Electronic brief personalised feedback interventions for alcohol use

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Developing and implementing effective interventions to prevent and intervene with harmful alcohol use remains imperative if the global burden of alcohol related harms is to be reduced and the lives of those affected improved. Excessive alcohol consumption remains a significant public health problem. Worldwide, three million deaths every year are attributed to the harmful use of alcohol (World Health Organization (WHO), 2018). Harmful use is linked to 200 health conditions; including liver disease, cardiovascular diseases, and poor mental health (WHO, 2018). The misuse of alcohol has negative health and social consequences for the individual and wider society. The WHO aims to cut the harmful use of alcohol by 10% by 2025 (WHO, 2018). Recent evidence suggests this target is unlikely to be met, instead it appears that annual consumption of alcohol globally is on the increase (Manthey et al., 2019). Brief alcohol interventions offer one means of rapidly intervening to reduce and avoid harmful alcohol use, particularly via electronic personalised feedback: the aim of this chapter is to review the intervention content, evidence base, effectiveness, future challenges and opportunities associated with the use of electronic brief interventions for alcohol.

Alcohol interventions

Brief alcohol interventions are one effective method for reducing harmful alcohol use (Platt et al., 2016; Angus, et al, 2014; Kaner, 2009). Brief interventions generally include a focus on individuals' beliefs and attitudes, their self-efficacy, and a focus on how an individual's behaviour or attitude compares to other people's (Kaner & Bewick, 2011). Brief alcohol interventions differ in their mode of delivery, intervention content, and duration. For example, they may be delivered in a single (e.g. Acuff et al., 2019) or multiple sessions (e.g., Liu et al., 2011), on an individual (e.g., Carey et al., 2006) or group basis (e.g., Kenney et al., 2014). They may include personalised normative feedback (e.g. Wilke et al., 2014), motivational interviewing (e.g., Daeppen et al., 2011), or cognitive behavioural therapy (e.g., Marques and Formigoni, 2001). Despite the growing evidence for the effectiveness of brief alcohol interventions, their impact on the prevalence of harmful alcohol use is unexpectedly low (Riper et al., 2018). In part this is due to the challenge of successfully implementing brief alcohol interventions. Traditional, human-supported brief alcohol interventions can be costly, labour intensive, and difficult to implement on a large-scale (Carey et al., 2007). Electronic brief alcohol interventions may address some of these challenges.

Electronic brief alcohol interventions

The development of the ubiquitous internet affords an opportunity for scalability of electronic brief alcohol interventions, and their availability continues to increase over time (Riper et al., 2011). Time has also seen an increase in the quality of studies, with a marked increase in studies using

randomised controlled trials (Cunningham et al., 2010) Electronic brief alcohol interventions provide several opportunities that are difficult to deliver with offline equivalents. For example, they are able to deliver interventions in ways that can be tailored to the individual and reactive to their beliefs and behaviours. This differs from other forms of public health intervention that are more static or passive in nature. For example, a mass media campaign to reduce harmful alcohol consumption through the use of posters and television adverts relies on the targeted individuals being exposed to intervention messages by passing by the poster locations or watching television during the selected television adverts. Even if a mass media campaign saturates the media channels of the target population there are still likely to be periods of time in which individuals will not encounter those media messages. This is largely outside of the control of the organisation or researchers who are delivering the intervention. Similarly, an individually-targeted BAI typically requires a relatively high degree of commitment from the target population, such as attendance at a physical location or a fixed time window in which their participation must occur. Whilst this may be simpler to achieve in some settings where individuals can to a degree be compelled to take part in activities or when dedicated time can be allocated for an activity this is not always feasible for other settings. . Electronic brief alcohol interventions provide opportunities to overcome many of these obstacles, by enabling interventions to be delivered in a schedule and format that is set by the researcher or health organisation. This is especially the case if the electronic brief intervention is delivered or facilitated by smartphones, given the high frequency with which a typical smartphone user checks their device each day (Deloitte, 2018).

Personalised feedback

One active ingredient of many electronic brief alcohol interventions is personalised feedback (Prosser et al., 2018). The tailoring or personalisation of feedback is usually based on user characteristics (e.g. gender; Pedersen et al., 2017a) or self-reported behaviour and attitudes (e.g. number of drinks consumed; Ridout and Campbell, 2014). Personalised feedback has been identified by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) as being a component of the most effective strategies to reduce harmful alcohol consumption on college campuses (NIAAA, 2015). Personalised feedback may be effective for several reasons. People are driven to determine how we compare to those around us (Festinger, 1954). Personalised feedback can offer an approximation of how our alcohol consumption compares to others . In the case of social norms-based personalised feedback it may explicitly quantity how one's alcohol use compares to their peers (Dempsey et al, 2018). People are motivated to seek out both positive and negative social information (Taylor et al, 2010), which can be inferred from any personalised feedback that we may receive about our individual alcohol use. Alcohol use is an example of a behaviour that can be viewed by individuals as both a positive or negative social behaviour (e.g. Sher et al, 2001) and, as such, individuals may engage with personalised feedback because they have an expectation of receiving either negative or positive social information.

The process of personalising the response means face-to-face delivery of personalised feedback is resource intensive, and so it was not initially feasible to deliver human-generated personalised feedback on a larger-scale or population level. Thus, at first personalised feedback interventions were only available in-person for those accessing specialist services (Borsari and Carey, 2000). Technological advances mean personalised feedback can now be generated and sent automatically to larger groups of participants who may access their feedback more remotely. Complex algorithms instantly take information provided by the user and generate increasingly nuanced personalised

feedback. Personalised feedback can be delivered as a standalone intervention or integrated with other active ingredients and behaviour change techniques.

The evidence base of electronic Personalised Feedback Interventions

Population

Providing an aid for early identification, prevention, and intervention, electronic personalised feedback interventions are almost always targeted at individuals with problematic, or at risk of developing problematic drinking behaviour. electronic personalised feedback interventions are particularly attractive for use in populations where help-seeking behaviour is relatively low; for example, college students (Wechsler et al. 2002), emergency department patients (Suffoletto et al., 2015), and military personnel (Pemberton et al., 2011; Miller et al., 2018). Electronic personalised interventions are not a substitute for more intensive interventions required to address alcohol dependence. The low-intensity nature of electronic brief alcohol interventions that include personalised feedback render them appropriate for being delivered population-wide; for example, in a workplace (e.g., Doumas & Hannah, 2008).

The majority of studies investigating the effectiveness of electronic brief alcohol interventions that include personalised feedback or electronic personalised interventions have targeted high schools (e.g., Ganz et al., 2018), and college/university students (e.g., Bewick et al., 2010; LaBrie et al., 2013). This evidence spans heterogeneous populations, including students from Brazil (Bedendo et al., 2019), Canada (e.g., Thompson et al., 2018), Germany (e.g. Ganz et al., 2018), New Zealand (e.g., Kypri et al., 2003), Sweden (e.g. Bendtsen et al., 2015), the United Kingdom (e.g., Bewick et al., 2010), and the United States of America (e.g., Strohman et al., 2016; Neighbors et al., 2019). The research literature has also paid particular attention to sub-populations of students who may be at higher risk for problematic alcohol use, including first-year students (e.g., Doumas & Andersen, 2009), student athletes (e.g., Doumas et al., 2010), mandated college students (e.g., Dunn et al., 2019), and students studying abroad (e.g. Pedersen et al., 2017b).

Delivery mode

Early variants of electronic personalised feedback interventions delivered relatively static content using CD-ROM or PC installed software (Carey et al., 2009). These interventions were quickly superseded by interventions delivered via email and the World Wide Web (e.g., Doumas and Anderson, 2011), the latter now constitutes the majority of electronic personalised feedback interventions tested today. We are, however, seeing the rise of electronic personalised feedback interventions using SMS (e.g. Bernstein et al., 2018; Suffoletto et al., 2015), social networking media (e.g., Facebook, Ridout & Campbell, 2014), and smartphone applications (e.g., Bertholet et al., 2019; Crane et al., 2018).

Duration of intervention test

Electronic brief alcohol interventions that include personalised feedback and electronic personalised feedback interventions vary substantially in the length of time users are expected to invest in the intervention. Some interventions are designed as very brief single sessions (e.g., Bewick et al., 2008), others deliver a series of interactions over a relatively brief period of time (for example, two sets of

SMS messages delivered over two days apart; Soffoletto et al., 2015). Some electronic brief alcohol interventions that include personalised feedback ask users to follow an entirely automated modular programme (e.g., Guillemont et al., 2017; Ingersoll et al., 2018). In a recent superiority randomised control trial an effective electronic screening and brief intervention that included electronic personalised normative feedback was as effective as an extended internet intervention (Cunningham et al., 2017).

Intervention

Electronic personalised feedback interventions, by their very nature, always include some form of alcohol-related personalised feedback. The electronic personalised feedback interventions delivered to date have, however, varied in their use of normative or comparative feedback (e.g., to others' alcohol behaviour or attitudes), the inclusion of additional therapeutic interventions to promote behaviour change, and the targeting of a range of health-related behaviours in addition to alcohol use. Many electronic personalised feedback interventions also incorporate self-monitoring into their intervention design; both of which are established as effective techniques for behaviour change (National Institute for Health and Care Excellence (NICE), 2014).

Interventions based solely on personalised feedback often include personalised normative feedback (electronic personalised normative feedback; e.g. Neighbors et al., 2015). Personalised normative feedback includes information on both the individual's own drinking behaviour/attitude and information on how that behaviour/attitude compares to those in a salient peer group. Electronic personalised normative feedback can be tailored to specific norms, in terms of, sex, ethnicity, and other more-context specific social norms (such as affiliation with student societies, e.g. LaBrie et al., 2013). These norms can be descriptive or injunctive norms (McAlaney et al., 2011). Descriptive norms refer to how frequent or common a behaviour is believed to be, such as the perception that an individual has about how frequently and heavily their peers drink alcohol. Injunctive norms refer to beliefs about attitudes, such as if an individual believes their peers to be supportive of drinking alcohol to the point of drunkenness. Personalised feedback interventions are also available that do not include these normative comparisons. Such interventions present a summary of the users' own behaviour/attitude without presenting any comparative norms. They may also include information on consequences and behaviour modification techniques.

Personalised feedback is sometimes integrated into electronic brief alcohol interventions that include components from other therapeutic principles (i.e., integrated interventions). A recent review of brief interventions for alcohol use concluded that integrated interventions (that included personalised feedback) were more effective than standalone electronic personalised feedback interventions (Riper et al., 2018); Riper et al.'s review excluded student and pregnant populations, and also excluded studies that included low-risk drinkers.

While many electronic brief alcohol interventions that include personalised feedback/ electronic personalised feedback interventions target drinking behaviour as experienced on a 'regular' day there is a body of evidence seeking to understand if targeting particular events or occasions could be effective in reducing alcohol related harms. For example, one could target students who are about to turn 21 years of age (e.g., Bernstein et al., 2018), or those attending Mardi Gras (e.g., Buckner et al., 2019).

The majority of electronic brief alcohol interventions that include personalised feedback/electronic personalised feedback interventions have alcohol as their only behavioural target. It is however possible to deliver e-interventions that target multiple behaviours. For example, Parekh et al. (2014) created a computer-tailored intervention that included personalised feedback for diet, smoking,

alcohol, physical activity, and Body Mass Index. Aharonovich et al. (2017) investigated the effectiveness of an intervention to reduce non-injection drug and alcohol use for people living with HIV. The extent to which theoretical underpinnings informed the development of personalised feedback interventions might explain the diversity in intervention targets, messages, and effectiveness.

Theoretical underpinnings

The normative feedback component of electronic personalised normative feedback interventions is designed to promote change in behaviour and/or attitudes by correcting misperceptions commonly held by heavier consumers of alcohol (Dempsey et al., 2018; McAlaney et al., 2011). The greater the misperception between an individual's own behaviour/attitude and the perceived behaviour/attitude of others the more likely the individual is to engage in that behaviour or conform to that perceived attitude (e.g., Neighbors et al., 2006). There is extensive evidence that these misperceptions exist for alcohol use and across other health-related behaviours (for a brief review see Dempsey et al., 2018). Electronic personalised feedback aims to challenge these misperceptions, and the implicit social pressure to engage in heavier alcohol use, by highlighting the discrepancy between individual's perceptions and the actual reported norms for that behaviour amongst a relevant social group through personalised feedback (e.g., other student peers at the same university, other employees in your organisation). Reducing this misperception gap, or 'self-other' discrepancy, is considered to be the mechanism underlying many social norms-focused electronic personalised normative feedback interventions (Dempsey et al., 2018). The normative comparison in electronic personalised normative feedback is theorised to motivate heavy drinkers to re-evaluate their use of alcohol and thereby alter their behaviour (Agostinell and Miller, 1994). Evidence of intervention effects being mediated by changes in perceptions of peer drinking (e.g., Dempsey et al., 2018; Doumas et al., 2010) lend support to this theoretical explanation of how electronic personalised normative feedback interventions work.

It should, however, be noted that many electronic brief alcohol interventions are not explicitly based on an established theoretical model in terms of their development or evaluation, and many provide limited information about their underlying theoretical basis (Tebb et al., 2016; Miller et al., 2015). Having a clear underpinning theory to electronic personalised normative feedback interventions is important as it accommodates an understanding of what works in an intervention and why (Tebb et al., 2016), facilitates efforts to replicate intervention findings, and also allows for further theory refinement, although many published electronic personalised normative feedback interventions do not attempt the latter (Garnett et al., 2018).

Effectiveness of electronic brief alcohol interventions with personalised feedback

The effectiveness of electronic personalised normative feedback for alcohol use appears to vary according to the specific alcohol use behaviours, and setting under scrutiny. By far the most widely studied group in relation to the effectiveness of electronic personalised normative feedback for alcohol use are university/college students, who represent a relatively homogenous and clearly identifiable social group who can be easily targeted for intervention. There is a growing evidence base of the effectiveness of electronic brief alcohol interventions that include personalised feedback and electronic personalised feedback interventions for modifying student drinking behaviour (Prosser et al., 2018). There is however a need to advance our understanding of how best to target and to tailor these interventions. Relatively little is known about what works best and for whom. It

may be that, for university students, some interventions are more effective when delivered early on in their university careers (i.e. during freshman and sophomore years) (Strohman et al., 2016). Multiple studies also suggest that electronic brief alcohol interventions including personalised feedback may be more effective for students who are high-risk drinkers (e.g. Doumas et al., 2017). SMS-based electronic personalised normative feedback interventions have also been found to be effective in college student populations. Students who received personalised feedback and interactive text messaging reported significantly greater reductions in likelihood of driving after drinking and a reduction in the number of drinks consumed before driving (Teeters et al., 2018)

Outside university and college campuses, outcomes for workplace-focused electronic personalised normative feedback interventions focused on employee alcohol use have been more mixed. Some studies suggest promising outcomes if recruitment and retention of users can be achieved (e.g., Brendryen et al., 2017; Pemberton et al., 2011). Other evidence suggests low intensity electronic personalised feedback interventions are not effective in occupational settings (e.g., Khadjesari et al., 2015). While studies support the feasibility and safety of delivering electronic personalised feedback interventions in an occupational setting, one of the main barriers to successful implementation remains recruitment and retention of users (Brendryen et al., 2017). The relatively low number of trials in occupational settings, combined with the heterogeneity of workplaces and interventions, makes it difficult to draw firm conclusions on the likely effectiveness of electronic personalised feedback interventions in workplace settings.

Results from electronic personalised normative feedback interventions delivered in healthcare settings are also mixed. Johnson et al. (2018b) reported no significant effect of an electronic personalised normative feedback interventions delivered to hospital outpatients with hazardous and harmful levels of drinking. Qualitative interviews suggested that participants did not believe their drinking was problematic and expressed a preference for face-to-face treatment by a General Practitioner (GP) rather than electronic interventions (Johnson et al., 2018a). SMS delivered electronic feedback that aimed to increase awareness of drinking intentions, promote goal-setting and goal attainment in order to reduce harmful alcohol use was effective in young adults attending USA emergency departments (Suffoletto et al., 2011). The positive intervention effects remained at 9-month follow-up. The authors concluded that the SMS interactive dialogue intervention was more effective, and importantly more acceptable for this population, than the traditional emergency department setting phone call 'boosters' (e.g., Donnovan et al., 2015). This provides an illustration of where electronic personalised feedback interventions could provide an effective alternative to more resource-intensive human-delivered low-level interventions.

Comparatively fewer studies have tested the use of electronic personalised normative feedback interventions at the general population level despite their potential to reach large numbers of the population. One study attempted to recruit participants via an email advertising campaign, with those who were identified as drinking at hazardous levels invited to enrol in a study that included an evaluation of an electronic brief alcohol intervention which incorporated personalised feedback (Guillemont et al., 2017). The study struggled to retain participants, with almost 70% of those allocated to the intervention arm of the study lost to follow-up before completion of baseline. Of those that completed the study, there was evidence that the electronic brief alcohol intervention had a positive impact on weekly alcohol intake and excessive drinking. While promising, these results should be treated with caution due to the high rate of loss to follow-up.

Electronic personalised normative feedback interventions can also be targeted towards and personalised for users based on their existing alcohol consumption patterns and event-specific drinking behaviours, in addition to targeting specific social groups or individuals living or working in a

specific geographical location. There is evidence to suggest that electronic personalised normative feedback interventions can be effective in improving alcohol-related outcomes amongst heavier consumers of alcohol, such as: heavy drinking first-year intercollegiate athletes (e.g., Doumas et al. 2010); and nightclub patrons classified as high risk (Sanchez & Sanudo, 2018). Targeting electronic personalised normative feedback interventions to those about to encounter a high-risk situation for harmful alcohol use (e.g., a 21st birthday party) can also be an effective strategy (Bernstein et al., 2018), especially for those at higher-risk for harmful alcohol consumption.

Given electronic brief alcohol interventions and electronic personalised feedback interventions are often disseminated population-wide (e.g., to all students at a university; to all nightclub patrons), concerns have been raised for the potential for such interventions to have a negative effective on those abstaining from alcohol or drinking at relatively low-levels; the so called 'boomerang' effect (Schultz et al., 2007). Worthy of particular scrutiny are personalised normative feedback interventions that could alert participants to their drinking below 'the norm' leading to increases in consumption. A US study, designed specifically to investigate the existence of the boomerang effect, found no such effect thereby suggesting that personalised normative feedback is not harmful for lighter drinkers (Prince et al., 2014). Rather, it appears that electronic personalised normative feedback for lighter drinkers and abstainers from alcohol use may have a protective effect against increases in future alcohol use (e.g. Larimer et al., 2007).

While there is a growing evidence of the effectiveness of electronic brief alcohol interventions that include personalised feedback for reducing alcohol behaviours it is not clear if targeting multiple behaviours at once undermines or not the effectiveness of electronic brief alcohol interventions that include personalised feedback/electronic personalised feedback interventions. While some studies report significant improvements in alcohol intake (e.g. Parekh et al., 2014; Aharonovich et al., 2017) others found no significant improvement (e.g. Kypri and McAnally, 2005).

Challenges associated with electronic brief alcohol interventions

Whilst there has been a rapid growth in the use of and sophistication of electronic personalised feedback interventions which aim to improve alcohol use outcomes, there remain a number of challenges for the field to address. Despite the growing evidence base for electronic brief alcohol interventions that include personalised feedback and electronic personalised feedback interventions, there remains a relative paucity of information on what motivates individuals to engage with these online programmes under voluntary conditions (Ganz et al., 2018). Studies in the general population often struggle to recruit, retain and engage participants (e.g., Bertholet et al., 2019; Guillemont et al., 2017), and similar issues with participant attrition have been noted amongst university student samples (Foxcroft et al., 2015). If we are to realise the potential for electronic personalised feedback interventions to contribute to reducing the global burden of alcohol misuse we must advance our understanding of how to successfully engage individuals with such interventions.

Studies evaluating the effectiveness of electronic personalised feedback interventions typically focus on the immediate or short-term effects of feedback on alcohol use, with few investigating the longer-term effects of electronic personalised feedback interventions (e.g., Neighbors et al., 2010). Given the typically brief and time-limited nature of personalised normative feedback, it may be additional top-up or booster administrations of brief feedback are required to maintain positive changes in alcohol use over the medium-to-longer term.

By necessity, many personalised feedback interventions include self-report assessments and self-monitoring components. There remains a cloud of scepticism around the use of self-report data when evaluating the effectiveness of electronic brief alcohol interventions that include personalised feedback and electronic personalised normative feedback interventions (e.g., Dempsey et al., 2018). The field would benefit from the development of objective measures of alcohol use that are widely available, cost-effective, and can be easily integrated into electronic personalised normative feedback interventions. It is likely that self-assessment/self-monitoring is an active ingredient of some personalised feedback interventions (e.g., Bewick et al., 2013; Marley et al., 2016), although the finding of significant reactivity to assessment is not consistent across all trials (e.g., Suffoletto et al., 2015). It may be that, where assessment leads to successful self-monitoring the effect of electronic brief alcohol interventions/electronic personalised normative feedback interventions is being underestimated. The field would benefit from the inclusion of four-group trial designs, which feature intervention and control groups which receive, or do not receive, baseline assessments (Solomon, 1949), allowing for the potential effects of baseline assessments on behaviour change to be accounted for.

Concerns have also been raised of the potential for personalised feedback to result in a self-report bias due to social desirability. This self-report bias could, it is argued, account partially/solely for the reported reductions in drinking/drinking related behaviour associated with interventions that include personalised feedback (Cunningham & Wong, 2013).

Future directions for research

The development of web-based technologies has enabled the delivery of more personalised feedback interventions for alcohol use, the increasing sophistication of mobile technologies provides opportunities to extend complexity and reach. The devices such as smartphones that are used to deliver electronic brief alcohol interventions have grown increasingly powerful, and are able to record a wide range of user data, which includes not only the direct usage of the device but also other information such as the physical movement of the individual and their geographic location. With regards to alcohol use for example it could be possible to use smartphone data to determine how often an individual visits bars, and if so which friends or work colleagues they are most likely to do so with. This type of data collection can occur in the background and requires no effort by the individual, other than providing the initial permissions for this data to be shared with researchers or health experts. This has the potential for opening up new areas of personalised feedback. For example, a system could be created to message an individual when they have spent a certain amount of time in a bar. By working with the individual this message could be personalised to a goal that they themselves set - for instance a request that they be sent an intervention message suggesting they may wish to go home if the system detects that they have been in a bar for more than two hours. Taken further such systems could link to other information available through the individual's smartphone. For example, any financial transaction relating to the purchase of alcohol by use of a credit or debit card could be blocked once the individual has spent a predetermined amount of money on alcohol on a night out. Such an approach is already being trialled in relation to problem gambling (Monzo, 2018).

Personalised feedback can also be delivered using systems that not only react to individual behaviour, but also predict future states of behaviour through the use of machine learning and artificial intelligence. This approach has been used to predict future suicide attempts with a high degree of accuracy (Walsh et al., 2017). For alcohol use such a system may be able to detect when

there is about to be an escalation in alcohol consumption, or when an individual may be about to place themselves in a dangerous situation as a result of drunkenness, and send personalised feedback either to the individual. More routinely, the system could learn the alcohol consumption practices of the individual and identify exactly when to send personalised feedback messages that are the most likely to have a beneficial impact. A system such as this could operate 24 hours a day and take action in the absence of any human operator, although this is not to say that such systems should be left completely unsupervised by human experts.

Conclusions

Electronic personalised feedback interventions are effective yet under-utilised. Web-based personalised feedback interventions have facilitated greater personalisation of feedback towards specific target groups – often based on personalised normative feedback. Many contemporary electronic personalised feedback interventions take the form of electronic personalised normative feedback. There is however a lack of clear theoretical bases to these interventions, making it difficult to identify the effective treatment mechanisms and active ingredients. Advances in mobile technology and the internet-of-things hold promise for the development of more sophisticated interventions and the collection of alcohol-related behaviours in addition to self-report measures. Realising the potential for new technologies to increase the effectiveness and successful implementation of personalised feedback will allow us to intervene early and thereby contribute to a reduction in the global burden of alcohol related harms and improve the lives of those affected.

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