

ORIGINAL ARTICLE

Is toothbrushing behaviour habitual? Cues, context, motivators and patient narratives

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Abstract

Objectives: Toothbrushing is generally considered as a key self-care behaviour necessary for maintaining good oral health. Although twice-daily brushing is widely recommended as beneficial since this provides both biofilm removal and a regular application of fluoride, some people such as those with low socio-economic (SES) backgrounds often brush less regularly. Habit theory identifies that behaviours become habitual when they are undertaken repeatedly in response to a particular cue within a stable context. Once behaviour becomes automatic, long-term maintenance is more likely even if motivation wanes. Establishing toothbrushing as a habitual behaviour is therefore an intervention strategy which may help reduce health inequalities. Therefore, the objective was to more fully understand the nature of toothbrushing behaviour in adults and what prompts its instigation and execution in the morning and evening, in order to inform the design of interventions in this area.

Methods: Twenty-nine semi-structured interviews were undertaken in an urgent dental care centre in a deprived area of North West England. Thematic analysis using a framework method was used to code the data into theoretically derived categories.

Results: Morning toothbrushing was found to be strongly integrated into cleansing routines and was identified as a behaviour predominantly initiated in response to visual cues. Some toothbrushing behaviour was prompted by internal cues, expressed as strong feelings or urges. These were more related to night-time toothbrushing habits. Common morning motivators were aesthetics and social acceptability. Evening motivators were relatively idiosyncratic. Cleaning of the mouth following a hard, manual working day emerged as a strong driver for low SES males.

Conclusion: Understanding the nature of habitual morning and evening toothbrushing is important for the design of effective behavioural interventions, especially those aiming to achieve sustainable improvement in the frequency of night-time toothbrushing.

KEYWORDS

behaviour, habits, health education, oral health, oral hygiene

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1 | INTRODUCTION

Regular toothbrushing with a fluoridated toothpaste has been repeatedly demonstrated as critical to preventing dental caries and maintaining good periodontal health.¹⁻⁵ It simultaneously removes harmful oral biofilm while delivering fluoride to the oral environment to help resist demineralization following sugar consumption.^{6,7} However, although toothbrushing is considered a relatively simple and low-cost behaviour, many people brush less regularly than is recommended, and this is associated with poorer oral health.^{8,9}

Previous approaches to interventions aimed at improving toothbrushing behaviour have predominantly focused on targeting behavioural change components, such as motivation (eg motivational interviewing), capability (eg self-efficacy interventions) and opportunity (eg supply of toothbrushes, toothpastes), necessary to instigate better behaviours. So far there has been relatively limited consideration of behaviour maintenance aspects of toothbrushing interventions,¹⁰⁻¹² and to what extent any intervention effects diminish over time.^{13,14}

Habit formation theory pays more attention to the behaviour maintenance aspect of behavioural change interventions. Habits are defined as automatic behavioural responses initiated by individualized, salient cues (stimuli).^{15,16} Cues can be either time (initiating behaviour at a certain time of day), activity (initiating behaviour at the end of a predetermined activity) or event-based (initiating behaviour by something in the environment).^{17,18} Habits are established by the constant repetition of behaviour following encounter of a cue in a stable context. Over time, when the salient cue is encountered, an automatic 'stimulus generates impulse to act as a result of a learned stimulus-response association' occurs.¹⁶ Automaticity, that is the automatic initiation and/or execution of behaviour following encounter of a cue, is therefore the 'active ingredient' or defining feature of a habit. Automaticity is defined by four distinct features: (a) absence of deliberation; (b) absence of awareness; (c) absence of mental effort and (d) absence of conscious control.¹⁹ It is the automatic nature of habits which has thought to determine long-term behavioural maintenance.

Although the word 'habit' is often used to refer to frequent, persistent and customary behaviours, there is some confusion in the way the term is used, even within the psychological literature.¹⁵ This is reflected in the dental literature where toothbrushing routines have been studied in relation to frequency and routines, but not necessarily in relation to mental context-behaviour associations or impulses to act which are generated by sub-conscious or automatic processes. A review by Gardner¹⁵ recommends that habits are defined as 'a process by which a stimulus generates an impulse to act as a result of a learned stimulus-response' association, so automaticity is a key defining feature in studies aiming to link the investigation of routines to underlying habit theory.

Consideration of toothbrushing behaviour as a 'habit' is starting to emerge in the literature, although this has been mainly a theoretical proposition with limited empirical work.^{20,21} Aunger (2007), for example, identified that toothbrushing is commonly routinized and

performed in such a recurring, standard sequence of actions that the behaviour becomes largely sub-conscious.²² He suggests the existence of scripts within people's routines, which chunk sequences of behaviour into sub-scripts where behaviour follows such a standardized pattern, that these are then done without intruding on working memory availability, thus enhancing cognitive economy. This proposition, however, does not appear to be supported by the little previous empirical work which has been done on toothbrushing routines in adults, which found that those with *less* regular and more flexible routines, brushed their teeth more frequently.²³ On the other hand, a recent study of children's toothbrushing habits and routines, which is the first to investigate toothbrushing routines using a measure of habit strength, found that after controlling for other factors, each increase Self-Report Habit Index was associated with a 21% decrease in missed evening brushing.²⁴ Having a more stable day-to-day routine was associated with stronger brushing habits both in the morning and evening.²⁴ Since toothbrushing behaviour in children is closely associated with the process of socialization, and with maternal influence,^{25,26} more studies of toothbrushing behaviour in adults are needed. This study therefore aimed to investigate the nature of toothbrushing behaviour in adults, especially considering what prompts its instigation (deciding to do) and execution (carrying out the behaviour) in the morning and evening and to investigate whether processes (once established) are automatically or cognitively driven.

2 | METHOD

2.1 | Data collection

A qualitative descriptive approach was taken to explore the nature of toothbrushing behaviour in adults. Ethical approval was obtained by the NHS Research Ethics Committee (15/EE/0053), and NHS research governance approvals were obtained prior to the study. Patients were approached when attending their urgent dental care appointment and were offered a choice their location for their semi-structured interviews, with the offer of being at home, in a café or at the UDC. All participants, however, wished to have this conducted at the UDC, while they waited for their dental appointment (or afterwards in some cases). Written informed consent was obtained from all participants.

Twenty-nine semi-structured interviews, lasting up to 30 minutes, were conducted by a single researcher (HR) using a topic guide. The topic guide explored people's dental experience, cues (stimuli), detailed description of daily routines including toothbrushing (both morning and evening) and motivators (motivation for behaviour repetition) for toothbrushing behaviour (Appendix 1 online). The guide was flexible to allow for the questioning of emerging data. In addition, after the first few interviews, the wider research team (including experienced supervisors) reviewed the transcripts of each of the interview to determine areas within the interview where further probing would have been appropriate or question phrasing could have been altered. All interviews were audio-taped and transcribed for analysis. Patient transcripts were anonymized using codes P1-P29.

TABLE 1 Participant characteristics

Participant	Gender	Age	Ethnicity	Occupation	IMD Quintile*	Toothbrushing Frequency (per day)	Pay for dental treatment**
P1	Female	77	White	Retired Child Care officer	5th	1/2	Yes
P2	Male	26	White	Factory worker	3rd	2	Yes
P3	Female	23	White	Copywriter	5th	2	Yes
P4	Male	68	White	Retired carpenter	2nd	1/2	Exempt
P5	Male	50	White	Legal counsel	2nd	2	Yes
P6	Male	50	Mixed ethnic groups	Manual Labour	3rd	3	Yes
P7	Male	60	White	Manual Labour	5th	1	Yes
P8	Male	29	White	Works within a finance company	4th	2	Yes
P9	Female	28	White	Support worker	5th	2	Exempt
P10	Male	36	White	Technical support	5th	2	Yes
P11	Female	37	White	Teacher	3rd	2	Exempt
P12	Female	20	White	Works in a chippy	5th	2	Exempt
P13	Female	28	White	Teaching assistant	5th	2	Exempt
P14	Male	47	White	Professional	4th	1	Yes
P15	Female	24	White	Un-employed	4th	1	Exempt
P16	Female	23	White	Works at First Bus Depot	5th	2	Yes
P17	Male	31	Asian	Factory worker	4th	3	Yes
P18	Male	28	White	Un-employed	3rd	2	Exempt
P19	Male	21	White	Un-employed	5th	1	Exempt
P20	Male	58	White	Carer	5th	2	Exempt
P21	Male	83	White	Retired	5th	1	Exempt
P22	Female	30	Asian	Media support	5th	2	Yes
P23	Female	35	White	Care assistant	4th	2	Yes
P24	Female	59	White	Un-employed	3rd	2	Exempt
P25	Male	37	White	Charity worker	4th	2	Yes
P26	Male	25	White	Electrician	3rd	2	Yes
P27	Male	19	White	Student	5th	2	Yes
P28	Female	27	White	Nursery worker	5th	2	Yes
P29	Female	67	White	Retired	3rd	2	Yes

* Quintile based on postcode of home address.

** Under NHS regulations certain categories such as pregnant women, un-employed and low-income individuals are exempt from patient co-payment for treatment.

In addition, field notes were made during and after the interviews as memos to capture additional observational data and the interviewer's reflections. Reflexivity is also important to ensure quality control.²⁷ Since the researcher who undertook the interviews and led data analysis had a dental background and was aware of theory relating to habit formation, this may have influenced perceptions and judgements about emerging themes. The interviewer who had been trained by undertaking a course on interviewing techniques was supported by two supervisors (one with a dental and one with a non-dental background), who gave feedback on interview technique and the emerging analysis. Analysis therefore required that there was a

constant critical reflection of the researcher's and wider research team's positionality, in terms of toothbrushing behaviour, values and personal routines, and how these might have impacted upon the knowledge formed via co-production (ie between the researchers and the participants).

2.2 | Sample and recruitment

Initially, purposive sampling was undertaken to ensure a mixture of participant ages, socio-economic status (SES) and daily toothbrushing

frequencies (see Table 1). Participant SES was determined by translating their home postcode into an Index of Multiple Deprivation (IMD) quintile—the fifth quintile being the most deprived. In addition, the individual's occupations were also recorded as a measure of SES. The principle underpinning purposive sampling in qualitative methods is the enabling of selection of 'information-rich' cases to study.^{28,29} It was important to have a range participant's SES as establishment of habitual behaviour, via routines, may be more challenging in low socio-economic groups due to a more 'hectic' nature of their lived experience.³⁰ As too was having a sample with a mixture of toothbrushing frequencies to help determine toothbrushing habits at different times of the day. It was therefore important to understand the lived experience from a range of groups, to obtain an in-depth understanding of the phenomena through this lens. However, when morning and evening toothbrushing behaviour emerged as being different in nature, the sampling method shifted to include a theoretical sampling dimension to ensure we had sufficiently diverse types of morning and evening routines to enable us to understand this more fully. Theoretical sampling followed from the emerging data analysis when initial exploratory interviews gave way to confirmatory fieldwork which sought to gather confirming as well as disconfirming cases (patients).²⁸ Recruitment finished when data saturation had been reached, and further cases did not add to the analysis.

A dental centre providing NHS urgent dental care in a deprived area of North West England was chosen as the recruitment site because patients attend from both high and low SES backgrounds. Prompted by study publicity (eg information posters and leaflets about the interview were displayed in appropriate areas such as the reception counter of the dental service and on the walls of the waiting area), individuals identified themselves as willing to participate. The researcher (HR) approached and discussed the participant information sheet with potential participants and answered any questions. Recruitment, consent and interviews all took place on the same day as attendance.

2.3 | Data analysis

Our enquiry used both deductive and inductive approaches with an interplay between the two.³¹⁻³³ The enquiry set out using deductive reasoning using key components of habit theory such as unconscious behaviour and the importance of stable contexts and cues as useful theoretical approaches to help guide exploration of the toothbrushing phenomenon. Using deductive reasoning, we sought to explore how habit theory might be expressed across a range of individuals' circumstances and routines, such as shift work, while being open to finding that the theory was not confirmed by the data. This meant that as the enquiry progressed, we progressively used inductive progresses, keeping an open mind to the possibilities of the data and the perspectives of participants.³³ As themes emerged, we reverted to deductive processes to seek

out cases to verify and elucidate what appeared to be emerging until data saturation was reached.

Framework analysis was used to analyse data.³⁴ NVIVO was used to organize data into broad themes initially developed from the theoretical literature on habitual theory behaviours, such as 'cues' and 'motivators'. Data collection and analysis occurred simultaneously so that the researcher could iteratively develop and refine the initial set of codes (codes and categories being developed or confirmed from the data rather from purely the initial theoretically proposed categories). Emerging themes were nested in subsequent interviews; additional interview data did not add to the analysis.

To strengthen the trustworthiness of the research, an audit trail of research decisions and how data were collected, recorded, and analysed was kept enabling cross-checking and confirmability. Line-by-line coding of a selection of transcripts was undertaken by the wider analytic team, including a nondentist, to ensure consensus of coding and understanding of the data, and interpretations were subject to peer debriefing in presentations of findings to neutral colleagues.³⁵ Participants are identified with codes P1-29 to preserve anonymity. In dialogue, Int = interviewer and P = participant.

3 | RESULTS

Twenty-nine participants were interviewed. The most frequently reported toothbrushing behaviour was in the morning. Only two participants reported not brushing their teeth (either regularly or irregularly) at this time (P7 & P15).

The next section of the results describes the five themes which emerged; Language used signals that participants experience toothbrushing as a habit; Sequence of events around toothbrushing routines takes precedence over temporal and environment contexts; Toothbrushing is initiated by stimuli embedded in routines; Toothbrushing motivators vary between people and by time of day; and Toothbrushing routines disrupted and re-established during the life course. The themes are described in turn as follows with example quotations for each.

3.1 | Language used signals that participants experience toothbrushing in terms of habit

Unprompted, many participants described toothbrushing as a 'habit'.

...I've just got into ... mmm ... I've gotten into the habit of brushing in the morning...' (P2, Male)

'It's a habit and if you break that habit... You don't want to break that habit....

(P9, Female)

While the topic guide involved open questions concerning describing their toothbrushing routines, how this was positioned in relation to other daily activities, and asking participants to describe what made them want to brush, and about circumstances and feelings on occasions when they had forgotten to brush (Appendix 1), linguistics in patient narratives referred to all four features of automaticity of toothbrushing behaviour, even the researcher did not specifically probe for information in these areas.

(i) absence of deliberation

No, it not like ... mmm ... yeah, I think I'll brush my teeth now, you know, it's just something that happens

(P23, Female)

(i) absence of awareness

... you know sometimes I'm not even aware that I've started to brush my teeth.

(P28, Female)

(i) absence of mental effort

Int: Okay, and then you finish watching TV and go and...'

P: Well I don't think, 'Oh, I've got to brush my teeth.

(P18, Male)

(i) absence of conscious control

Int: Okay. And do you have a reminder, to remind you to do it or ...?

P: No, I just do it'.

(P1, Female)

3.2 | Sequence of events around toothbrushing routines takes precedence over temporal and environment contexts

A distinction between morning and evening toothbrushing behaviour was evident. Morning brushing was consistently described by participants as being strongly integrated into their well-established, daily cleansing routines, such as showering or face washing. This

remained true even when time pressures, such as 'sleeping-in' became a factor.

...I'll always brush even if I've hit the snooze button one too many times...it makes me uncomfortable if I don't.

(P26, Male)

Interestingly, when time of day was reversed (as in night shift routines), links between showering and toothbrushing before leaving for work were still observed.

Right so that's the same every single day. So, I will get up, I will go in the shower, I will have a shower erm I do the teeth, go downstairs, get changed....

(P18, Male).

Features of habitual behaviour were also identified by participants' reports that the sequence of events had pre-eminence over the environment in which they were carried out. For example, morning and evening habitual toothbrushing appeared to be unaffected when travelling away for work or moving countries, where individual routines remained constant.

Yeah if I am working away and staying in a hotel, it's the same routine when I'm away yeah.

(P8, Male)

Int: And have you always done it like that [brush after showering]?

P: Yes, yes always.

Int: Even when you changed country?

P: Yes, yes.

(P2, Male)

3.3 | Toothbrushing is initiated by stimuli embedded in routines

When participants described their daily routines, they referred to specific stimuli which prompted toothbrushing behaviour in the morning and evening, which was evocative of the importance of cues in initiating the enactment of habitual behaviour.¹⁶ Morning brushing was found to be predominantly initiated in response to external, event or activity cues.

...Yeah cause if they are there [in the bathroom], my toothbrush and toothpaste are there so if I keep them there then I will [brush]...

(P12, Female)

Errr...I get out of bed and go and have a wash and brush my teeth, erm...do my hair get ready, go downstairs let the animals out erm...have a coffee, have breakfast and then set off to work, go and get the bus.

(P17, Male)

For evening toothbrushing, various cues were involved: both external and internal cues. Internal cues or strong feelings (urges) were described as initiating the toothbrushing behaviour to the extent, on occasion, of even being able to hinder a person's ability to sleep until brushing was completed. Such urges are characteristic of behaviour which is automatically driven.³⁶

As I said, I feel it's quite natural for me now in the morning...it wasn't at night, but it's become part of my night routine, and I'm not comfortable... I will get into bed and I won't be comfortable.... You know, so if I don't do that, I just don't feel right... silly... It's not, you know, it's not dramatic or anything it's just my silly way of my brain saying to me you must clean your teeth, you know.

(P4, Male)

External cues also initiated evening toothbrushing behaviour. For example, taking off make-up was a common external, activity-based cue which initiated toothbrushing behaviour.

So, yeah, I'll do whatever I need to do, then take my make-up off, brush my teeth, get changed ...

(P22, Female)

3.4 | Toothbrushing motivators vary between people and by time of day

Toothbrushing motivators were found to vary between participants, with differences found between morning and evening behaviour. Evening toothbrushing motivators appeared to be more idiosyncratic than morning ones. Two important motivators were included a) perceived aesthetics and b) cleansing.

3.4.1 | Perceived aesthetics

A common morning motivator described was the perceived aesthetic benefit of brushing teeth, increasing social acceptability. Participants reported wanting to make themselves presentable to others at the start of their day.

I try to because when you start work the first thing is people look at your outer skin, your oral health and

stuff like that, especially when you are engaging with people you have got to do all this.

(P11, Female)

3.4.2 | Cleansing

One important motivator, especially reported by people with low SES backgrounds, was the cleaning effect of brushing. Participants felt motivated to remove the contaminants from the day (such as smoking and unhealthy eating) and restore their mouth to a fresh, unspoiled state.

Well I love the feeling of just like having a clean mouth after a long day after eating all my junk food and whatever it's just nice to feel and the taste of them, I like the taste of them knowing its fresh.

(P16, Female)

The 'cleansing' motivator was described as not only a physical, but a psychological cleansing. 'Cleansing' the mouth following a hard, manual working day, was sometimes a motivator to brush at an additional, third time in the day (once home from work). Interestingly, this additional toothbrushing behaviour was still strongly linked to bodily cleansing and cued by taking a shower or having a bath.

Just to be clean and know that I have got the day gone out of my mouth.

(P14, Male)

3.5 | Toothbrushing routines disrupted and re-established during the life course

Twice-daily toothbrushing was only rarely reported to have been established and maintained without disruption from childhood and then completely throughout adulthood. Instead, interviewees reported experiencing disruptions in their toothbrushing behaviour at critical times in their lives or through experiences in adulthood which had challenged the level of importance they placed on (and their motivation towards) brushing twice daily.

And then when my front tooth went, like the side one I thought go to the dentist and then obviously I thought if they are working with me, I have to work with them [start brushing twice daily]...

(P13, Female)

While changes in toothbrushing frequency were often related to these critical moments, at which point the behaviour was effortfully performed, over time there were signs that the behaviour then became automatically initiated. Critical moments or events for participants included experiencing visible anterior dental decay (where previous

posterior decay did not initiate behavioural change), experience of dental pain / toothache, dental extraction and realization of the importance of retaining dentition in later life.

With my teeth being how they were, and alarm bells are ringing now I am nearly 30-year- old I need to start caring for my teeth a bit more.

(P9, Female)

I think I started when I started getting my first toothache, 'cause it was really painful. I thought if I start brushing it might help and obviously help my other teeth because it's horrible, it's not something I like going through - so I started brushing my teeth.

(P25, Male)

...having like serious problems like that [dental pain] it makes you want to look after your ...[teeth]

(P3, Female)

4 | DISCUSSION

This study helps in developing our understanding of the nature of morning and evening toothbrushing behaviours, which in turn aids the effective design of future interventions aiming to establish twice-daily toothbrushing. In summary, toothbrushing behaviour in adults appears to be automatically performed in individuals who brush regularly. Indeed, toothbrushing (principally morning) behaviour is predominantly integrated into personal daily sequences of behaviour, cued by several different salient stimuli. Finding toothbrushing to be an automatic behaviour built into routines is consistent with the theory outlined earlier by Auger.²²

Toothbrushing in the evening was found to be relatively less habitual, perhaps due to a lack of a strongly routinized evening brushing routine, resulting in some inconsistent toothbrushing prior to bed. This mirrors a recent study into children's toothbrushing behaviours where the lack of an evening routine was found to be related to poor brushing behaviours.²⁵ Therefore, future habitual interventions would need to include a focus on establishing a stable evening routine prior to bed and then including toothbrushing within this sequence of events. Alternatively, toothbrushing could be attached to an already stable evening behaviour. For example, finishing the evening meal might be identified as an appropriate external cue to brush, and habitual brushing established around the end of the meal. This approach would require caution and future exploration to ensure that the efficacy of brushing was not affected by other activities such as snacking on cariogenic foods or drinks after brushing.

Motivators for behaviour repetition are important to habit establishment,³⁷ although these can diminish over time without impacting upon habitual behaviour, since action (eg brushing) eventually becomes automatically initiated by cues without conscious processing.³⁸ This study suggests that motivating components of future

interventions should include a personalized, and not necessarily scientific reason for toothbrushing. This may be particularly useful when developing toothbrushing interventions for low SES groups. Examples may include psychological as well as physical cleansing from the burdens of the day. There is good evidence, from outside dentistry, that mouthwashing results in psychological benefits for individuals because it is effective as a moral cleansing activity.^{39,40} This may provide an effective potentially effective way promote toothbrushing in sub-populations who place a low value on having good oral health. This study is the first study on oral health behaviour in adults to identify this and has an important implication for intervention approaches.

Although there is a lot of evidence for childhood toothbrushing being an important motivator for maintaining the behaviour into adult life,⁴¹ there was little evidence for this in our data. One reason for this may have been the selective nature of our sample—or, this may also have been due to parental prompts (reminders) being the predominant cue for children's toothbrushing behaviour rather than a child's own individualized salient cue. Once the parental reminder (cue) is removed, habitual toothbrushing behaviour is no longer initiated and results in lapsed toothbrushing behaviour in adult life. This supports previous evidence from a school intervention, which demonstrated that once the external cue was removed (ie participants left school, toothbrush or toothpaste supply removed), toothbrushing behaviour diminished.⁴²

It is therefore important that future interventions which establish habitual toothbrushing behaviour rely on the identification and consideration of individual, salient cues to action initiation. For some adults, the restoration of twice-daily toothbrushing behaviour required a critical moment to act. These events challenged their view of their current oral hygiene practices. Behaviour change was initially reported as cognitively effortful, with individuals having to consciously remember to brush their teeth twice-a-day. However, over time, the behaviour began to occur automatically, without the thoughtful effort initially required. This is in line with the habit formation of other behaviours such as weight loss.⁴³

A few study limitations are noted. Data collection was limited to one dental centre, and participants attending for urgent care, and this may limit transferability to other contexts. An alternative approach could perhaps have been to recruit from general dental practices or indeed a general population, which in turn could have encouraged maximum variation sampling and strengthened transferability. On the other hand, we viewed recruiting sufficient research participants from disadvantaged backgrounds who would be those least likely to have regular routines such as toothbrushing, as a key challenge, and felt that an UDC would be a setting which was most likely to yield this type of participant. The study findings show a relatively high proportion of patients even attending the UDC reported twice-daily toothbrushing routines across the socio-economic spectrum, and so we may have struggled to recruit sufficient numbers of participants with irregular toothbrushing routines, if we had situated the study in a dental practice setting.

Since recruitment was opportunistic in these centres, it was not possible to spend an extended time engaging with participants in the

field to build maximum rapport and confidence enabling informants to disclose full, and possibly sensitive details concerning their daily routines and personal hygiene habits. In addition, with participants wishing the interviews to take place within the urgent care centres, this could have limited participants' willingness to disclose or provide socially undesirable responses about toothbrushing. It was also not possible to undertake member-checking with informants double-checking interpretations made by researchers, since the study did not involve any follow-up contact of participants. Nevertheless, there were some steps taken to assure credibility which included testing of all data to be sure there were no internal conflict or inconsistencies, triangulation of data coding involving multiple investigators and peer debriefing.⁴⁴ Providing a thick description of methods and context, maintaining an audit trail of research processes as well as a reflexive journal, and undertaking purposive and theoretical sampling facilitated transferability.⁴⁴ However, since this is a qualitative study with the purpose of generating research questions and hypotheses,⁴⁵ and the first study of its kind, it provides some important and new evidence about the elements which underpin toothbrushing behaviour.

This study only focused on eliciting patient narratives around toothbrushing behaviour, although it should be acknowledged that other aspects of daily routines such as habits relating to sugar consumption, interdental cleaning, dental visiting, smoking and alcohol consumption also impact oral health, although these were beyond the scope of this study. However, given that there have been so few studies concerning the automatic nature of oral health behaviours and that we know that complex behaviours achieve lower levels of automaticity than simple behaviours,²⁹ we decided to limit this investigation to toothbrushing since this was the simplest of these behaviours to study, and also usually frequently undertaken. It is likely that more complex behaviour such as sugar consumption behaviours would require design of more complex interventions, and perhaps habit theory may only apply to a proportion of the behaviour sequences involved. Nevertheless, these other behaviours are still important future areas of study in this light. For example, a systematic review for healthcare seeking, for example, identifies that there are very few studies in this area which takes this perspective.⁴⁶

Our study demonstrates that adults indeed, do engage in toothbrushing as an automaticity driven behaviour. It finds that although the environmental context is important (the presence of visual cues, eg of a toothbrush in the bathroom), although the behaviour may be so ingrained in scripts of personal routines that it is sustained when travelling, or during shift work—when the wider environment has shifted. The interplay between the social and environmental context and personal routines is an important area for future study—especially since a previous study of adults found that it was those with *more* regular and less flexible routines, who brushed less often.²³ This will be important when considering how oral health promotion programmes might help mitigate the effects of socio-economic differences and reduce inequalities in health. It also remains to be seen whether interventions which explicitly treat toothbrushing as routine are more effective than those who do not.²² These might involve inserting a toothbrushing 'scene' into a

nightly routine, for example, but would probably also involve using visual cues (eg a note on the fridge), and motivational components (eg cleansing away the day).

In conclusion, this study helps understand the nature of toothbrushing behaviour which appears, when established, to be performed in a habitual manner. However, there is a need, perhaps, to start to consider toothbrushing behaviour in the morning separately from the evening when designing future habitual interventions. Due to the distinct differences in cues to initiate behaviour and motivators to drive the behaviour repetition identified, future design of interventions would require tailoring to the specific target behaviour. The important components would be to identify and consider salient cues to initiate toothbrushing and ensure appropriate motivators for behaviour repetition are considered.

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CONFLICT OF INTEREST

No conflict of interest to report.

AUTHOR CONTRIBUTIONS

Dr Heather Raison contributed to conception, design, data acquisition and interpretation; performed analyses; drafted; and critically revised the manuscript. Professor Rhiannon Corcoran contributed to conception, design, data interpretation; drafted; and critically revised the manuscript. Professor Rebecca Harris contributed to conception, design and data interpretation and analysis; drafted; and critically revised the manuscript.

DATA AVAILABILITY STATEMENT

Research data not shared.

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REFERENCES

- Zimmermann H, Zimmermann N, Hagenfeld D, Veile A, Kim T, Becher H. Is frequency of tooth brushing a risk factor for periodontitis? A systematic review and meta-analysis. *Community Dent Oral Epidemiol.* 2014;43:116-127.
- dos Santos APP, Ndanovsky P, de Oliveira BH. A systematic review and meta-analysis of the effects of fluoride toothpastes on the prevention of dental caries in the primary dentition of preschool children. *Community Dent Oral Epidemiol.* 2013;41:1-12.
- Frencken JE, Peters MC, Manton DJ, Leal SC, Gordan VV, Eden E. Minimal intervention dentistry for managing dental caries – a review. *Int Dent J.* 2012;62:223-243.
- Buzzalaf MAR, Pessan JP, Honório HM, ten Cate JM. Mechanism of action of fluoride for caries control. *Monogr Oral Sci.* 2011;22:97-114.
- Wong MC, Clarkson J, Glenny AM, et al. Cochrane reviews on the benefits/risks of fluoride toothpastes. *J Dent Res.* 2011;90:573-579.
- Pitts NB, Zero DT, Marsh PD, et al. Dental caries. *Nat Rev Dis Primers.* 2017;3:17030.

7. Walsh T, Worthington HW, Glenny MA, Appelbe P, Marinho VCC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev*. 2010;20:CD007868. <https://doi.org/10.1002/14651858.pub2>
8. Joshi S, Suominen AL, Knuuttilla M, Berabé E. Toothbrushing behaviour and periodontal pocketing: an 11-year longitudinal study. *J Clin Periodontol*. 2018;45(2):196-203.
9. Office of National Statistics. *Social Survey Division. Information Centre for Health and Social Care. Adult Dental Health Survey* [data collection]. 2nd Edition. UK: UK Data Service; 2009. SN:6884.
10. Gao X, Lo ECM, Kot SCC, Chan KCW. Motivational interviewing in improving oral health: a systematic review of randomized controlled trials. *J Periodontol*. 2014;85(3):426-437.
11. Anopa Y, McMahon AD, Conway DI, Ball GE, McIntosh E, Macpherson LM. Improving child oral health: cost analysis of a national nursery toothbrushing programme. *PLoS One*. 2015;10(8):e0136211.
12. Kwasnicka D, Dombrowski SU, White M, Sniehotta F. Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychol Rev*. 2017;10(3):277-296.
13. Fjeldsoe B, Neuhaus M, Winkler E, Eakin E. Systematic review of maintenance of behavior change following physical activity and dietary interventions. *Health Psychol*. 2011;30(1):99-109.
14. Dombrowski SU, Knittle K, Avenell A, Araújo-Soares V, Sniehotta FF. Long term maintenance of weight loss with non-surgical intervention in obese adults: Systematic review and meta-analysis of randomised controlled trials. *BMJ*. 2014;348:g2646.
15. Gardner B. A review and analysis of the use of 'habit' in understanding, predicting and influencing health-related behaviour. *Health Psychol Rev*. 2015;9(3):277-295.
16. Verplanken B, Wood W. Interventions to break and create consumer habits. *JPPM*. 2006;25(1):90-103.
17. Einstein GO, McDaniel MA. Normal aging and prospective memory. *J Exp Psychol Learn Mem Cogn*. 1990;16(4):717-726.
18. Kvavilashvili L, Ellis J, Brandimonte M, Einstein G, McDaniel M. Varieties of intention: some distinctions and classifications. *Prospective memory: Theory and applications*. 1996;6:183-207.
19. Bargh JA, Bargh JA, Wyer RS. The four horsemen of automaticity: Awareness, intention, efficiency and control in social cognition. In: Wyer RS, Sryll TK, eds. *Handbook of Social Cognition. Basic processes; Applications*. Vols. 1-2, 2nd Ed. (pp 1-40). Hillsdale, NJ: Lawrence Erlbaum Associates, INC, 980 pp; 1990.
20. Newton JT, Asimakopoulou K. Minimally invasive dentistry: Enhancing oral health related behaviour through behaviour change techniques. *BDJ*. 2017;223(3):147-150.
21. Innes NP, Manlon DJ. Minimum intervention children's dentistry – the starting point for a lifetime of oral health. *BDJ*. 2017;223(3):205-213.
22. Aunger R. Tooth brushing as routine behaviour. *Int Dent J*. 2007;57(S5):364-376.
23. Abegg C, Croucher R, Marcenes WS, Sheiham A. How do routines of daily activities and flexibility of daily activities affect tooth-cleaning behavior? *J Public Health Dent*. 2000;60(3):154-158.
24. Trubey RJ, Moore SC, Chestnutt IG. Children's toothbrushing frequency: the influence of parents' rationale for brushing, habits and family routines. *Caries Res*. 2015;49:157-164.
25. Trubey RJ, Moore SC, Chestnutt IG. Parents' reasons for brushing or not brushing their child's teeth: a qualitative study. *Int J Paediatr Dent*. 2014;24(2):104-112.
26. Blinkhorn AS. Influence of social norms on toothbrushing behaviour of preschool children. *Community Dental Oral Epidemiol*. 1978;6(5):222-226.
27. Berger R. Now I see it, now I don't: researcher's position and reflexivity in qualitative research. *Qual Res*. 2015;15(2):219-234.
28. Coyne IT. Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? *J Adv Nurs*. 2008;26(3):623-630.
29. Verplanken B. Beyond frequency: habit as mental construct. *Br J Soc Psychol*. 2010;45(3):639-656.
30. Evans GW. The environment of childhood poverty. *Am Psychol*. 2004;59(2):77-92.
31. Patton MQ. *Qualitative Evaluation and Research Methods*. 2nd ed. Newbury Park, CA: Sage Publications; 1991.
32. Kirk J, Miller ML. *Reliability and Validity in Qualitative Research*. Newbury Park, CA: Sage Publications; 1986.
33. Hyde K. Recognising deductive process in qualitative research. *Qual Mark Res*. 2000;3(2):82-89.
34. Gale NK, Heatham G, Cameron E, Rashid S, Redwood S. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol*. 2013;13:117.
35. Morse JM, Barrett M, Mayan M, Olson K, Spiers J. Verification strategies for establishing reliability and validity in qualitative research. *Int J Qual Methods*. 2002;1(1):13-22.
36. Kelly MP, Barker M. Why is changing health-related behaviour so difficult? *Public Health*. 2016;136:109-116.
37. Lally P, Van Jaarsveld CH, Potts HW, Wardle J. How are habits formed: Modelling habit formation in the real world. *Eur J Soc Psychol*. 2010;40(6):998-1009.
38. Rothman AJ, Sheeran P, Wood W. Reflective and automatic processes in the initiation and maintenance of dietary change. *Ann Behav Med*. 2009;38(Suppl 1):4-17.
39. Lee SW, Schwarz N. Wiping the slate clean: psychological consequences of physical cleansing. *Curr Dir Psychol Sci*. 2011;20(5):307-311.
40. Lee SW, Schwarz N. Washing away the past with cleaning products: of dirty mouths, dirty hands, and post-decisional dissonance. *Adv Consumer Res*. 2011;38:57-58.
41. Lissau I, Hoist D, Friis-Hasché E. Dental health behaviours and periodontal disease indicators in Danish youths. *J Clin Periodontol*. 1990;17(1):42-47.
42. Wind M, Kremers S, Thijs C, Burg J. Toothbrushing at school: effects on toothbrushing behaviour, cognitions and habit strength. *Health Educ J*. 2005;105(1):53-61.
43. Lally P, Wardle J, Gardner B. Experiences of habit formation: a qualitative study. *Psychol Health Med*. 2011;16(4):484-489.
44. Anney VN. Ensuring the quality of the findings of qualitative research: looking at trustworthiness criteria. *JETERAPS*. 2014;5(2):272-281.
45. Golafshani N. Understanding reliability and validity in qualitative research. *Qual Rep*. 2003;8(4):597-606.
46. Raison H, Corcoran R, Harris RV. A systematic review of interventions using cue-automaticity to improve the uptake of preventive healthcare in adults: applications to dental visiting. *Community Dent Health*. 2018;35(1):37-46.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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