

A systematic review of interventions using cue-automaticity to improve the uptake of preventive healthcare in adults: applications to dental visiting

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Objective: Since behaviour is underpinned by both cognitive and automatic processes, psychological interventions aiming to instigate or modify habitual behaviour (cue-automaticity interventions) offer an alternative to the more commonly used (mainly educational) strategies to increase preventive healthcare use. Theory suggests that low socio-economic (SES) groups are especially likely to benefit. Cue-automaticity describes how repetition of behaviour, initiated by a particular ‘cue’, in a constant context, leads to the automatic instigation and/or execution of behaviour. Our primary objective was to assess the effectiveness of cue-automaticity interventions to improve the uptake of adult preventive healthcare, and to consider how this might be applied to the design of interventions to promote preventive dental visiting. **Basic research design:** An electronic search, with citation snowballing, of cue-automaticity interventions to influence adult preventive healthcare use was undertaken. **Results:** Searching identified 11,888 titles and abstracts. Paper screening left 26 papers, of which 6 RCTs met the inclusion criteria. All 6 incorporated an Implementation Intention (I-I) component. Four studies involved cancer screening and 2 involved vaccination programmes. Five studies showed a significantly positive increase in preventive healthcare use, while one did not. **Conclusions:** Whilst few studies using cue-automaticity to underpin the promotion of preventive care use have been undertaken, studies that do exist have promising results. As cue-automaticity interventions may be of particular benefit to low SES groups, research is needed to investigate whether cue-automaticity interventions can translate into reducing inequalities in attendance for dental check-ups.

Key words: Prevention, Oral health, Health promotion, Dental Visiting Habits

Introduction

Dual processing models of behaviour explain how behaviour is influenced by both cognitive and automatic processes (Evans, 2008; Hofmann *et al.*, 2008). This means that two alternative strategies can be taken when designing behaviour change interventions. One approach, which is the basis of most educational and psychological interventions, is to focus on altering cognition – for example increasing awareness of the benefits of receiving care (Dela Cruz *et al.*, 2012; Cilbulka *et al.*, 2011), or increasing awareness of their ability to undertake a task (self-efficacy) (Kakudate *et al.*, 2009; Persson *et al.*, 1998; Stewart *et al.*, 1996). An alternative is to focus on instigating or modifying behaviour that is performed automatically (or impulsively); an approach which sits within the habit formation theory literature (Lally & Gardner, 2013; Gardner, 2015; Lally *et al.*, 2010; Gardner *et al.*, 2012; Aarts, Paulussen, Schaalma, 1997). A recent empirical review of habit-theory-based interventions showed promising results (Gardner, 2015), but was limited to relatively frequently undertaken behaviours such as exercise and healthy eating. Whether habit-theory based interventions are similarly effective in improving preventive health service use (which is a generally less frequent behaviour), has yet to be established.

Habits are defined as ‘automatic behavioural responses to environmental cues, thought to develop through repetition of behaviour in consistent contexts’ (Lally & Gardner, 2013) (Figure 1). Automaticity is considered to be a continuum, with the following four features; absence of deliberation, absence of awareness, absence of mental effort and absence of conscious control (Bargh *et al.*, 1994). Cue-automaticity describes behaviour that automatically occurs when prompted by a particular cue (stimulus). The cue may be either external (for example: completing a preceding action in a sequence; seeing a visual prompt etc.), or internal (for example: a strong internal urge such as hunger). Indeed, internal cues may also be emotion-based such as anger or shame. Once experienced, such emotions may lead to automatic behaviour initiation and/or execution.

One way cue-automaticity may be established is by laying down an Implementation Intention (I-I). This involves identifying a pre-determined circumstance whence a particular behaviour will be enacted, and linking a cue to the behaviour through a statement such as: “*If situation x arises, then I will initiate the goal-directed response y*”. The I-I (or ‘if-then’ plan) might be written down, visualised or verbalised – the important aspects being to heighten individual’s awareness to the predetermined cue and establish a mental link between the specific cue and

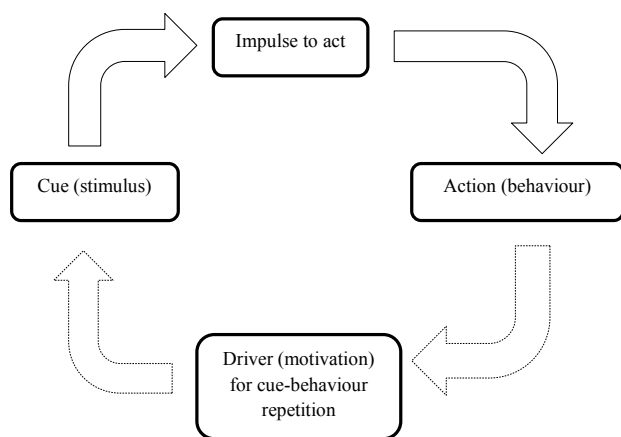


Fig 1. Cycle of stimulus and behaviour leading to habit formation

action (Webb & Sheeran, 2007; Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2008). Through this mechanism, control for the performance of the behaviour is transferred from the self to the environment in the shape of the predetermined, personalised cue (Gollwitzer, 1999). Whilst sufficient motivation and cognition is required to undertake the thought processes involved in setting the I-I (Sheeran *et al.*, 2005), once the behaviour is carried out repeatedly according to the stipulated cue, behaviour gradually transfers from being cognitively enacted, to being automatic. The benefit of this, is that behaviour that is automatic is more likely to be maintained longer term, because when motivation wanes, the cue continues to prompt behaviour (Lally *et al.*, 2011; Rotham *et al.*, 2009). Although I-I are often used in intervention design as a means to establish habitual behaviours, habits can also be established without the use of this mechanism; for example, as a consequence of repeated, conscious, responses to particular cues (Lally *et al.*, 2008).

Since studies show that living in poverty places such strains on internal resources that cognitive processing capacity is effectively reduced (Mani *et al.*, 2013; Mauraven & Baumeister, 2000), interventions that establish automatic behaviour may have benefits in addressing socio-economic related health inequalities. This is because automatic behaviour is relatively un-demanding of cognitive processes (Strack & Deutsch, 2004). In the context of interventions to promote early dental visiting, this is important, since those most in need of regular, preventive dental care are the least likely to take it up (Petersen *et al.*, 2005; Thomson *et al.*, 2010; Office of National Statistics, 2009; Petersen, 1990; Donaldson *et al.*, 2008; Watt, 2007). Lower rates of preventive dental visiting are found to account for at least some of the reduced level of oral health at the lower end of the SES visiting spectrum (Thomson *et al.*, 2010; Sanders *et al.*, 2006). Thus, interventions that promote preventive dental visiting are one way in which health inequalities may be reduced, and theoretically, cue-automaticity is designed type of intervention design which could offer particular benefits in this area.

Interest in the role of automatic behaviour in the instigation and maintenance of oral health behaviours is growing, most particularly in relation to promotion of daily flossing (Orbell & Verplanken, 2010; Judah *et*

al., 2013). A toothbrushing intervention study has also shown promising results (Wind *et al.*, 2005). The same approach has yet to be explored however, in relation to preventive dental visiting. Before we consider translating this approach to this third oral health behaviour, it is important to recognise that dental visiting is a much less frequent behaviour than either flossing or toothbrushing. This raises the question as to whether the use of cues to prompt dental visiting is sufficient to establish a pattern of habitual behaviour, given the extended timescales involved. To help answer this question, this paper reviews evidence from the wider healthcare context, and considers whether there is evidence that cue-automaticity interventions are effective for other similar types of preventive visiting behaviour such as attendance for cervical smears, examinations, eye tests etc. The paper also identifies the design features of these types of studies in order to help inform the design of cue-automaticity intervention in preventive dental visiting. The aim of our study was therefore two-fold: to assess the effectiveness of interventions containing a component of cue-automaticity aiming to improve the uptake of preventive healthcare (addressed in the results section), and to discuss how this approach might be applied to preventive dental visiting.

Methods

Study identification and selection criteria

Literature was identified by electronic searching, forward and backward citation searching and personal contact with experts in the field. A detailed search strategy was constructed using terms from key papers with each search strategy tailored to each of the eleven databases (details available in online appendix 1 and 2). Forward citation searching included screening all papers that cited the electronic searching inclusion papers, backward citation searching involved screened all papers cited within included papers identified from the electronic search.

One author screened all titles and abstracts. A sample of twenty per cent was screened by a second reviewer for agreement of exclusion/inclusion. Full paper versions of studies meeting the following inclusion criteria were retrieved to assess eligibility:

1. Design: Studies were limited to RCTs, quasi-RCTs, pilot studies, feasibility studies and cluster randomised trials of interventions aiming to improve the uptake of preventive healthcare services. Studies had to have a minimum of 8-10 weeks follow up (as literature suggests that a habit takes on average 66 days to form (Lally *et al.*, 2009)). Where data relating to follow up were not reported, authors were contacted to see whether they were available and if they could be obtained, the study was included. Studies were not restricted by language or publication date but were to primary data only. Inclusion criteria for health care services was any type of publicly or privately funded service that would benefit people's health. 'Preventive' was defined as services based on the principle of anticipatory action such as vaccination, health checks etc, where disease or ill health symptoms are not yet apparent.

- Types of participants: Adults (aged 18 years or older) who were eligible for preventive healthcare services. We did not place any limitation by setting, and so interventions may have been undertaken in population (e.g. workplace) as well as health care settings.
- Types of interventions: Only interventions that clearly linked the intervention to the production of automated behaviour (such as describing cue-automaticity associations) were included. Group (including family unit), community and individual interventions were all included. Each study had to have a control group (defined as a group that received standard preventive healthcare advice only) and/or an alternative intervention group.

Data extraction, data synthesis and quality assessment

The primary outcome was any type of attendance at a health service that was specifically for preventive purposes. Secondary outcomes included cognitive variables such as self-efficacy and measures of automatic behaviour. Data extraction was completed by a first assessor (HR) into structured data extraction tables and grouped according to the preventive healthcare service type (for example, cancer screening or vaccinations). Data extraction was double checked by a second assessor (SW),

with any discrepancies resolved by a third assessor (RH). Due to the heterogeneity of studies ($\text{Chi}^2 = 23.64$, $\text{df} = 6$ ($P=0.0006$); $I^2= 75\%$), data pooling i.e. meta-analysis was inappropriate. An assessment of risk of bias of included studies was completed using the Cochrane Tool (Higgins *et al.*, 2011) by two assessors (HR, SW). The overall quality of evidence was also assessed using the GRADE approach (Higgins *et al.*, 2011).

Results

Electronic searching, alongside backward and forward citations identified 11,888 titles and abstracts. Twenty six full papers were screened for eligibility of which twenty were excluded. Figure 2 is a PRISMA diagram with reasons for exclusion. The six RCTs included in the review were all published between 2000 and 2014. Included studies concerned either vaccinations (Hepatitis B (Vet *et al.*, 2014) and influenza (Milkman *et al.*, 2011) or cancer screening programmes (colorectal (Neter *et al.*, 2014; Greiner *et al.*, 2014), cervical (Sheeran & Orbell, 2000) and breast (Rutter *et al.*, 2006)). Length of follow up ranged from three to six months. One study did not report length of follow-up within the manuscript (Rutter *et al.*, 2006). However, clarification was achieved from the authors. Table 1 summarises the included studies.

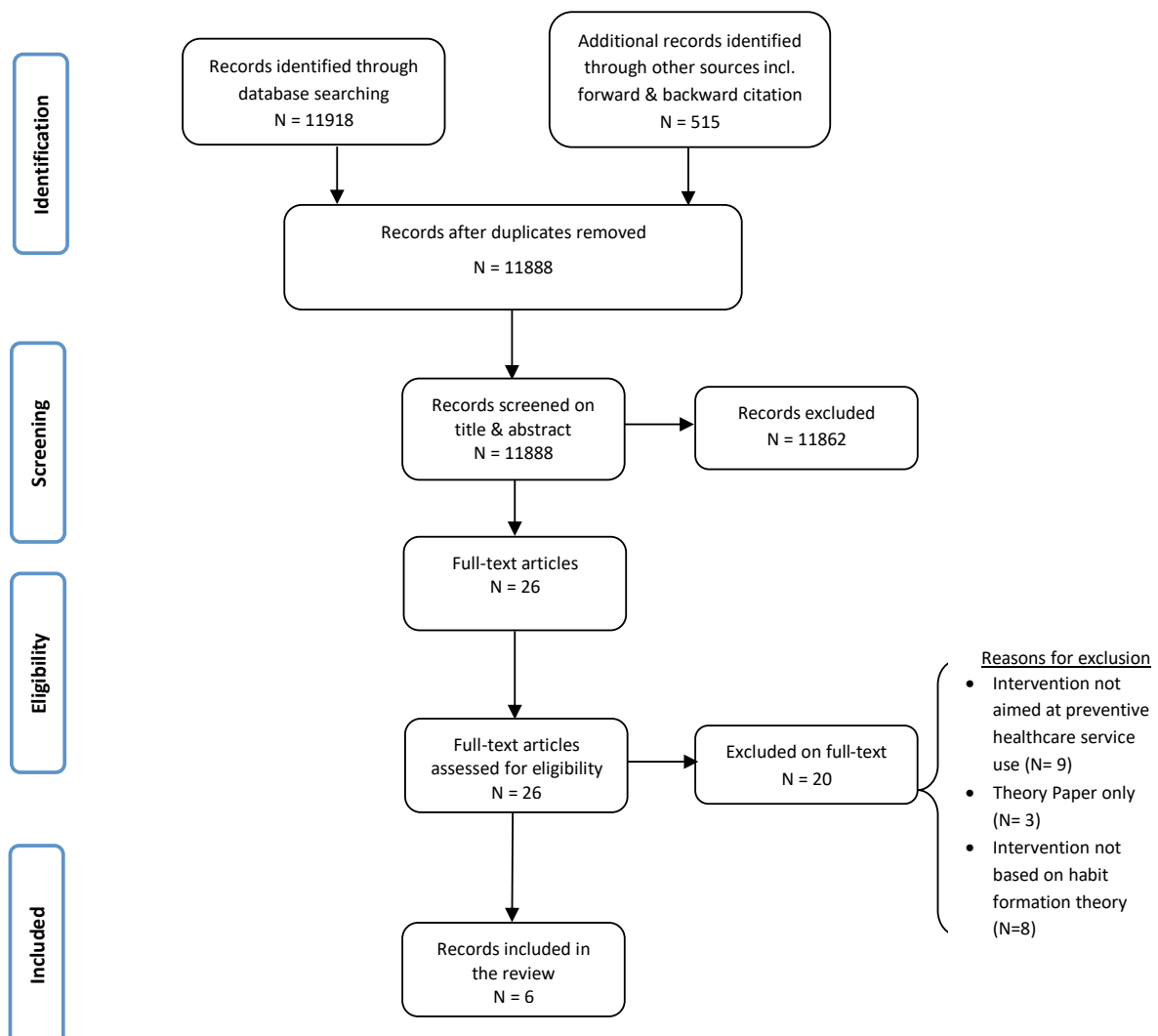


Figure 2. PRISMA diagram of study inclusion

Table 1. Included papers

Study, Year, Country, Recruitment population	Participant demographics	Outcome and other measures	Intervention	Control	Method of delivery	Results	Conclusion
Preventive healthcare service: Vaccinations							
Milkman et al, 2011 USA n=3272 Employees at a large Midwestern utility firm	<u>Age</u> 51.1 years ± 8.1 (mean) <u>Gender</u> 72.5% Male 27.5% Female <u>Ethnicity /Race</u> 76.6% Caucasian 20.5% African-American 2.8% Asian	<u>Inclusion</u> Vaccination indicated by CDC guidelines: Individuals 50 years of age or older OR Those with chronic health conditions that increase the risk of influenza related complications <u>Time Plan Condition</u> Control + prompt to write down date & time employees planned to get their vaccine	<u>Date Plan Condition</u> Control + prompt to write down date employees planned to get their vaccine 4.2% higher vaccination rate than control – significant (unadjusted OR 1.19 95% CI 1.01 to 1.40)	<u>Outcome</u> Influenza vaccination – receipt of a seasonal influenza vaccine at one of the firm's on-site clinics <u>Baseline</u> N/R	<u>Info. about workplace vaccination clinics</u> (locations & times). Info. on importance of receiving influenza vaccine. 4.2% higher vaccination rate than control – significant (unadjusted OR 1.19 95% CI 1.01 to 1.40)	<u>Email</u> 1.5% higher vaccination rate than control – NS (unadjusted OR 1.12, 95% CI 0.92 to 1.35)	I-I intervention significantly increased influenza vaccinations, but only when both the date & time planned.
Vet et al, 2014 Netherlands n=616 Online participants	<u>Age</u> 32.6 years ± 12.4 (mean) <u>Gender</u> 100% Male <u>Ethnicity/Race</u> 95% Dutch 5% Ethnic minority	<u>Inclusion</u> Male Had sex with a man in previous year Not infected with HBV Not previously vaccinated against HBV Didn't immediately make HBV vaccination appt online Intended to make a vaccination apt at some point	<u>Provide details of when, where & how they would make HBV vaccine appt.</u> Either email or printed I-I given with info. about HBV vaccine sites.	<u>Outcome</u> Receipt of HBV vaccine – as recorded on vaccination register <u>Baseline</u> - Goal intention -I-I complete -ness	<u>General info. including contact details of Public Health Services offering HBV vaccines</u>	<u>Online</u> Strong intention more likely to have obtained HBV vaccination than men with a weak (p<0.01) Significant association between I-I & HBV vaccination (unadjusted OR 2.73 95% CI 1.38 to 5.4) Association between intention strength & completeness of I-I (p<0.05)	Having a strong goal intention to obtain HBV vaccine and forming a complete I-I, each significantly & independently increase likelihood of MSM obtaining HBV vaccination.
Completeness of I-I significantly associated with HBV vaccination uptake (p<0.001)							

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Preventive healthcare service: Cancer screening

Greiner et al, 2014 USA n=470 Attendees at 9 safety-net clinics	Age 55 years (median) <u>Gender</u> 36.4% Male 63.6% Female <u>Ethnicity/Race</u> 27% Hispanic 42% Non-Hispanic African-American 28% Non-Hispanic white 3% Other	Inclusion Patients aged ≥ 50 years Have a provider visit on enrolment day Exclusion Income > 150% federal poverty level No home address No working phone Received faecal occult blood test of FIT in last year Sigmoidoscopy or barium enema in last 5y Colonoscopy in last 10y Acute medical illness Reported current GI bleeding History of colon polyps History of CRC First-degree relative with CRC before age 60y Inherited polyposis/non-polyposis syndrome Inflammatory bowel disease Another household member in study Cognitive impairment	Outcome Colorectal cancer screening – completion of either FIT or screening colonoscopy Baseline -PAPM staging -Perceived susceptibility to CRC -Self-efficacy for CRC screening -Cancer fatalism	Received info. & education on CRC screening. Completed I-I around CRC screening planning. Given print out of I-I Those “deciding to” pursue screening test were given either an FIT kit or colonoscopy scheduling info. & bowel prep materials before leaving clinic.	Received info. & education on CRC screening. Given questions and print out on diet, exercise & health living. Those “deciding to” pursue a screening test were given either an FIT kit or colonoscopy scheduling info. & bowel prep materials before leaving clinic.	Touch-screen computer Higher self-efficacy were more likely to complete CRC screening (AOR=1.57)	Individuals who completed an I-I had higher odds of completing CRC screening than comparison (AOR=1.83). Higher self-efficacy were more likely to complete CRC screening (AOR=1.57)	I-I approach can contribute to successful completion of CRC screening even among very low-income & diverse primary care pop ⁿ
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	<u>Age</u>	<u>Inclusion</u>	<u>Outcome</u>	Mailed FOBT kit & leaflet containing instructions to write down when, where & how to complete the FOBT test	Mailed info. leaflet & FOBT kit	Post	Individuals who completed an I-I were significantly more likely to complete FOBT testing than controls (unadjusted OR 1.18, 95% CI 1.12 to 1.24)	I-I technique is useful in increasing adherence to CRC screening, even in a mailed form rather than a face-to-face situation
Neter et al, 2014 Israel n=27633 HMO-insured members	62.31 years ± 6.66 (mean) <u>Gender</u> 43.8% Male 56.2% Female <u>Ethnicity /Race</u> N/R	<u>Inclusion</u> Performed FOBT test in last year No inflammatory bowel disease or malignancy No colonoscopy within previous 3 years Insured member	<u>Outcome</u> Colorectal cancer screening - completion of FOBT test <u>Baseline</u> -Intention -Perceived efficacy -CRC knowledge -Risk perception -Perceived health					
Rutter et al, 2006 UK n=2082 Patients on NHSBSP screening database	<u>Age</u> 56.1 years (mean) <u>Gender</u> 100% Female <u>Ethnicity /Race</u> 98.6% White British	<u>Inclusion</u> Members of 2 screening cohorts from Kent, England <u>Assessment-only</u> Postal questionnaire measuring health behaviours, beliefs about attending for breast screening & details of their demographic background, prior to their invitation to screening.	<u>Outcome</u> Breast cancer screening – as recorded by screening centre <u>Baseline</u> -Intention -Beliefs -Subjective norm -Perceived behavioural control	<u>Intervention</u> Postal questionnaire measuring health behaviours, beliefs about attending for breast screening & demographic details. Also a section to formulate I-I to overcome 3 potential obstacles: Changing inconvenient appointment Arranging transport Negotiating time off work before invitation to screening.	Sent invitation for screening. NS (unadjusted OR 0.99, 95% CI 0.72 to 1.38)	Post	NS (unadjusted OR 0.92, 95% CI 0.68 to 1.24) However, women who made a plan to negotiate time off work were more likely to attend than those who did not or for whom planning was irrelevant (p<0.01)	I-I did not lead to an overall increase in attendance for breast screening.

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Sheeran et al., 2000 UK n=217 Patients at a single medical practice	<u>Age</u> 40.62 (SD=11.69) <u>Gender</u> 100% Female <u>Ethnicity /Race</u> N/R	<u>Inclusion</u> Due for a cervical smear test during a 3-month period	<u>Outcome</u> Uptake of cervical smear test <u>Baseline</u> -Attitudes -Subjective norms -Perceived behav- ioural control -Intention	Standard postal reminder to attend for cer- vical smear. Then a postal questionnaire on their views of cervical smear test and asked to form an I-I speci- fying when, where & how they would make an ap- pointment to go for cervical smear test.	Standard postal reminder to attend for cervical smear. Then a postal ques- tionnaire on their views of the cervical smear test.	Post	Women who formed I-I were significantly more likely to attend for their appointment (unadjusted OR 4.83, 95% CI 1.64 to 14.22)	Forming I-I to make an ap- pointment to attend increases likelihood of at- tendance – even when participants strongly intend to achieve their goal.
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Two studies (Greiner *et al.*, 2014; Rutter *et al.*, 2006) were deemed to be of high risk of bias, while the remaining four were of unclear risk (Appendix 3). The overall quality of evidence (as assessed by the GRADE approach) was considered to be low.

All six studies incorporated an Implementation Intention (I-I) (i.e. ‘if-then’ plans) component. Table 2 details the cue-automaticity component from each publication. In three studies, the ‘if-then’ plan was combined with other intervention components such as information about benefits of attendance for screening (Milkman *et al.*, 2011; Neter *et al.*, 2014; Greiner *et al.*, 2014). ‘If’ components were all personally predetermined by participants and consisted of a combination of dates, times and or places. For example, Milkman *et al.* (2011) emailed employees, at a large utility firm, one of three different emails about workplace vaccination clinics. All emails contained educational information about where and when influenza vaccinations would take place at the firm. The two intervention arms both encouraged participants, via e-mail, to construct an I-I. The first encouraged forming I-I round the date they planned to receive their vaccination, whilst the other encouraged the record of both the date and time.

The importance of full completion of the I-I (rather than partial completion) had a significant effect in two studies. Vet *et al.* (2014), recruited men online via a number of different websites for men who have sex with men (MSM). Consented participants were asked to complete online, an I-I about when, where and how to make an appointment for Hepatitis B vaccination. Those who provided a valid, registered response about when, where and how were classified as having a complete I-I. Sixty per cent of participants formed complete I-I plans and completeness was significantly associated with HBV vaccination uptake (unadjusted OR 3.64 95% CI 1.89 to 7.03). The other study, by Milkman *et al.* (2011), showed the I-I intervention significantly increased influenza vaccinations, but only in the intervention arm where both the date and the time were documented (unadjusted OR 1.19 95% CI 1.01 to 1.40).

Five studies showed a significant positive increase in preventive health service use (Table 1; Appendix 4). For example, Sheeran *et al.* (2000), who incorporated an I-I intervention at the end of a postal questionnaire around cervical cancer screening, reported 92% of interventional individuals attended for cervical cancer screening compared to 69% of controls (unadjusted OR 4.83, 95% CI 1.64 to 14.22). Neter *et al.* (2014) posted a fecal occult blood test (FOBT) kit to HMO-insured members with either an information leaflet (control) or a leaflet containing I-I instructions to write down when, where and how they would complete the FOBT test (intervention). Individuals within the intervention group were more likely to complete and return the FOBT test than controls (unadjusted OR 1.18, 95% CI 1.12 to 1.24). Another study by Greiner *et al.* (2014) incorporated, via computers within a healthcare setting (safety-nets), information and education on colorectal cancer (CRC) screening. Participants in the intervention group completed an I-I around when, where and how they would complete CRC screening, and were given a printout copy of their individualised I-I to take home. The control group were asked questions and given printout information on diet, exercise and healthy living. Individuals who completed the I-I intervention had higher odds of completing CRC screening compared to controls (AOR=1.83).

Table 2. Documentation of intervention forming cue-automaticity or link to its production

<i>Study, Year</i>	<i>Intervention details</i>
Vet et al, 2014	Implementation Intention (I-I) “... <i>The resulting increased cognitive accessibility of the specified situational cue facilitates the detection of an attention to this cue. In addition, forming an implementation intention is thought to automate the execution of a behavioural response...</i> ” pg 123
Milkman et al, 2011	Implementation Intention (I-I) “... <i>Simply asking people to develop such a plan, or an “implementation intention,” is all that is necessary to trigger an association between the desired behaviour and a concrete future moment...</i> ” pg 10415
Sheeran et al, 2000	Implementation Intention (I-I) “... <i>Rather, “the underlying theory is that by forming implementation intentions people pass on control of goal-directed activities from the self to the environment. The intended behaviour is subject to external control through the environmental cues specified in one’s implementation intention ... when these cues ... are encountered, they are expected to prompt the intended behaviour...</i> ” pg.284
Neter et al, 2014	Implementation Intention (I-I) “... <i>The automation transfers goal-directed behaviour from effortful, conscious control into reacting to situational cues...</i> ” pg.274
Rutter et al, 2006	Implementation Intention (I-I) “... <i>implementation intentions “pass on control of goal-directed activities from the self to the environment...”</i> pg.128
Greiner et al, 2014	Implementation Intention (I-I) “... <i>I-I can lead to initiation of action even when people are stressed...</i> ” pg. 704

Only one of the six included studies did not show a significant intervention effect (Rutter *et al.*, 2006). This study incorporated an I-I intervention component via a postal questionnaire aimed at increasing the uptake of attendance for breast cancer screening. The I-I addressed three key barriers to attendance; namely changing an appointment, travelling to the screening unit and arranging time off work. Participants were required to form I-I for all three key barriers and return the questionnaire. Results showed a non-significant I-I intervention effect (78.9%) compared to controls (80.3%) (unadjusted OR 0.92 95% CI 0.68 to 1.24). Possible explanations for this finding could be a ceiling effect of high attendance in the control condition or because the I-Is were focused around antecedents (barriers) to the behaviour, rather than on the barrier itself.

Just one study explored the differential interventional effects of a cue-automaticity intervention by SES background. Participants in Neter *et al.* (2014) were from diverse SES backgrounds (based on clinic SES), with intervention effects consistent across the SES spectrum. In addition, Greiner *et al.* (2014) delivered the intervention to individuals from a low SES background (income >150% of the Federal Poverty Level), via recruitment from 9 different safety-net clinics within the US. They also demonstrated a positive increase in uptake of colorectal cancer screening with an I-I component (54%) compared to an education only intervention (unadjusted OR 1.18, 95% CI 1.12 to 1.24 (42%). The remaining four studies did not consider SES as an explanatory variable.

No outcome measures of automatic behaviour, such as the Self-Report Behavioural Automaticity Index (SRBAI) (Gardner *et al.*, 2012), were reported in any of the included papers. A number of different baseline variables were measured such as: behavioural intention, self-efficacy, perceived susceptibility and perceived behavioural control. Of these variables, only intention to perform the behaviour was found to be significantly associated with intervention effectiveness (Vet *et al.*, 2014; Neter *et al.*, 2014; Sheeran & Orbell, 2000; Rutter *et al.*, 2006).

Discussion

The aim of this systematic review was to assess the effectiveness of interventions, containing a component of cue-automaticity, to improve the uptake of preventive healthcare, and to consider how this approach might be applied to preventive dental visiting. Given that only six studies were identified, with five of them effective, this suggests that whilst this area of research is relatively new, it may offer an effective way to improve preventive health care service uptake. An important note of caution however should be added; none of these studies were rated as high quality.

Dental visiting is an infrequent, complex behaviour. While included studies also addressed infrequent, complex behaviours such as attendance for breast cancer screening (yearly – every 3 years), influenza vaccination (yearly) and cervical cancer screening (every 3-5 years), few incorporated long term follow-up (the maximum follow-up in included studies was six months). This, therefore raises a question as to whether included interventions (all of which incorporated an I-I intervention component) can be truly seen as establishing cue-automaticity in the context of complex, infrequent health behaviours. I-I interventions, in this setting, may increase behaviour by heightening the mental accessibility of an opportune moment to act, rather than establishing a memorable link between a particular cue and behaviour (Gollwitzer & Sheeran, 2006). Therefore, the active mechanism within these interventions requires further exploration, and should include determination as to whether cue-automaticity has been established using a long term follow-up strategy. Indeed measures such as self-reported behavioural automaticity index (SRBAI) would be important to consider, as well as longer follow-up periods in future intervention work in order to help determine the level of automaticity established to predetermined cues for infrequent behaviours.

Whilst only one included study focussed on low SES participants exclusively and another explored the gradient of improvement across the SES spectrum, the impact of this type of psychological intervention across the gradient remains to be determined. However, the limited available evidence suggests that a uniform impact across the gradient may be likely (Neter *et al.*, 2014; Greiner *et al.* 2014). This outcome will depend, however, on the extent to which full adherence to the I-I intervention is consistent across all SES groups as completeness of I-I may impact significantly on preventive behaviour.

Moreover, the intervention format of the one study where no evidence of effectiveness was found (Rutter *et al.*, 2006) suggests that I-I interventions maybe more effective when they focus on the behaviour itself rather than antecedent steps to attendance, including how one might travel to an appointment. This suggests that for dental visiting, the I-I intervention might be most effective when it documents where (i.e. which dental practice you will contact), when (i.e. which date and time you will contact with the dental practice) and how (i.e. telephone / email /face-to-face) patients will make an appointment, rather than overcoming barriers (such as arranging time off work) for dental attendance.

Certainly the infrastructure around dental appointment systems may lend itself to being used to incorporate I-I plans when making appointments for check-ups, since reminder cards and postcard messages have previously been used successfully to increase attendance (Patel *et al.*, 2000; Reekie & Devlin, 1998). The addition of an I-I intervention to the end of such reminder prompts may assist individuals with an intention to attend, by heightening their awareness to the predetermined cue associated with attendance and establishing a mental link between the specific cue and attending (Gollwitzer & Sheeran, 2006).

Finally, a number of study limitations should be acknowledged. Firstly, all of the preventive healthcare services included within the review were free for the individuals from the point of contact. Although this is true in certain situations, such as those who qualify for free dental treatment (e.g. pregnant women in the United Kingdom), treatment cost presents a substantive filter to preventive dental attendance. It is possible that this factor might prove so great a barrier as to impact on the efficacy of cue-automaticity interventions in the dental context. Secondly, preventive healthcare services within the review included cancer and Hepatitis B, which carry a significant mortality and morbidity risk. It is likely that this heightens individual's intentions to conduct this type of preventive behaviour, making this form of psychological intervention more effective. It is unclear therefore, whether this efficacy would translate into the less urgent, dental context.

Conclusion

While interventions using cue-automaticity to underpin the promotion of preventive care use are relatively rare, studies that do exist have promising results. Studies also indicate that cue-automaticity interventions in this context can be effective for low SES groups, potentially reducing health inequalities, although more work is required to

explore the effect of I-I interventions that aim to establish cue-automaticity towards preventive oral health behaviour. In particular, work is required to understand the active mechanism, over the long term, of such interventions and their impact across the SES gradient.

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References

- Aarts, H., Paulussen, T. and Schaalma, H. (1997): Physical exercise habit: on the conceptualization and formation of habitual health behaviours. *Health Education Research* **12**, 363-74.
- Bargh, J.A., Bargh, J.A., Wyer, Robert, S. (Jr) (Ed); Strull, Thomas K. (Ed). (1994): The four horsemen of automaticity: Awareness, intention, efficiency and control in social cognition. *Handbook of social cognition: Basic processes; Applications*, Vols. 1-2, 2nd ed. (pp.1-40). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc, 980 pp.
- Cibulka, N.J., Forney, S., Goodwin, K., Lazaroff, P. and Sarabia, R. (2011): Improving oral health in low-income pregnant women with a nurse practitioner-directed oral care program. *Journal of the American Association of Nurse Practitioners* **23**, 249-57.
- Dela Cruz, A., Mueller, G., Milgrom, P. and Coldwell, S.E. (2012): A Community-based Randomized Trial of Postcard Mailings to Increase Dental Utilization Among Low-income Children. *Journal of Dentistry for Children* **79**, 154-8.
- Donaldson, A., Everitt, B., Newton, T., Steele, J., Sherriff, M. and Bower, E. (2008): The effects of social class and dental attendance on oral health. *Journal of Dental Research* **87**, 60-4.
- Evans, J.S.B. (2008): Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology* **59**, 255-78.
- Gardner, B. (2015): A review and analysis of the use of 'habit' in understanding, predicting and influencing health-related behaviour. *Health Psychology Review* **9**, 277-295.
- Gardner, B., Abraham, C., Lally, P. and de Bruijn, G.J. (2012): Towards parsimony in habit measurement: Testing the convergent and predictive validity of an automaticity subscale of the Self-Report Habit Index. *International Journal of Behavioral Nutrition and Physical Activity* **9**, 102
- Gardner, B., Lally, P. and Wardle, J. (2012): Making health habitual: the psychology of 'habit-formation' and general practice. *British Journal of General Practice* **62**, 664-6.
- Gollwitzer, P.M. and Sheeran, P. (2006): Implementation Intentions and Goal Achievement: A Meta-analysis of Effects and Processes. *Advances in Experimental Social Psychology* **38**, 69-119.
- Gollwitzer, P.M. (1999): Implementation intentions: Strong effects of simple plans. *American Psychologist* **54**, 493.
- Greiner, K.A., Daley, C.M., Epp, A., James, A., Yeh, H-W., Geana, M., Born, W., Engelman, K.K., Shellhorn, J., Hester, C.M., LeMaster, J., Buckles, D.C. and Ellerbeck, E.F. (2014): Implementation intentions and colorectal screening: a randomized trial in safety-net clinics. *American Journal of Preventive Medicine* **47**, 703-14.
- Higgins, J.P., Altman, D.G., Gøtzsche, P.C., Jüni, P., Moher, D., Oxman, A.D., Savovic, J., Schulz, K.F., Weeks, L. and Sterne, J.A.C. (2011): The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *British Medical Journal* **343**, d5928.

- Higgins, J.P. and Thomas, J. (2011): *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0 [updated March 2011]. The Cochrane Collaboration 2011. Available from www.cochrane-handbook.org/
- Hofmann, W., Friese, M. and Wiers, R.W. (2008): Impulsive versus reflective influences on health behavior: A theoretical framework and empirical review. *Health Psychology Review* **2**, 111-37.
- Judah, G., Gardner, B. and Aunger, R. (2013): Forming a flossing habit: An exploratory study of the psychological determinants of habit formation. *British Journal of Health Psychology* **18**, 338-53.
- Kakudate, N., Morita, M., Sugai, M. and Kawanami, M. (2009): Systematic cognitive behavioral approach for oral hygiene instruction: a short-term study. *Patient Education and Counseling* **74**, 191-6.
- Lally, P. and Gardner, B. (2013): Promoting habit formation. *Health Psychology Review* **7**, S137-S58.
- Lally, P., Wardle, J. and Gardner, B. (2011): Experiences of habit formation: A qualitative study. *Psychology, Health and Medicine* **16**, 484-9.
- Lally, P., Van Jaarsveld, C.H., Potts, H.W. and Wardle, J. (2010): How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology* **40**, 998-1009.
- Lally, P., Van Jaarsveld, C.H., Potts, H.W. and Wardle, J. (2010): How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology* **40**, 998-1009.
- Lally, P., Chipperfield, A. and Wardle, J. (2008): Healthy habits: efficacy of simple advice on weight control based on a habit-formation model. *International Journal of Obesity* **32**, 700-7.
- Mani, A., Mullainathan, S., Shafir, E. and Zhao, J. (2013): Poverty Impedes Cognitive Function. *Science* **341**, 976-80.
- Milkman, K.L., Beshears, J., Choi, J.J., Laibson, D. and Madrian, B.C. (2011): Using implementation intentions prompts to enhance influenza vaccination rates. *Proceedings of the National Academy of Sciences* **108**, 10415-20.
- Muraven, M. and Baumeister, R.F. (2000): Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin* **126**, 247.
- Neter, E., Stein, N., Barnett-Griness, O., Rennert, G. and Hagoel, L. (2014): From the bench to public health: population-level implementation intentions in colorectal cancer screening. *American Journal of Preventive Medicine* **46**, 273-80.
- Office for National Statistics. Social Survey Division ICfHaSC. Adult Dental Health Survey (2009): [data collection]. 2nd Edition. UK Data Service, 2012 [Accessed 17 November 2015]. Available from: <http://dx.doi.org/10.5255/UKDA-SN-6884-2>
- Orbell, S. and Verplanken, B. (2010): The automatic component of habit in health behavior: habit as cue-contingent automaticity. *Health Psychology* **29**, 374-83.
- Patel, P., Forbes, M. and Gibson, J. (2000): The reduction of broken appointments in general dental practice: an audit and intervention approach. *Primary Dental Care* **7**, 141-4.
- Reekie, D. and Devlin, H. (1998): Preventing failed appointments in general dental practice: a comparison of reminder methods. *British Dental Journal* **185**, 472-4.
- Persson, R.E., Persson, G.R., Powell, L. and Klyak, H.A. (1998): Periodontal effects of a biobehavioral prevention program. *Journal of Clinical Periodontology* **25**, 322-9.
- Petersen, P.E., Bourgeois, D., Ogawa, H., Estupinan-Day, S. and Ndiaye, C. (2005): The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization* **83**, 661-9.
- Petersen, P.E. (1990): Social inequalities in dental health. Towards a theoretical explanation. *Community Dentistry and Oral Epidemiology* **18**, 153-8.
- Rothman, A.J., Sheeran, P. and Wood, W. (2009): Reflective and automatic processes in the initiation and maintenance of dietary change. *Annals of Behavioral Medicine* **38**, 4-17.
- Rutter, D.R., Steadman, L. and Quine, L. (2006): An implementation intentions intervention to increase uptake of mammography. *Annals of Behavioral Medicine* **32**, 127-34.
- Sanders, A.E., Spencer, A.J. and Slade, G.D. (2006): Evaluating the role of dental behaviour in oral health inequalities. *Community Dentistry and Oral Epidemiology* **34**, 71-9.
- Sheeran, P., Webb, T.L. and Gollwitzer, P.M. (2005): The Interplay Between Goal Intentions and Implementation Intentions. *Personality and Social Psychology Bulletin* **31**, 87-98.
- Sheeran, P. and Orbell, S. (2000): Using implementation intentions to increase attendance for cervical cancer screening. *Health Psychology* **19**, 283.
- Stewart, J.E., Wolfe, G.R., Maeder, L. and Hartz, G.W. (1996): Changes in dental knowledge and self-efficacy scores following interventions to change oral hygiene behavior. *Patient Education and Counseling* **27**, 269-77.
- Strack, F. and Deutsch, R. (2004): Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review* **8**, 220-47.
- Thomson, M.W., Williams, S., Broadbent, J., Poulton, R. and Locker, D. (2010): Long-term Dental Visiting Patterns and Adult Oral Health. *Journal of Dental Research* **89**, 307-11.
- Vet, R., de Wit, J.B. and Das, E. (2014): The role of implementation intention formation in promoting hepatitis B vaccination uptake among men who have sex with men. *International Journal of STD & AIDS* **25**, 122-9.
- Watt, R.G. (2007): From victim blaming to upstream action: tackling the social determinants of oral health inequalities. *Community Dentistry and Oral Epidemiology* **35**, 1-11.
- Webb, T.L. and Sheeran, P. (2008): Mechanisms of implementation intention effects: the role of goal intentions, self-efficacy, and accessibility of plan components. *British Journal of Social Psychology* **47**, 373-95.
- Webb, T.L., Sheeran, P. (2007): How do implementation intentions promote goal attainment? A test of component processes. *Journal of Experimental Social Psychology* **43**, 295-302.
- Wind, M., Kremers, S., Thijs, C. and Brug, J. (2005): Toothbrushing at school: Effects on toothbrushing behaviour, cognitions and habit strength. *Health Education Journal* **105**, 53-61.