with lower stress and higher effort, while effort and stress were not associated with any other factors. On the other hand, temptation, motivation, and alcohol consumption were clustered together around mood. Better mood was linked to higher levels of motivation but also higher temptation, which were in turn linked to higher alcohol consumption. There was a weaker association, but being more often in situations with alcohol was linked to higher temptation and also better mood.

The graph is centred around mood, which appears to be the key factor linking the other dimensions. The overall structure is much more clustered than the previous respondents, with many triadic structures of direct links between three variables. Acknowledging that other causal interpretations are possible; these triadic clusters could be interpreted narratively as follows:

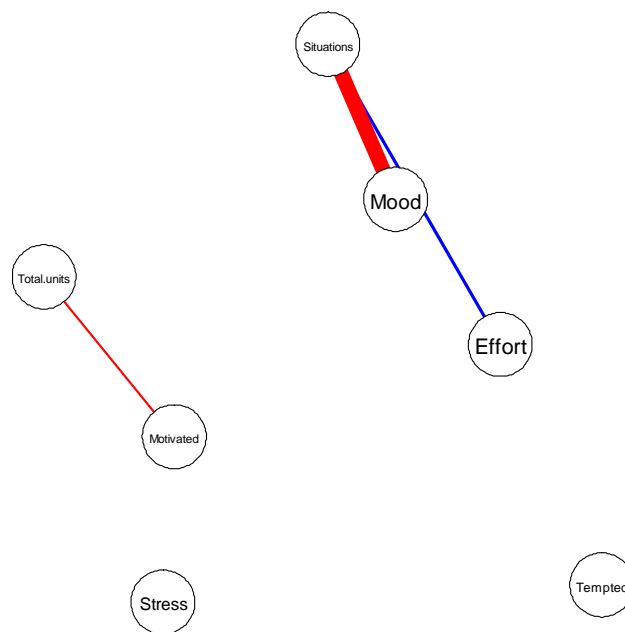
- *Mood – Motivation – Total Units*: On days where 1005 reported better mood, mood acted as a protective factor, increasing motivation not to drink, however

– the elevated motivation may have acted as a limiting factor against otherwise uncontrolled use.

- On most days, 1005 was never around alcohol. On the few days where she was more often in alcohol-available situations, her mood improved – perhaps through the social support and interaction, but being in this risk situation increased temptation, which had a subsequent effect on alcohol consumption.

In qualitative analysis of text message responses, 1005 reported using alcohol under social circumstances, in some cases this was reported under controlled circumstances “only 2 small glasses I enjoyed but had enough at that”, but sometimes guilt “after [stressful social interaction] I bought 1 bottle of wine But I am not proud that I done that”.

Figure 41: Partial correlation plot for ID 1006



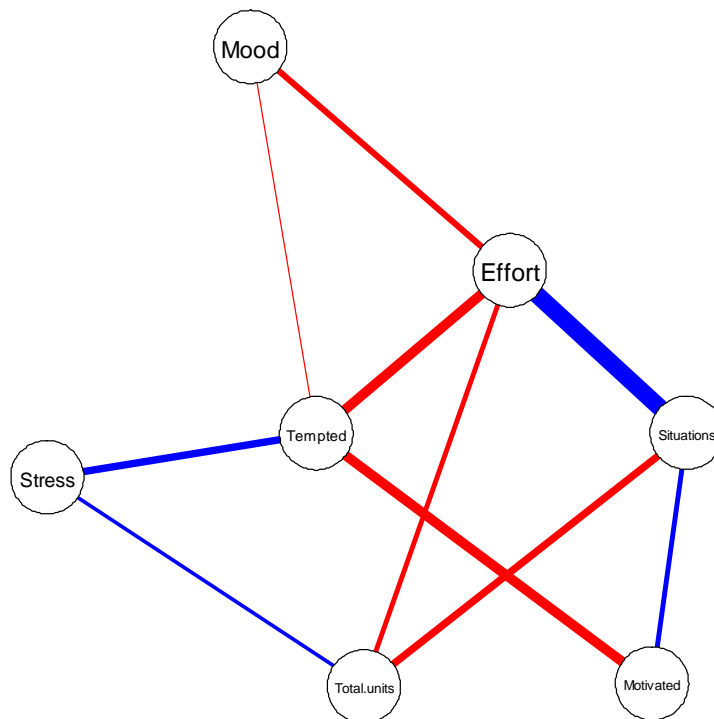
Participant 1006 had an intermitted data response pattern, frequently missing a couple of days at a time, and completing the survey for a few days in a row. This again compromises the ability to make strong conclusions over the analysis. There was also rather little variability in their answers to the situations question, reporting quite a high proportion of the days being in situations where alcohol was available, with only one day where this was very low.

The graph is highly disconnected, suggesting there are few connections between factors. This may be explained by the low variability in their responses and the missing data. The main connections suggest that on days where they were in higher alcohol availability situations, they reported better mood and lower effort, but these factors didn't relate to their drinking. The only factor that was related to their alcohol was their

motivation, which was not protective but may be evidence of a reactive restraining factors (higher motivation was linked to higher consumption).

In the qualitative text responses, 1006 reported working shifts, and time off from work was related to their drinking. The disconnected structure may reflect the influence of working routines having a larger influence than the psychosocial factors captured in the data.

Figure 42: Partial correlation plot for ID 1007



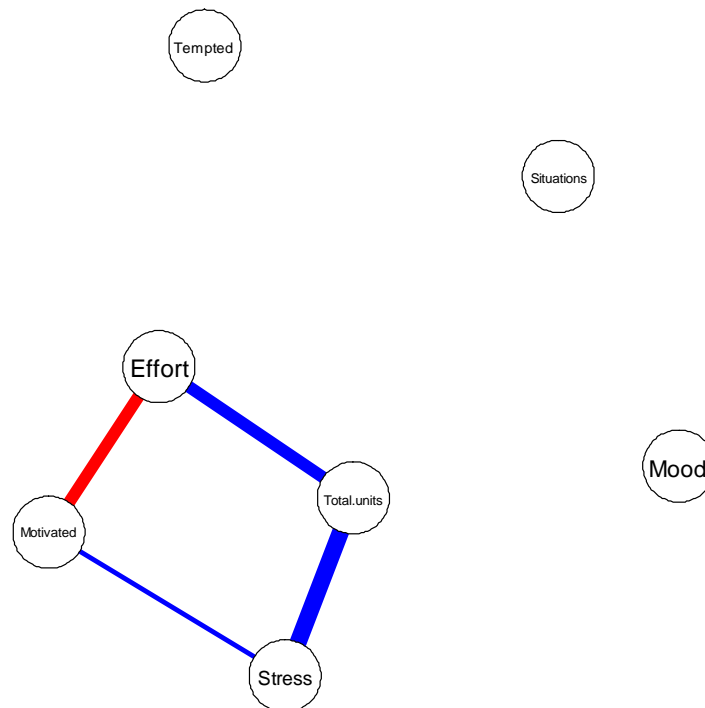
Participant 1007 had marginal quality data as they responded on less than 50% of study days. She reported drinking on 38% of those days, and always reported the same number of units on the drinking days, which was always one bottle of cider. As such, the correlation with total units essentially represents a drinking (yes/no) association.

1007's graph also shows a complex, clustered set of relationships. The two most highly connected and central factors were temptation and effort. Higher temptation was related to higher effort and lower stress, but temptation was not directly related to drinking.

Lower mood, being more often in situations around alcohol, and lower temptation were linked to lower effort – this in turn related to slightly lower drinking. Alcohol consumption itself was directly related to lower levels of stress, and more often being in situations where alcohol was available. This could perhaps be explained by the participant reporting drinking cider at home while avoiding social contact.

Looking at the network structure, temptation and effort were the two most central factors with four connections each, but effort could be considered more central through its relation to drinking outcome. This graph also has a complex, clustered pattern.

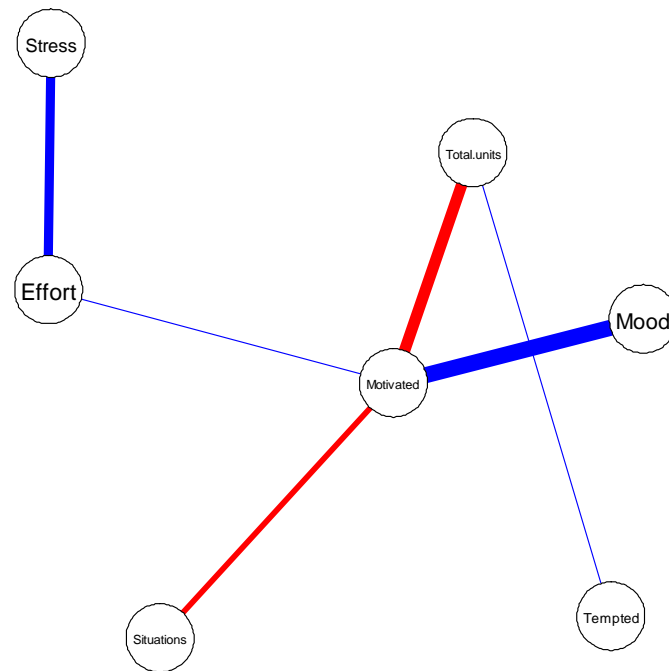
Figure 43: Partial correlation plot for 2001



Participant 2001 provided high quality data, answering on over 75% of days. He reported drinking on 22% of the surveyed days. He reported drinking either one or two bottles of cider per day - or occasionally beer, cider or spirits with friends - in the early part of the survey. After the first of June, he reported drinking either one bottle of spirits, or a 12 pack of beer. On days where his alcohol consumption was higher, he reported lower effort but also lower stress. Higher motivation was linked to higher effort and lower stress, but neither motivation, nor any other factors were connected to alcohol use.

There is no single central factor that is more connected than others, and the overall structure of the graph is very disconnected. This suggests that 2001 has very limited factors to act as psychosocial resources that could limit alcohol use, apart from making a conscious effort – but must contend with sources of stress that encourage greater drinking. The sources of stress don't seem to relate to situations where alcohol was available, so may be broader social factors that weren't captured in the daily survey questions.

Figure 44: Partial correlation plot for 2004

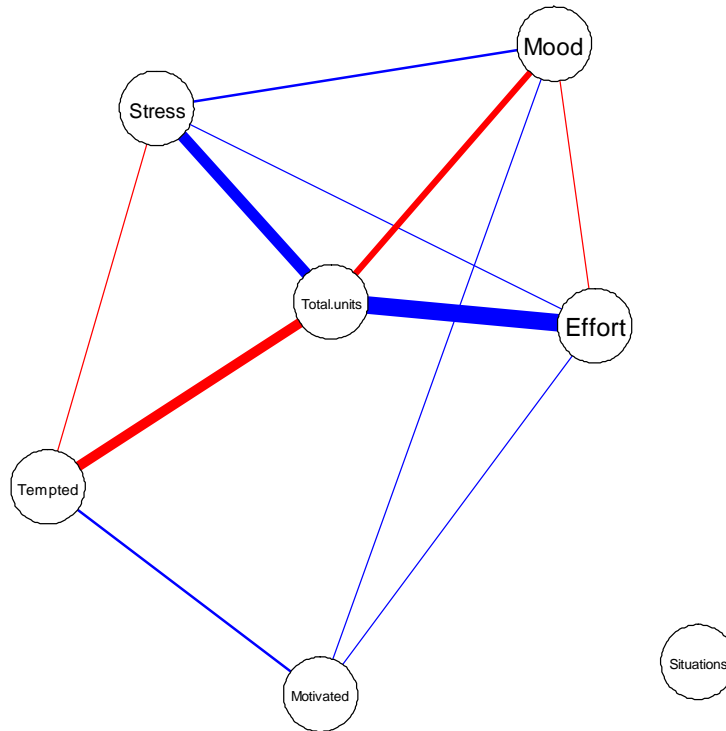


Responded 2004 provided reasonably good quality data and reported drinking on most days of the study. The respondent drank a half bottle of spirits on most days of the study, occasionally drinking beer and wine as well.

Higher motivation and to a lesser extent, lower temptation was linked with higher consumption. The key determinants of high motivation were, low mood, and being in situations where alcohol was more often available. Higher levels of stress were also associated with lower effort, and higher effort had a small link to lower motivation. The positive correlation between consumption and motivation may be an indication that – on drinking days – he was motivated to control the amount he drank.

Overall, the graph had a very centralised structure. Motivation was the key limiting factor of negative influences on alcohol use: acting either to curtail the influence of risk social situations with alcohol, or limiting the extent low mood influenced elevated drinking. While motivation played a central role in how he controlled his drinking, it appeared that situations of high stress elicited lower effort to control drinking.

Figure 45: Partial correlation plot for 2006



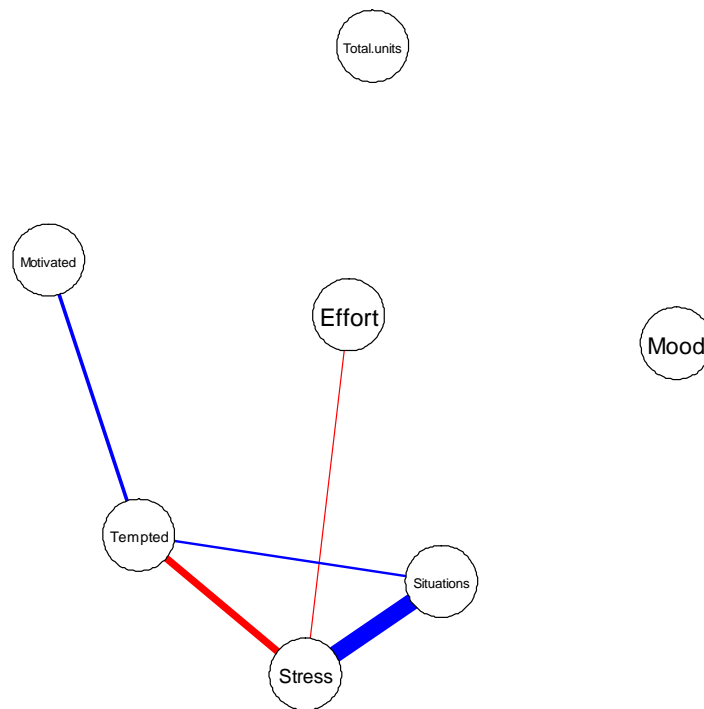
Respondent 2006 reported drinking on only two days. He reported 100% effort on all days apart from the two drinking days, similarly, temptation was reported at maximum. Given the low number of observations, it's important not to overinterpret the connections to the level of alcohol use.

While there was a high overall level of clustering, there were only minimal connections between the other factors, and none of them seemed to relate to being in situations where alcohol was available (which was reported as being at very low levels throughout the study). 2006 reported frequent contact with family, friends, mutual aid and professional services throughout the study, and in free text surveys reported that they were aware of the key triggers in their environment and his conscious attempts to avoid succumbing to them.

“This is the toughest time I’ve had in my abstinence. As a frosty jack drinker it is now cheaper to buy a bag of smack than it is to buy this.”

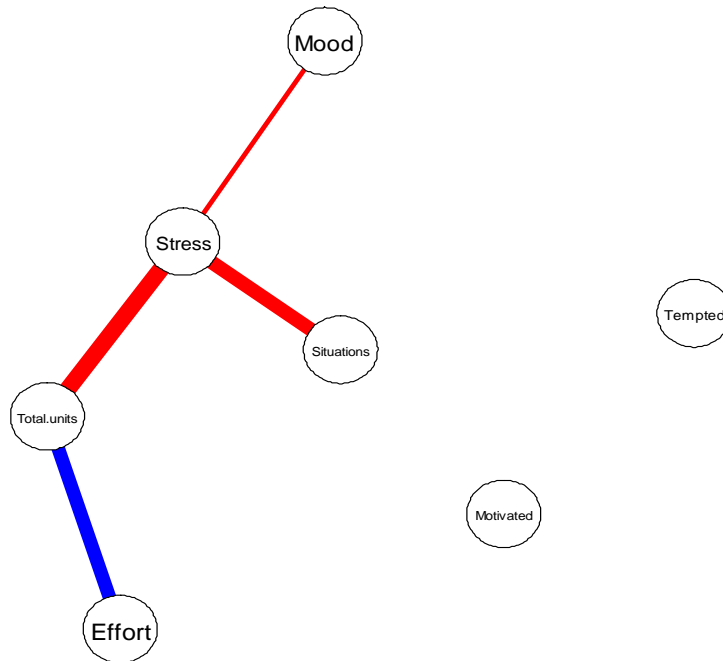
NB: A 310cl bottle of Frosty Jack’s cider contains 22.5 units of alcohol. Before MUP it was priced around £3.59, after the policy change the price went up to £11.25. A “bag of smack” refers to heroin, sold in bags averaging 0.2 grams.

Figure 46: Partial correlation plot for 2011



Respondent 2011 had moderate quality data. He missed out a large number of days at the start of the study, before beginning to answer more regularly via paper completion. He drank one bottle of cider on most days of the survey, occasionally reporting other alcohol use. There was very little variability in his answers on other questions, which may be an artefact of the paper completion. The correlation graph appears above for transparency of reporting, but given the data quality issues, we offer no substantive interpretation.

Figure 47: Partial correlation plot for 2017

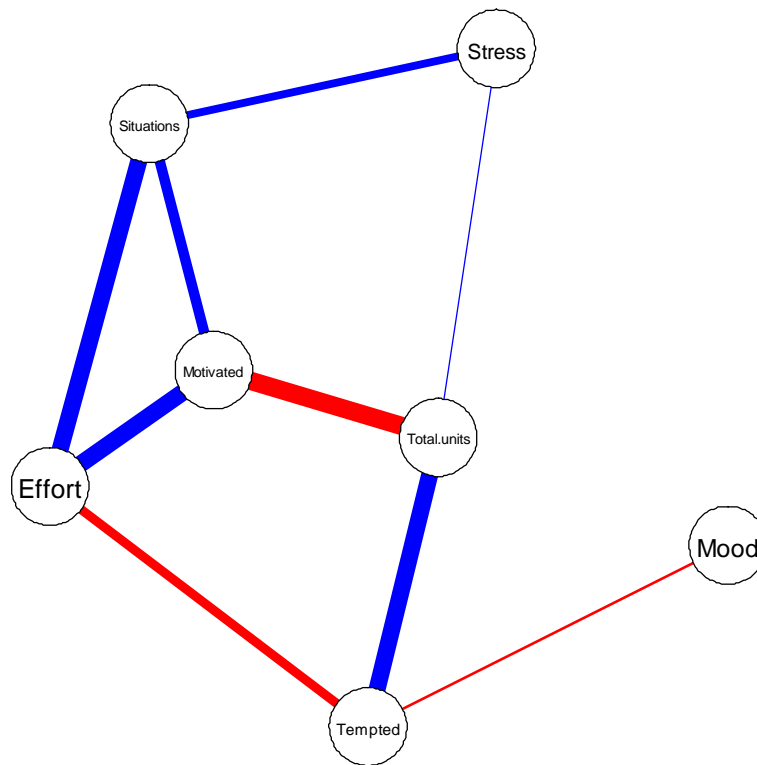


Respondent 2017 provided reasonable quality data, responding on over 65% of days. She reported drinking on over 80% of those days, with wide variation in amounts, drinking wine and spirits, and occasionally beer and cider.

Stress was the most central factor. Higher stress was linked to being in situations where alcohol was more often available (she reported very high levels of situational availability throughout the survey); higher alcohol units, and slightly better mood. Temptation and motivation weren't linked to any other factor, but higher effort was related to lower consumption.

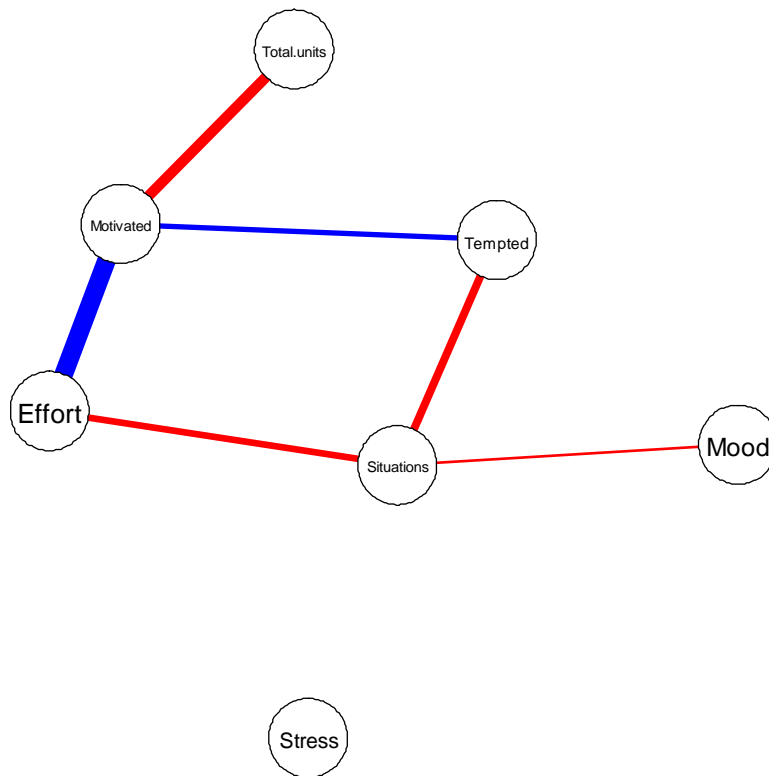
The overall structure suggests that 2017 doesn't have a strong set of preventive factors, relying primarily on effort to reduce use. In the free text responses, she reported enjoyment and socialising with others, but also being very stressed, in relation to general social circumstances, not alcohol specifically.

Figure 48: Partial correlation plot for 3003



Respondent 3003 provided moderate quality data, completing on only 40% of study days. He only drank on three days during the study, all around one week apart. Given the low data quality and low levels of drinking, we do not offer an interpretation of the graph.

Figure 49: Partial correlation plot for 3006



Respondent 3006 provided moderate quality data, participating on around 50% of the study days. On the days where he did report drinking (about 40%) he reported drinking the maximum number of cans of beer possible in the survey (ten or more). Hence, the total units variable represents a drinking versus a non-drinking day.

The pattern of responses for 3006 were not conducive to statistical analysis. For most variables, the response was 50% (the default value on the survey), 0%, or 100%. For example, motivation varied between these three values on the drinking days, but was rated at 100% on non-drinking days.

The low variability in response patterns makes it difficult to draw interpretations, so we do not offer an interpretation.