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# A realist review of nudge interventions to decrease alcohol and tobacco use

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# Abstract

Previous research suggests nudge theory interventions to reduce alcohol and tobacco use have been effective. But research has provided limited insight into who such interventions have worked with, under what conditions they worked, and how these interventions reduced alcohol or tobacco use. We conducted a realist review of alcohol or tobacco interventions that explicitly used nudges, choice architecture, or principles from behavioural economics to influence behaviour. The literature search was conducted in ProQuest, APA Psych Net, and EBSCO (Academic Search Premier), Google, and Google Scholar. Aligned with a realist review approach, data from six studies were compared, contrasted, and synthesized. Of these six studies, three reported significant decreases in alcohol consumption, one reported a significant decrease in tobacco use (smoking behaviour), and two reported no statistical effect from the intervention. In general, interventions were effective when they used active engagement with the nudge and immediately measured consumption. Interventions were ineffective when they had small sample sizes and passively nudged people in complex environments. Nudge theory interventions targeting alcohol or tobacco use are effective with diverse populations, conditions, and mechanisms. However, there appears to be limited explicit testing of nudge interventions targeting alcohol or tobacco use, and more research is needed to evaluate effectiveness for various populations, conditions, and mechanisms. The results of this realist review have implications for applying nudge theory to alcohol or tobacco cessation programs, as well as nudge theory intervention research, and how alcohol or tobacco interventions are reported.

# Significance to defence and security

As requested by the Directorate of Force Health Protection, this Scientific Report details various intervention strategies for decreasing alcohol and tobacco consumption in the CAF. The results can inform health promotion interventions to improve the health and operational readiness of CAF members. The information presented is derived from public sources and is therefore unclassified.

# Résumé

Des études précédentes suggèrent que les interventions fondées sur la théorie de l'incitation (Nudge Theory) pour réduire la consommation de tabac et d'alcool sont efficaces. Mais ces travaux de recherche ne décrivent pas en détail les populations sur lesquelles ces interventions ont fonctionné, ni les circonstances, ni la manière dont elles ont réussi à réduire la consommation d'alcool et de tabac. Nous avons mené un examen réaliste des interventions liées à l'alcool et au tabac qui ont explicitement utilisé l'incitation, l'architecture du choix ou des principes de l'économie comportementale pour influencer les comportements. Nous avons procédé à une recherche de la littérature scientifique dans ProQuest, APA Psych Net, et EBSCO (Academic Search Premier), Google, et Google Scholar. Dans une approche d'examen réaliste, nous avons comparé, mis en opposition et synthétisé les données de six études. Parmi ces six études, trois faisaient état d'une diminution substantielle dans la consommation d'alcool, une faisait état d'une diminution substantielle dans la consommation de tabac (comportement de fumeur), et deux ne signalaient aucun effet statistique à la suite de l'intervention. En général, les interventions étaient efficaces lorsqu'elles engageaient activement la personne à l'égard de l'incitation et qu'elles mesuraient immédiatement la consommation. Les interventions étaient inefficaces quand l'échantillon avait une petite taille, et quand l'incitation était passive dans un environnement complexe. Les interventions fondées sur la théorie de l'incitation qui ciblent la consommation d'alcool ou de tabac sont efficaces auprès de diverses populations, dans diverses conditions et dans divers mécanismes. Toutefois, il semble y avoir peu d'essais explicites d'interventions fondées sur la théorie de l'incitation qui ciblent la consommation de tabac ou d'alcool. D'autres recherches sont nécessaires pour évaluer l'efficacité sur diverses populations et dans diverses conditions, et au moyen de divers mécanismes. Les résultats de cet examen réaliste ont une incidence sur l'application de la théorie de l'incitation dans les programmes de cessation du tabagisme ou de réduction de consommation de l'alcool, ainsi que dans la recherche sur les interventions fondées sur la théorie de l'incitation, et sur la manière dont on fait rapport des interventions en matière d'alcool ou de tabac.

# Importance pour la défense et la sécurité

À la demande du Directeur – Protection de la santé de la Force, ce rapport scientifique détaille les diverses stratégies d'intervention pour diminuer la consommation d'alcool et de tabac dans les FAC. Les résultats peuvent servir à soutenir des interventions de promotion de la santé visant à améliorer la santé et l'état de disponibilité opérationnelle des membres des FAC. L'information présentée est dérivée de sources publiques, elle est alors non classifiée.

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# Introduction

Alcohol and tobacco use cause morbidity in Canadian Armed Forces (CAF) personnel (Thériault et al., 2016). Within the CAF, approximately 23% of personnel smoke cigarettes, and 20% have hazardous drinking habits, leading to illnesses such as respiratory infections, asthma, and acute injuries (Thériault et al., 2016). A wide range of interventions could be employed to discourage consumption (e.g., Stockings et al., 2016), including nudge theory interventions (e.g., Giné et al., 2010; Norman et al., 2018; Blaga et al., 2018). The term nudge comes from behavioural economics and was popularized by Thaler and Sunstein (2008) who define a nudge as an intervention that systematically influences the decisions people make without restricting their freedom or using financial incentives. For example, graphic health warning labels on packages of cigarettes are considered to be a nudge, banning the sale of cigarettes would not. Nudge theory has been effective in mitigating alcohol and tobacco consumption using techniques such as commitment contracts, which are agreements signed with oneself to follow through on intentions (e.g., Giné et al., 2010; Witvorapong & Watanapongvanich, 2019), and theory-based messages (e.g., Kong et al., 2014; Norman et al., 2018).

Nonetheless, knowledge of the boundary conditions (i.e., moderating factors; Busse et al., 2017) is limited (Szaszi et al., 2018; Hollands et al., 2019). A given alcohol or tobacco intervention may be more effective with some populations than with others. An example from outside nudge literature suggests that increasing alcohol taxes by 10% can reduce alcohol consumption by 5% (Wagenaar et al., 2010). In their critical review, however, Nelson and McNall (2016) showed that the effects of increasing taxes on alcohol were visible only in certain subpopulations, such as older and unemployed adults, and not in all populations.

In addition to knowing who will respond to an alcohol or tobacco nudge, another boundary condition is the circumstances in which these interventions are effective. Nudge interventions to curb smoking have been effective on worksites (Halpern et al., 2015) and in state-wide media campaigns (Linkenbach & Perkins, 2003), but it is not known whether they can be effectively delivered online, for example, or in person. Nor do we know much about how these interventions should be designed or evaluated (e.g., duration of nudge exposure, mediation analyses). The number of studies that test a single nudge technique in multiple settings remains low (Szaszi et al., 2018), making it difficult to generalize findings across contexts.

Further, the mechanisms underlying the effectiveness of nudge interventions are not well understood. Researchers have identified many nudge techniques (e.g., Dolan et al., 2012; Hollands et al., 2017) that may influence behaviour. The acronym MINDSPACE (Dolan et al., 2012) was coined by the Behavioural Insights Team to represent nine effective nudge techniques in behavioural policy (i.e., messenger, incentives, norms, defaults, salience, priming, affect, commitments, ego), for example, and the Typology of Interventions in Proximal Physical Micro-Environments (TIPPME) classifies how an environment has been changed (e.g., placement, presentation of products) to nudge behaviour (Hollands et al., 2017).

Understanding which nudge techniques work in which environments on which populations would help health practitioners design better alcohol and tobacco interventions. Health practitioners would benefit from knowing whether successful nudge interventions (e.g., presumed consent defaults in organ donation; Van Dalen & Henkens, 2014) continue to be successful in new settings and contexts (e.g., presumed consent defaults for tobacco cessation programs; Richter & Ellerbeck, 2015). To our knowledge, such a

review of the effective technique-environment-population mix for alcohol and tobacco interventions has not yet been conducted.

At the request of Directorate of Force Health Protection (DFHP), Director General Military Personnel Research and Analysis (DGMPRA) was approached to conducted a review of alcohol and tobacco nudge interventions. DFHP is a branch of the Canadian Forces Health Services Group involved in public health, policy development, and providing evidence-based guidance and advice to CAF members and their families. The purpose of this Scientific Report is to conduct a realist review of alcohol and tobacco nudge interventions to help DFHP gain insight into how these interventions could be effectively implemented within the CAF. Realist reviews examine complex social interventions, such as health programs, whose effects depend on contextual factors and intervention implementation (Pawson et al., 2005). This approach focuses on the population targeted by intervention, the context in which it was delivered, the mechanisms by which it was effective, and the outcomes (Pawson et al., 2005). The findings of a realist review can help health practitioners draw inferences about the effectiveness of nudge interventions for different populations in various contexts (Pawson et al., 2005) so they can design evidence-based policy (cf. Xiao & Watson, 2019).

# Method

We used the five steps recommended by Pawson et al. (2005) to guide this realist review. Specifically, we first clarified the scope of the study, then searched for evidence, appraised primary studies and extracted data, and then synthesized evidence and drew conclusions. The final step recommended by Pawson and colleagues is to disseminate (e.g., publish findings), implement and evaluate our recommendations.

## Step 1. The scope of the review

We focused on nudge interventions aimed at changing alcohol or tobacco use (i.e., behaviour) using the following inclusion and exclusion criteria. The review was limited to full-text papers that were written in English. Papers did not need to be published in a peer-reviewed journal since many nudge interventions are reported in grey literature (e.g., Behavioural Insights Team, 2019). Additionally, eligible studies empirically investigated one or more behavioural intervention techniques that the researchers attributed to nudge/choice architecture/behavioural economics. The decision to include only studies attributed to nudge theory was guided by DFHP. As subject matter experts on alcohol and tobacco cessation programs, DFHP was interested in research on nudge interventions targeting alcohol or tobacco use/misuse, and to understand how these interventions could be implemented in the Canadian Armed Forces. Further, studies had to have a behavioural outcome variable (not intentions or attitudes) to be included in this review. Finally, we excluded interventions that used counselling or coercion to influence behaviour.

Our focus was the relationship between the target of the nudge intervention (e.g., participant age, sex, health status), the context in which the intervention was delivered (e.g., location, medium, outcome measures), the mechanisms responsible for the changes in alcohol or tobacco behaviour, and whether behaviour changed as a result of the intervention. Nudges were expected to be the mediating cause that explained why the nudge intervention was effective. Interventions were deemed effective if they contributed to a statistically significant decrease in alcohol or tobacco consumption. If the study was longitudinal, the last available follow-up evaluation was used to classify whether an intervention was effective.

## Step 2. Search for nudge theory tobacco and alcohol cessation interventions

Our search strategy included two phases. We first used a systematic search to identify nudge interventions for alcohol or tobacco use. The reference lists of systematic reviews were also used as sources of data. The systematic literature search involved three academic databases: ProQuest, APA Psych Net, and EBSCO (Academic Search Premier). We also used forward search methods to identify articles that met eligibility. Google and Google Scholar were used in the second phase to search for relevant grey literature (e.g., non-published, non-peer-reviewed reports) and for conducting the forward search of articles. The search was completed in November 2019 and data analysis was completed in February 2020.

The systematic search was limited to studies between January 2008 and October 2019, to include only those published after the book Nudge (Thaler & Sunstein, 2008). Aligned with our research question, client interests, and previous nudge theory reviews (e.g., Wilson et al., 2016), we sought papers that the original authors deemed to be inspired by nudge/choice architecture/behavioural economics. Another reason for limiting the search to articles that the authors deemed to be nudge theory is that the definition

of a nudge is broad and, thus, does not provide an operational definition of the applied meaning, making subjective assessments difficult. The search terms entered into databases included ([nudge OR choice architecture OR behavio* economics] AND [experiment OR intervention] AND [alcohol OR tobacco OR smok* OR chew*]). The asterisk associated with a search term designates proximity searches. For example, "smok*" captured smoking, smoker, and smoke.

As seen in the PRISMA diagram in Figure 1, the systematic search resulted in 2,747 articles, and the follow-up search of Google and Google Scholar resulted in an additional 93 articles, for a total of 2,840 potentially eligible articles. The authors individually screened the titles and abstracts retrieved during the searches and eliminated 2,797 articles for reasons displayed in Figure 1. The full texts of potentially eligible articles (43; see Figure 1) were examined by both authors. Subsequently, 38 articles were excluded for not meeting eligibility. The primary reason for elimination at this stage was the absence of an association to nudge theory. There was a total of five research articles and six unique nudge theory-based alcohol or tobacco interventions evaluated in this review. Although the study by Halpern et al. (2015) included an incentive to aid smoking cessation, the article was not excluded because the primary research question was to test a commitment device nudge, not incentives to quit tobacco use.

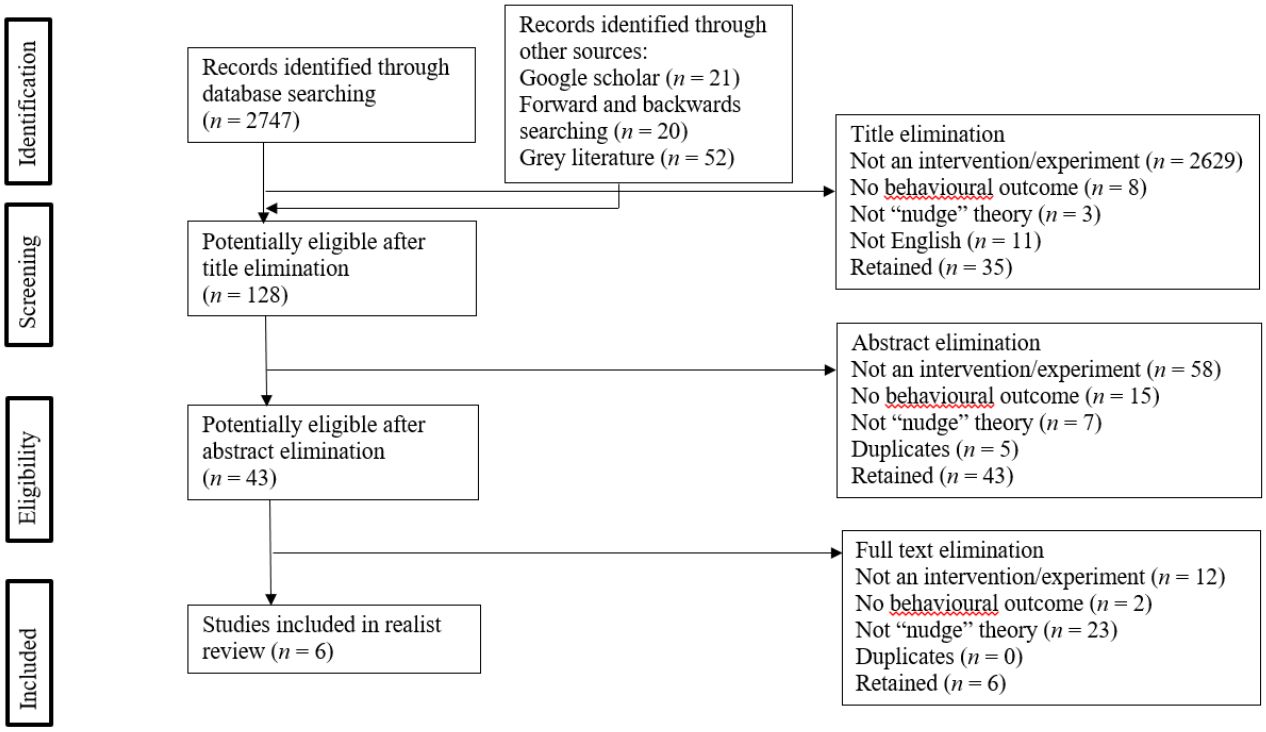


***Figure 1:*** *Results of literature search.*

## Step 3. Appraise literature and extract data for review

Data were extracted independently by two reviewers for each study selected for inclusion. Aligned with Pawson et al. (2005), we declined to use a standard quality appraisal checklist since these are considered insufficient and inappropriate for realist reviews. Instead, we evaluated quality using two dichotomous items, (1 = *yes*; 0 = *no*) to assess research relevance and rigour. Relevance refers to whether a study is appropriate to answer our research question. Articles were considered relevant if they aligned with the

scope of this review (i.e., met inclusion criteria). Further, rigour refers to the quality and thoroughness of the research. If the conclusions of a study were appropriate for the research design and results, it satisfied our rigour requirement. Articles needed to be deemed both relevant and rigorous to be included in this review.

To assist coding consistency, we created a data extraction tool with operational definitions of the variables we wanted to code from each article. We met to establish the relevant data to extract from collected articles. We then coded and discussed two articles in detail to familiarize ourselves with the coding process before commencing data extraction of the collected articles. We met after coding each article to consolidate data extracted, compare relevant notes for each coded variable, and reach consensus. Any coding discrepancies were resolved through discussion and referral to the article.

Regarding targets of the interventions, variables coded included demographic descriptors of participants who received the alcohol or tobacco nudge intervention. The 10 indicators were age, gender, ethnic composition, education, pre-intervention health status, whether the study was conducted with a military sample, inclusion and exclusion criteria, sample size, and whether participants actively wanted to reduce their alcohol or tobacco consumption (see Table 1).

Conditions variables included those describing the context in which the study took place and the research methods. The 11 indicators included the country where the study was conducted, contact type (e.g., in-person or online), research design, recruitment procedures, selection into the study, financial cost of the study, outcome measure, length of follow-up assessments, type of analyses, and whether moderation or mediational analyses were conducted (see Table 2).

Finally, the how variables included those describing the delivery of the intervention itself and the proposed mechanisms to influence behaviour. The five indicators were the theoretical framework that guided the intervention, targeted structural modification, nudge techniques employed from the MINDSPACE framework, choice architecture categories and techniques, and environmental changes (see Table 3).

# Results

After coding was completed, we performed an inter-rater reliability analysis to assess the extent to which we consistently evaluated the data reported in each study. We used Cohen's (1960) kappa due to its suitability for two coders (Hallgren, 2012) and obtained a kappa k = .90 for the six studies coded, which indicates a high level of consistency between two coders. This is a sufficient level of agreement, according to evaluation guidelines provided by Landis and Koch (1977).

## Step 4: Synthesize data and draw conclusions

Despite only finding six nudge interventions targeting alcohol or tobacco use, some insight can be gleaned from the articles available. We carefully reviewed the articles, including explicit and implicit reasons the interventions were effective or ineffective. Based on the 26 indicators extracted from each study, descriptive tables were derived for effective and ineffective nudge interventions for alcohol use (See Tables 1–3 below). Only one study regarding tobacco use was included in the review and thus did not warrant a descriptive table. Despite our interest in the misuse of alcohol and tobacco, we found no evidence of nudges targeting misuse, and thus focused our review on alcohol or tobacco use/behaviour.

***Table 1:*** *For whom nudge theory alcohol interventions are (in) effective.*

| | Demographics | Eligibility Criteria | Sample Size | Education | Health status |
|---|---|---|---|---|---|
| | | Strategies that reduced alcohol consumption | | | |
| Kersbergen et al., 2018a | *M* Age (SD): 24.82 (±10.48)<br>Sex: Mixed<br>Ethnicity: Not reported | 18+ years of age, Consume >10 UK units of alcohol per week, breath alcohol content of 0. | *n* = 114 | Not reported | Not reported |
| Kersbergen et al., 2018b | *M* Age (SD): 34.89 (±12.45)<br>Sex: Mixed<br>Ethnicity: Not reported | 18+ years of age. | *n* = 164 | Not reported | Not reported |
| Bernheim, Meer, & Novarro, 2016 | *M* Age (SD): N/A<br>Sex: Mixed<br>Ethnicity: Not reported | States where policy was modified regarding availability of alcohol purchase via Sunday sales hours. | 46 changes in on-premise Sunday sales hours, distributed over 30 states | Not reported | Not reported |
| | | Strategies that did not reduce alcohol consumption | | | |
| Brendryen et al., 2017 | *M* Age (SD): 43 (±11)<br>Sex: Mixed<br>Ethnicity: Not reported | 18+ years of age, employed, valid email address and phone number, at-risk drinker. | *n* = 85 | Some higher education | -At-risk (~17 drinks per week) |

| | Demographics | Eligibility Criteria | Sample Size | Education | Health status |
|---|---|---|---|---|---|
| Schulze, 2019 | *M* Age (SD): 24.60 (±6.23)<br>Sex: Mixed<br>Ethnicity: Not reported | 18+ years of age, Consume >10 UK units of alcohol per week, breath alcohol content of 0. | *n* = 45 | High school or higher education | Not reported |

***Table 2:*** *Under what conditions nudge theory alcohol interventions are (in) effective.*

| | Design | Recruitment procedures | Program setting | Measures | Mode of Delivery | Analyses |
|---|---|---|---|---|---|---|
| | | | Strategies that reduced alcohol consumption | | | |
| Kersbergen et al., 2018a | Randomized Controlled Trial | Centre-based | University | Alcohol consumed in 1 hour | In-person | Multi-level regression |
| Kersbergen et al., 2018b | Randomized Controlled Trial | Centre-based<br>Targeted mailings<br>Local media | Public bar | Alcohol consumed in 3 hours | In-person | Multi-level regression |
| Bernheim, Meer, & Novarro, 2016 | Quasi-experimental with control | Archival | On-premise (e.g., bars) | Alcohol sales | Policy | Logistic regression |
| | | | Strategies that did not reduce alcohol consumption | | | |
| Brendryen et al., 2017 | Randomized Controlled Trial | Centre-based | Online | Alcoholic drinks per week | Text and e-mails | Intention-to-treat, per protocol, regressions, t tests, longitudinal |
| Schulze, 2019 | Mixed Between-Group design | Centre-based | Public grocery store | Intentions to buy alcohol, sales figures | In-person | Chi-square, one-way ANOVA, Spearman's Rho |

***Table 3:*** *How nudge theory alcohol interventions are (in) effective.*

| | Targeted structural modification | Nudge employed | Choice-architecture technique | Environmental change |
|---|---|---|---|---|
| | | Strategies that reduced alcohol consumption | | |
| Kersbergen et al., 2018a | Physical environment | Defaults | Change choice defaults | Size of alcoholic beverage |
| Kersbergen et al., 2018b | Physical environment | Defaults | Change choice defaults | Size of alcoholic beverage |

| | | | | |
|---|---|---|---|---|
| Bernheim, Meer, & Novarro, 2016 | Social environment | Defaults | Change choice defaults, Change range or composition of options | Availability of alcohol |
| | | Strategies that did not reduce alcohol consumption | | |
| Brendryen et al., 2017 | Physical environment | Norms | Make information visible, Provide social reference point, Provide reminders, Facilitate commitment (e.g., public commitment) | None |
| Schulze, 2019 | Social environment | Priming Salience | Make information visible, Change option related effort | Availability (i.e., increase awareness) Position (i.e., location) |

Note: A default nudge is a pre-set option that determines what an individual receives if nothing is specified by the decision maker. A norm is a reference point of others behaviour. Priming refers to instigating sub-conscious cues. Salience refers to drawing attention to something novel and of relevance to an individual.

Detailed information regarding the characteristics of the interventions is presented as answers to the following questions.

## For whom are nudge interventions for alcohol or tobacco cessation effective?

In the effective intervention studies Kersbergen et al. (2018a; 2018b) included a university sample, and patrons of a bar, respectively. In Bernheim et al. (2016) they studied policy changes between states and thus, did not have a defined subsample. In the ineffective intervention studies both Brendryen et al. (2017) and Schulze (2019) included general samples based in a workplace, and public establishment, respectively.

There were multiple similarities across studies regarding the intervention recipient and what was reported. One exception when comparing targets across studies was the article by Bernheim et al. (2016), which examined on-premises (e.g., restaurants, bars) liquor sales through policy changes, not individuals per se. With the exception of the study by Bernheim and colleagues (2016), all other studies (n = 5) included men and women who were 18 years or older and had no association with the military. Ethnicity was not reported in studies that targeted alcohol behaviour, while the study targeting smoking cessation included people from multiple ethnicities. Only one study reported health status, an ineffective alcohol nudge (Brendryen et al., 2017) that targeted hazardous drinkers. The three effective alcohol nudge interventions did not report on the education status of their participants; however, the two ineffective alcohol studies both targeted people with higher education, and one of those studies also included people with high school education. Only the study examining smoking cessation included those who wanted to quit, the remaining articles made no mention of whether people wanted to reduce their consumption. Regarding the smoking cessation study using a commitment device, few people (< 1%) wanted to participate in the intervention because it required an up-front commitment of $150 to participate (Brendryen et al., 2017). Finally, there was no consistency between effective and ineffective nudge interventions, whether they measured previous alcohol or smoking behaviour or did not report previous behaviour in each respective domain. Descriptive summaries of the target indicators are presented in Table 1.

## Under what conditions are nudge theory alcohol or tobacco cessation interventions effective?

The conditions in the six studies we found were varied, ranging from in-person lab, and applied settings (i.e., Kersbergen et al., 2018a; 2018b) to online communication through texts and e-mails in a workplace setting (i.e., Brendryen et al., 2017). Bernheim et al. (2016) conducted a quasi-experiment between states who changed (or did not change) on-premise sales hours of alcohol. Schulze (2019) conducted an in-person study in a public grocery store in an attempt to nudge people towards purchasing non-alcoholic beer.

Three of the four effective interventions used randomized controlled trial (RCT) designs (the other study used a quasi-experimental design), while the ineffective studies were split between RCT (n = 1) and quasi-experimental designs (n = 1). Brendryen et al. (2017) used a longitudinal design and found significant changes at 2-months but not 6-months post-intervention when they conducted a per protocol analysis, and found no effects at any time point when they conducted an intention-to-treat analysis.

Effective nudges included sample sizes ranging from 114 to 2,538, and in the Bernheim et al. (2016) policy paper, the authors analyzed hourly changes in Sunday alcohol sales in 30 states. Ineffective nudges were tested on smaller sample sizes (i.e., $n \leq 85$). All studies except for Bernheim et al. (2016) used centre-based recruiting procedures. In addition to centre-based recruiting, Kersbergen et al. (2018b) used targeted mailings and local media to encourage people to attend the establishment where they conducted the study on the night they completed it. The interventions targeting alcohol consumption were all conducted in different settings, and effective interventions took place at a university, a public bar, and examined liquor sales across on-premise drinking establishments in the United States. Ineffective alcohol interventions took place online and in a public grocery store. Regarding how interventions were delivered, the intervention curbing on-premise drinking consumption was delivered through policy changes, the online alcohol intervention was delivered through texts and emails, while the remaining studies were delivered in-person. The smoking cessation intervention was delivered online.

None of the studies looking at alcohol discussed the financial cost of the study; however, the smoking intervention study estimated the cost to be as much as $800 for a successful quit at 12 months. The expense is highly cost effective since the estimated cost of employing a smoker is $5,816 more each year than employing a non-smoker (Berman et al., 2014). Effective interventions were conducted in the UK and the USA, ineffective nudges were conducted in Norway and the Netherlands. Effective alcohol nudges measured alcohol consumption either by the hour (Kersbergen et al., 2018a; 2018b) or hourly on-premise liquor sales. Ineffective nudges examined weekly alcohol consumption at 6-months (Brendryen et al., 2017) and alcohol sales after 1 week (Schulze, 2019). Regression analyses (n = 5), as well as intention-to-treat and per-protocol analyses, were conducted by both effective and ineffective nudge interventions (Halpern 2015; Brendryen et al., 2017). None of the authors reported a moderation or mediation analysis.

## How are nudge theory alcohol or tobacco cessation interventions effective?

None of the studies that met eligibility referenced seminal frameworks in nudge literature (e.g., MINDSPACE; Dolan et al., 2012). One study (Schulze, 2019) identified dual-processing theory (Kahneman, 2003) as an overarching framework, with System 1 (e.g., automatic, unconscious and fast) and System 2 (e.g., effortful, monitored and slow) processing being mentioned as part of the design of effective interventions. All effective alcohol interventions used defaults to nudge behaviour by changing

the size of the glass in which alcohol was served (Kersbergen et al., 2018a; 2018b) or the hours of serving availability (Bernheim et al., 2016). Ineffective alcohol nudges used priming (i.e., availability and position) and salience by advertising non-alcoholic beer through a visual display, and then guiding participants through a hypothetical purchasing situation (Schulze, 2019), or by using social norms among other behavioural change techniques (Brendryen et al., 2017). The smoking cessation nudge used both a commitment device and an incentive by asking people to deposit some of their own money as a commitment, in addition to providing a financial reward for abstaining from smoking.

## Step 5: Disseminate, implement, and evaluate

The purpose of this realist review was to examine the targets, conditions, and how alcohol and tobacco nudge interventions were effective at reducing consumption. Overall, evidence of the effectiveness of nudge interventions on alcohol and tobacco behaviour was mixed because four of the six studies included in the review found a statistically significant effect and two did not. The lack of reported interventions that use nudge techniques makes it difficult to detect patterns in the data and draw general conclusions.

Based on the available data we developed theories of what works and what does not and gathered observations and recommendations for practitioners. Finally, Step 5 is an ongoing process and we offer suggestions regarding how implementation could be done, and identify areas for future research to advance understanding of nudge theory alcohol and tobacco interventions.

## Summary of Results

### Why nudges to change alcohol consumption work

**Actively engaging with the nudge is automatic**. All three effective alcohol nudges involved people engaging with the nudge due to changes in serving size or policy (Bernheim, et al., 2016; Kersbergen et al., 2018a; 2018b). By changing the size of the glasses in which beer was served, all participants in Kersbergen et al.'s (2018a; 2018b) studies needed to expend more effort to get more alcohol and, on average, consumed less alcohol, proportional to the reduced serving size (~30%) in one sitting. Likewise, when policy was changed, as in Bernheim et al.'s (2016) study, everyone was subjected to reduced on-premise sales hours, it reduced consumption. Perhaps defaults that make it slightly more effortful for people to access alcohol are effective. Even seemingly small policy changes (i.e., changing defaults) can have a substantial impact (cf. Prentice & Miller, 1992) because the reach of the intervention can be vast through widespread exposure.

**Immediate impact and subsequent measurement of the outcome.** Default availability interventions are expected to have an effect each time people are exposed. In general adult populations, mechanisms designed to have immediate impact at the point of consumption were effective when outcomes were measured directly after exposure to the intervention. Our findings show that changing how and when alcohol is served immediately impacts consumers (i.e., Kersbergen et al., 2018a; 2018b; Bernheim et al., 2016).

Overall, the combination of defaults that affect everyone, behaviour being influenced immediately at the point of consumption, and outcome measures taken promptly, may have contributed to detecting a statistically significant effect for alcohol consumption. Default nudges coupled with proximal measurement of outcomes should be given consideration in future nudge interventions to influence alcohol consumption.

## Why nudges to change alcohol consumption do not work

**People may ignore the nudge.** Ineffective interventions provided information to participants who may have ignored the intended nudge (Brendryen et al., 2017; Schulze, 2019). Practitioners should consider that effects may not be visible when participants' attention is optional, which entails that their level of engagement with the information will remain unknown. If a nudge relies on the recipient's attention, moreover, one visual cue to prime their attention may not be sufficient (Schulze, 2019). When engagement with the nudge is optional, information presented can be passively absorbed or ignored entirely. For example, the intensive self-help program implemented by Brendryen et al. (2017) was delivered through multiple interactive sessions, reminder emails, and mobile phone text messages. People being required to process the nudge among other methods of intervention may be one factor limiting effectiveness. That is, using many behaviour change techniques may weaken the effects of a single nudge embedded within multicomponent interventions due to limited attention given to each component.

**There is a delay between exposure and measurement of impact.** Nudges expected to have a delayed influence on consumption may be less impactful (e.g., Brendryen et al., 2017). Nudges may be less effective when System 2 thinking is targeted, and immediate impact cannot be measured. In Brendryen et al. (2017), for example, reading about a social norm was one mechanism within a larger, more intensive intervention and was not potent enough to make a difference in alcohol consumption 2-months or 6-months later. Since there was no detectable effect 6-months after the intervention, the expected impact of the nudge is likely reduced. Further, in Schulze (2019), an advertisement in the store either was not impactful enough to carry over to purchasing behaviour once the customer reached the alcohol aisle or customers may have missed the nudge entirely because of the many advertisements and products competing for their attention. The delay between being nudged and consumption behaviour may have influenced the impact of this nudge.

**The nudge is tested on too few people.** Studies that examined the effects of a nudge on $\leq 85$ people did not have a statistically significant effect (Brendryen et al., 2017; Halpern et al., 2015; Schulze 2019). The small sample sizes may have resulted in being underpowered to detect a small effect. However, larger studies ($n \geq 114$) were statistically significant, finding small-to-medium effects (Bernheim et al., 2016; Kersbergen et al., 2018a; 2018b). Perhaps detecting an effect is less likely when a small sample size is combined with passive nudges that do not ensure engagement, as well as delayed measurement of behaviour in an open environment (Brendryen et al., 2017; Schulze, 2019).

# Discussion

## Overview

We conducted a realist review of how interventions work, who was targeted, and in what circumstances by analyzing patterns between populations, context, mechanism, and outcomes. However, our search returned few studies, and these few heterogeneous studies do not provide rich patterns to analyze. The four effective interventions included in this realist review demonstrate that the positive effect of alcohol or tobacco nudge interventions is evident, but not assured, across populations and settings. One promising nudge for curbing alcohol consumption was selling smaller units of alcohol (Kersbergen et al., 2018). The additional effort for consumers to request another drink appears to be enough of a hindrance to reduce consumption. However, the authors note that implementing this strategy may be difficult due to reduced profit margins, and people may display psychological resistance to reduced autonomy over the volume of beer sold per serving (Kersbergen et al., 2018). Since patrons can order as many drinks as the establishment will allow, reducing the serving size does not limit their autonomy to consume. Researchers should examine this and other nudges in various populations under various conditions. Below we outline three observations and recommendations based on our review.

## Observation 1. Effectiveness concerns

The nudge interventions identified in this review showed mixed effectiveness. Of the six studies identified, four were effective at reducing alcohol or tobacco consumption. This finding underscores the need to test nudge interventions before implementation to determine effectiveness. We found articles suggesting that nudges be adopted for changing behaviour (e.g., defaults; Richter & Ellerbeck, 2015), despite a lack of evidence supporting the use of those nudges in the contexts being recommended. To curb smoking, for example, Richter and Ellerbeck (2015) contend that tobacco users should be offered evidence-based care regardless of readiness to quit because most of them want to quit and there was no evidence supporting the effectiveness of targeting those who are deemed ready as a precondition for receiving treatment. The authors suggest that smokers should receive treatment because changing defaults has been shown to change choices and outcomes for various health behaviours. In our review, however, we did not find evidence that defaults are effective nudges for smoking cessation. Although we did not find nudge theory literature for the effective use of defaults for smoking cessation, we were made aware of one program implementing default care for cessation treatment. The Ottawa Model for Smoking Cessation from the University of Ottawa Health Institute identifies and treats tobacco users who come into contact with the healthcare system. Despite finding numerous articles supporting this practice (e.g., Nahhas et al., 2016; Nahhas et al., 2017; Faseru et al., 2017; Baker et al., 2015; Buchanan et al., 2017), we did not find any RCTs that used defaults associated with nudge theory to influence tobacco behaviour. Despite the potential effectiveness of this nudge approach, RCTs are needed to demonstrate the effectiveness with various populations and settings.

### Recommendation 1

Future research is needed to test nudge interventions to determine their effectiveness before implementation. Examining nudge techniques independently would help determine whether a certain nudge is effective in a given context for a particular sample. Further, mediation and moderation analyses would help identify the mechanisms that explain the effects. Finally, using larger samples of people

would help to ensure results are due to the intervention and eliminate concerns of being underpowered. As the literature base grows, we will gain greater understanding about what works, for whom, and under what conditions, and be better able to generalize which nudges may change alcohol or tobacco behaviour.

## Observation 2. Few publications

Our search of both peer-reviewed articles and grey literature only identified six nudge interventions targeting alcohol or tobacco use. Finding so few nudge interventions targeting alcohol and tobacco use is perhaps surprising given that many nudge techniques could, in principle, be applied to alcohol and tobacco use. Interventions to alter the portion or package size of foods have been widely developed (Hollands et al., 2015), for example, but we found little evidence for similar interventions to alter the use of alcohol or tobacco products. Hollands et al. (2015) examined portion and packaging of alcohol and tobacco on consumption and found no studies that manipulated alcohol products. Although Hollands et al. (2015) found three studies that addressed tobacco consumption, they did not refer to nudge theory since they were published between 1978 and 1980. One reason we may not have found many nudge interventions targeting tobacco is that many nudge interventions, such as packaging, do not target tobacco use and instead look at attractiveness, attitudes, salience of health warning, etc. (e.g., Moodie et al., 2012).

Finding a limited number of studies that use nudge theory to influence alcohol or tobacco use is aligned with previous literature, such as Hollands et al. (2019), who conducted a review of studies using availability and proximity (i.e., two nudge techniques) to alter alcohol and tobacco consumption, and did not find any relevant research articles. We extended Hollands et al.'s (2019) results by finding few alcohol or tobacco interventions that explicitly use nudge theory.

### Recommendation 2

Nudge theory research targeting alcohol or tobacco behaviour is ripe for exploration. Research is needed to understand which nudge techniques might be effective for reducing alcohol or tobacco consumption, and how those nudge techniques could be used most effectively.

## Observation 3. Classification issues

Finding few eligible studies for this review could be a consequence of where nudge theory literature is published. Although peer-reviewed publications are one outlet for documenting work in this area, organizations such as the Behavioural Insights Team and government agencies such as the Australian government's Behavioural Economics Team, document their nudge interventions in annual reports. As the field of behavioural economics expands beyond academia to organizations, it could become difficult to locate nudge trials. Because of the various avenues grey literature is being archived, accessing nudge intervention reports could be an issue. It is likely that more RCTs on these topics exist but are difficult to locate because they are documented in unfamiliar avenues. In the current study, we used Google and Google Scholar to search for grey literature and used forward and backward search methods for additional eligible articles.

Further, relevant RCTs may not have been reviewed because they had no association with the field of behavioural economics, creating classification issues for archiving nudge interventions. Our review of full-text papers resulted in eliminating 23 articles because they did not identify an association between their research and nudge, choice architecture, or behaviour economics. Some behaviour change

mechanisms, such as social norms messaging, is considered a nudge, for example, but authors may not label them as such (e.g., Norman et al., 2018). As another example, Vasiljevic et al. (2018) studied the effects of verbal descriptors of alcohol content on wine and beer appeals; however, this paper was not linked to the nudge literature (e.g., no mention of nudge, behavioural economics, or choice architecture) and, thus, was not included in our review.

### Recommendation 3

Create an accessible repository of brief nudge reports. Peer-reviewed journals are suitable for nudge trials. For grey literature, a more centralized repository could be created for this purpose, instead of tasking researchers with monitoring reports from each organization publishing nudge trials. Additionally, researchers need to be aware of streams of research and to bridge their work to relevant research fields to aid dissemination. For example, studies such as Pilling et al. (2020) that do not intend to examine a nudge, could use keywords (i.e., choice architecture) to link their work to relevant fields of research. In contrast, future reviews on nudge interventions to decrease alcohol and tobacco use may benefit from a broader literature search approach that captures those studies that employ nudge techniques without explicitly using that terminology.

## Limitations and Conclusions

Finding only six studies increased our ability to elucidate patterns between populations, contexts, mechanisms, and outcomes, but failed to provide the rich detail sought in a realist review. We focused only on the six studies that explicitly used nudge theory in an intervention aimed at influencing alcohol or tobacco use. Although narrowing our focus improved understanding of nudge theory interventions, it ultimately limited the scope of the review. Another limitation is the lack of variability reported in the study samples. For our research interests, we wanted to learn about nudges that may be effective in a military setting; however, none of the studies targeted this population. All studies included in this review had non-specific general samples, which makes it particularly difficult to understand what might work most effectively for some subpopulations. Unfortunately, since only one (ineffective) study looked at a subpopulation, hazardous drinkers (Brendryen et al., 2017), the evidence is too limited to draw conclusions.

This is the first review to synthesize alcohol and tobacco nudge interventions from a realist perspective. Overall, we found limited evidence of alcohol and tobacco interventions that used nudge theory to influence behaviour. The evidence we found showed mixed effectiveness of nudging for influencing alcohol or tobacco use. More research is needed to examine various nudge techniques with different groups of people under different circumstances to enrich our understanding of how nudges can best be employed to reduce alcohol and tobacco use. Since nudges to reduce alcohol and tobacco have not been research extensively, DFHP has an opportunity to lead this research. To integrate nudges that may curb alcohol and tobacco use in the CAF, we would suggest DFHP conduct a trial (e.g., reducing the size of alcoholic beverages served in messes) to study any potential effects in this novel context. Such research would help inform CAF health promotion, and ultimately, could improve CAF health and operational readiness.

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Previous research suggests nudge theory interventions to reduce alcohol and tobacco use have been effective. But research has provided limited insight into who such interventions have worked with, under what conditions they worked, and how these interventions reduced alcohol or tobacco use. We conducted a realist review of alcohol or tobacco interventions that explicitly used nudges, choice architecture, or principles from behavioural economics to influence behaviour. The literature search was conducted in ProQuest, APA Psych Net, and EBSCO (Academic Search Premier), Google, and Google Scholar. Aligned with a realist review approach, data from six studies were compared, contrasted, and synthesized. Of these six studies, three reported significant decreases in alcohol consumption, one reported a significant decrease in tobacco use (smoking behaviour), and two reported no statistical effect from the intervention. In general, interventions were effective when they used active engagement with the nudge and immediately measured consumption. Interventions were ineffective when they had small sample sizes and passively nudged people in complex environments. Nudge theory interventions targeting alcohol or tobacco use are effective with diverse populations, conditions, and mechanisms. However, there appears to be limited explicit testing of nudge interventions targeting alcohol or tobacco use, and more research is needed to evaluate effectiveness for various populations, conditions, and mechanisms. The results of this realist review have implications for applying nudge theory to alcohol or tobacco cessation programs, as well as nudge theory intervention research, and how alcohol or tobacco interventions are reported.

Des études précédentes suggèrent que les interventions fondées sur la théorie de l'incitation (Nudge Theory) pour réduire la consommation de tabac et d'alcool sont efficaces. Mais ces travaux de recherche ne décrivent pas en détail les populations sur lesquelles ces interventions ont fonctionné, ni les circonstances, ni la manière dont elles ont réussi à réduire la consommation d'alcool et de tabac. Nous avons mené un examen réaliste des interventions liées à l'alcool et au tabac qui ont explicitement utilisé l'incitation, l'architecture du choix ou des principes de l'économie comportementale pour influencer les comportements. Nous avons procédé à une recherche de la littérature scientifique dans ProQuest, APA Psych Net, et EBSCO (Academic Search Premier), Google, et Google Scholar. Dans une approche d'examen réaliste, nous avons comparé, mis en opposition et synthétisé les données de six études. Parmi ces six études, trois faisaient état d'une diminution substantielle dans la consommation d'alcool, une faisait état d'une diminution substantielle dans la consommation de tabac (comportement de fumeur), et deux ne signalaient aucun effet statistique à la suite de l'intervention. En général, les interventions étaient efficaces lorsqu'elles engageaient activement la personne à l'égard de l'incitation et qu'elles mesuraient immédiatement la consommation. Les interventions étaient inefficaces quand l'échantillon avait une petite taille, et quand l'incitation était passive dans un environnement complexe. Les interventions fondées sur la théorie de l'incitation qui ciblent la consommation d'alcool ou de tabac sont efficaces auprès de diverses populations, dans diverses conditions et dans divers mécanismes. Toutefois, il semble y avoir peu d'essais explicites d'interventions fondées sur la théorie de l'incitation qui ciblent la consommation de tabac ou d'alcool. D'autres recherches sont nécessaires pour évaluer l'efficacité sur diverses populations et dans diverses conditions, et au moyen de divers mécanismes. Les résultats de cet examen réaliste ont une incidence sur l'application de la théorie de l'incitation dans les programmes de cessation du tabagisme ou de réduction de consommation de l'alcool, ainsi que dans la recherche sur les interventions fondées sur la théorie de l'incitation, et sur la manière dont on fait rapport des interventions en matière d'alcool ou de tabac.