Combining the COM-B Model and Habit Theory to Leverage Understanding of Adolescents' Tooth-brushing Behavior

Although brushing teeth twice a day is not difficult, a surprisingly large proportion of adolescents do not behave accordingly. This paper brings together the COM-B model and the habit formation theory in order to create a basis for a more comprehensive, customer-oriented, theory-based understanding of the issue. A total of nine focus group interviews were conducted among adolescents to further understand underlying aspects and develop solutions. In findings, barriers related to adolescents tooth brushing behaviour were identified in all areas of COM-B model. Especially the role of automatic motivation was highlighted as in mornings tooth brushing seemed not to have a stable place in daily routines. To further understand this issue and develop suitable solutions, habit formation theory together with identified enablers provided effective starting point. This also demonstrated how these two theories can complement each other. The study provides actionable insights for public sector marketers to understand and assists adolescents' tooth-brushing behaviour.

Keywords: adolescents; tooth brushing; COM-B; habit; intervention design; social marketing

1. Introduction

Tooth brushing is the primary method for preventing dental caries and other periodontal diseases. Brushing the teeth requires a toothbrush, some toothpaste, and a couple of minutes twice a day. Although these prerequisites are few and simple, the number of adolescents[1] who conform is surprisingly low in many European countries (see, e.g., Honkala et al., 2015), especially in countries where there appears to be no reason to avoid the practice, such as Finland, where only a little over half of 11–15-

[1] The term "adolescent" is used in this paper to describe children aged 13-16 years. The empirical data for this study was collected among adolescents aged 14 to 15.

year-olds brush their teeth twice a day (59.7 %) (HBSC, 2013/2014). Although the practice is higher in neighbouring countries such as Sweden (82.8%), Denmark (78.1%), and Norway (75.3%) (HBSC, 2013/2014), the number of adolescents brushing twice a day decreased between 1994 and 2010 within these countries (Honkala et al., 2015). These statistics raise questions about the reasons for this situation and, more importantly, what can be done to change it.

With regard to dental flossing, a lack of motivation is identified among adolescents as an important reason for not following guidelines (Mattos-Silveira et al., 2017). Scaring them with the threat of dental caries appears not to be effective as a means of motivating the behavior. On the other hand, the importance of clean teeth in social situations is identified as an important driver for tooth brushing and flossing (Tolvanen et al., 2012). Similarly, adolescents' tooth-brushing motivation is found to be related to factors such as personal grooming, general cleanliness, and a pleasant personal appearance or attractiveness (Stokes et al., 2006; Maida et al., 2015). For adolescents, oral health is related to their "ability to relate to the world on social levels" and their success in life (Maida et al., 2015, p. 2747).

Naturally, in the context of adolescents' dental health, theory-guided interventions are found to be more effective than conventional instructions (Aleksejūnienė & Brukienė, 2018). Within this study, a behavior change model, COM-B (see Michie et al., 2011), is presented as a basis for analyzing adolescents' tooth-brushing behavior systematically. The COM-B model provides a description of factors that influence one's behavior and is highly applicable in the intervention design phase to identify aspects that need to be taken into account. The model proposes that behavior occurs if one has the capability, motivation, and opportunity to perform it (Michie et al., 2011). Capability and opportunity are also seen as having an impact on motivation. In

this model, motivation is defined as “all those brain processes that energize and direct behavior, not just goals and conscious decision-making. [It] includes habitual processes, emotional responding and analytical decision making” (Michie et al., 2011, p. 4). In its broadest definition, it includes both automatic and reflective motivation. Capability is defined as “… having the necessary knowledge and skills” (Michie et al., 2011, p. 4) and includes both physical and psychosocial capabilities. Opportunity is defined as “all factors that lie outside the individual that make the behaviour possible or prompt it” (Michie et al. 2011, p. 4). This captures both physical and social opportunities.

Understanding underlying issues that enable or prevent adolescents from performing a behavior is important, but unfortunately does not go far enough to help them make permanent changes to their behavior. It is widely agreed that tooth brushing should be a routinized behavior that is performed in a regularized, automatic manner (Aunger, 2007), in other words, that is habitual. Habits are learned automatic responses to contextual cues (Wood & Rünger, 2016; Judah et al., 2018, p. 1). What differentiates it from “routine” is its automatic nature. According to a cybernetic model of habit formation, habits are formed through repeated response to a stimulus (cue) that leads to a certain outcome (reward) (de Wit & Dickinson, 2009). Cues should be stable (Judah et al., 2013) and can be time-based, event-based, or activity-based (Einstein & McDaniel, 2007). Placing new intended habits into existing routines has been found to support habit formation, for example in the context of dental flossing (see Judah et al., 2013). Also, integrating new products into existing habits is known to be key to successful product adoption (Labrecque et al., 2017). Thus, in order to create stable cues, it is crucial to understand the context in which the habit is supposed to be performed. Furthermore, to trigger new behaviors, formation of implementation intentions (if–then plans) has been shown to be effective in changing self-care habits and specifically

beneficial in the dental health context (see, e.g., Judah et al., 2013; Judah et al., 2018; Sniehotta et al., 2007; Pakpour et al., 2016). In brief, this means creating a concrete plan specifying when and where to perform the behavior. The amount of needed repetition varies greatly between different behaviors and target groups and can be facilitated with carefully thought-out rewards.

With regard to rewards, intrinsic motivation and pleasure in particular have been found to be beneficial, rather than aspects such as perceived utility or benefits (Judah et al., 2018). For this reason, arguments related to preventing caries may not be effective when creating behavior for the long term. However, in the context of tooth brushing, intrinsic motivation and pleasure may be challenging to promote. Nevertheless, attention may be drawn to positive outcomes of the behavior that may not have been noticed or to the reduction of the unpleasant consequences associated with not performing the behavior (Judah et al., 2018). Intrinsic motivation is linked with important goals in life that can be used. According to self-determination theory, intrinsic motivation can be encouraged through autonomy, competence (e.g., self-monitoring and feedback), and connection with others (support from important people) (see Judah et al., 2018). Recent theories of habit formation see habits and goals interacting with one another. Goals play an important part in triggering habits and motivating people to repeat actions (Wood & Rünger, 2016), especially when the habit has not yet become ingrained. When habits (cue–action link) become strong, behavior becomes unconscious.

Previous studies have mainly focused either on creating tooth-brushing habits (see, e.g., Aunger, 2007; Sniehotta et al., 2007; Judah et al., 2013; Judah et al., 2018; Pakpour et al., 2016) or on understanding motivations for brushing (see, e.g., Stoker et al., 2006; Tolvanen et al., 2012; Maida et al., 2015). However, combining these two

perspectives would provide a more comprehensive and practical starting point for developing an appropriate intervention. For example, habit-based interventions are found to boost tooth-brushing behavior but additional intervention components could increase their effectiveness (Pakpour et al., 2016). Thus, this paper takes both these perspectives, habit creation and motivation, into account in seeking a more comprehensive understanding of adolescents' tooth-brushing behavior. In practice, a COM-B model (see Michie et al., 2011) and the theory of habit formation (see e.g., Wood & Rünger, 2016) are used to guide data collection, analysis, and suggestions for interventions.

Theoretically, this paper is an example of how to apply the COM-B model to analyze a situation systematically and identify enablers and barriers to tooth-brushing behavior. Further, the paper draws on the theory of habit formation to make suggestions for increasing adolescents' frequency of tooth brushing.

2. Materials and methods

2.1. Study design and population

The data were collected from focus group interviews. Participants were recruited in one local school that permitted access to interview their eighth-grade students during their health education class. As the interviews were conducted within the school day as part of regular class activities, the school directors' permission was enough to ensure that ethical standards were met. Adolescents and their parents were informed two weeks before the interviews were conducted. The purpose and protocol of the study were explained and students were given the opportunity to decline to take part by providing them with other activities during the interviews. The studied group consisted of 51 adolescents aged 14 to 15, who themselves decided to participate in the study and gave their written consent.

2.2. Data collection

A total of nine focus groups were organized, each containing 5–7 pupils. Two thirds (n=35) of the participants were boys and one third (n=16) girls (total 51 interviewees) (Table 1). The school where the students were recruited was located in a small town of 10,000 inhabitants close to a bigger city. The population of the area is better educated and healthier than the average for the country and the interviewed students were a representative group for eighth-graders in that area.

The effective length of each discussion was approximately half an hour (27–37 min) and were conducted by three interviewers (the main researcher and two trained research assistants). In the interviews, both direct and a projective technique were used. This meant that questions were asked in generic format ("What do you think that adolescents of your age think about … ?") whenever possible. This was done to secure a relaxed atmosphere during and after the interviews.

Table 1. Interview details

<insert table 1 here>

The interview comprised four themes:

1) Routines: Students were asked to write down what happens from the time they wake until they leave for school and later to indicate the place where they would most often brush their teeth. → This theme was designed to help understand the context of the behavior, as well as the physical opportunities and the students' automatic motivation to brush their teeth.
2) Attitudes toward tooth brushing: To prompt the discussion, students were shown different cards representing percentages of adolescents who brush their teeth twice a day and asked to evaluate which card had the true percentage, whether

the number was surprising or acceptable, and what could be done to get the percentage higher. Students were also asked to list and then discuss the pros and cons of tooth brushing that were discussed together. Discussion also concerned general guidelines for brushing, the consequences of not brushing, and reasons for not brushing. → This theme was designed to help understand participants' motivation for brushing, as well as identify the key value that adolescents attach to tooth brushing.

3) Brushing skills: Students were asked whether they felt capable of brushing correctly, by having the right knowledge and skills.
4) Influencers and social norms: Students were asked whether they ever talked about tooth brushing with their friends or with anyone else and whom they perceived as having most influence on their tooth brushing behavior. → This topic helped understand social opportunities to encourage behavior.

2.3. Data analysis

Interviews were recorded and transcribed verbatim. Data were analyzed abductively (see e.g. Dubois & Gadde, 2002; 2014), meaningthat a theoretical framework (the COM-B model) was used to provide structure without restraining the analysis. In practice, the COM-B model was utilized to organize the data into categories related to capability, opportunity, and motivation, following the inductive identification of enablers and barriers within each category (see Handley et at. 2016). Each interviewer organized their own transcribed interview material under the COM-B categories and reduced barriers and enablers from the material by using commonly agreed codes and the main researcher went through all the coded material to ensure unity of interpretations. After this, axial coding was performed together with the interviewer team to ensure the right interpretations. Atlas.ti was employed to assist analysis.

3. Results

3.1. *Understanding adolescents' tooth-brushing behavior*

The analysis revealed many types of barriers and few enablers relevant to tooth-brushing behavior. Table 2 summarizes these barriers and enablers using the COM-B framework.

Table 2. Focus group analysis applying COM-B classifications to barriers and enablers affecting adolescents' tooth-brushing behavior

<insert table 2 here>

3.1.1. Motivation: automatic and reflective motivation

Motivation-related aspects, in particular automatic motivation, were found to play the greatest role in adolescents' tooth-brushing behavior. In general, adolescents described their morning routines as simple but somewhat busy. In most cases, adolescents woke up, went to the toilet, possibly did their make-up, got dressed, had breakfast, and left for school. Tooth brushing was most often something done as the last activity before leaving, if there was time, but equally it could be skipped if one was busy and it was not a major part of the morning routine.

> Interviewer G2: Are you busy in the mornings?
>
> Interviewee G2: Yeah [all interviewees answer and laugh].
>
> Interviewer G2: So, if you are busy in the morning, what do skip doing [from the list of things you do in the morning]?
>
> Interviewee G2: Sometimes it's brushing my teeth.

Few students said that they brushed their teeth before getting dressed and eating breakfast, and there was a lot of discussion about whether breakfast tasted bad or not after tooth brushing. This was not perceived as the main obstacle; rather, that adolescents saw no point in brushing before breakfast because the teeth would become

"dirty" again during breakfast. This showed a lack of understanding the medical reasons for brushing. The participants' uncertainty about the correct place for brushing might also have discouraged the behavior.

> Interviewee G3: There are people who do not like to brush their teeth twice a day. Like, after breakfast, it does not taste that good when you have just brushed your teeth.

In evening routines, by contrast, teeth brushing had a stable place, being the last thing that was done before going to bed. Adolescents agreed that they were more likely to forget to brush their teeth in the morning than in the evening because in the evening they "had more time". If they were not brushing their teeth in the evening, the reason seemed to be related to pursuing hobbies or tiredness late at night.

> Interviewee G9: In the morning, it's busy; in the evening, you can go to bed later.
>
> --
>
> Interviewee G9: Well, if you get back home around ten or half past ten in the evening, after you have been exercising strenuously for three hours, you are just too tired [to brush your teeth].
>
> -
>
> Interviewee G3: If you are busy in the morning and don't have time and if you have a hobby and you come home late, then it [tooth brushing] just gets left.

In terms of reflective motivation, the general attitude toward tooth brushing was positive. Adolescents perceived tooth brushing as important but a bit boring, just something that needed to be done. However, the adolescents were not surprised by the low amount of young people who really brushed their teeth twice a day.This indicates

that not brushing teeth twice a day is an acceptable social behavior among adolescents, thus reflecting the lack of an injunctive norm to perform the behavior.

[Interviewees were shown percentages of how many of their age (on average, boys, girls) brushed their teeth twice a day and asked what they thought about the numbers.]

Interviewee G6: Well, it's better than none.

Interviewer G6: Does this describe your own behavior?

Interviewees G6: Yeah [laughter].

Interviewer G6: Do you think it is weird that people do not brush their teeth twice a day or is it normal?

Interviewee G6: It is normal.

Interviewee G6: I don't always do it.

Furthermore, the big gender difference between brushing activity surprised the adolescents. When discussing this difference further, the interviewees however recognized it as reflecting the real situation. They explained the difference by stating that generally girls were perceived to be more thorough in brushing their teeth, like also in many other areas of life.

The main identified benefits related to brushing were the avoidance of bad breath, avoidance of cavities, appearance (white teeth and no food stuck between the teeth), and a fresh and clean feeling in the mouth. The main negatives around not brushing teeth were toothache and the embarrassment of having bad breath. As seen, the identified benefits and consequences of non-conformity were rather short-term and egocentric (i.e., cavities were bad because they caused pain and made eating difficult, bad breath was bad if someone would notice it and it would be embarrassing).

The reasons for failing to brush their teeth were related to being lazy or in a hurry. It was not on their priority list in the morning. Not having bad breath was seen as the main benefit, but the participants also thought that they could ensure their breath was fresh by other means such as sucking mints or chewing gum, important competitors for tooth brushing.

Interviewee G3: I'm too tired [to brush twice a day].

Interviewer G3: You are too tired [to brush]? Okay.

--

Interviewer G7: Do you have any feelings about the fact that many people don't brush their teeth twice a day?

Interviewee G7: Not really. If they eat a mint or something so that their breath does not smell bad. … or chew gum …

3.1.2. Capabilities: physical and psychological capabilities

Although the participants felt they had enough knowledge to brush their teeth correctly, they were uncertain about a few aspects (see Table 2), notably whether to brush before or after breakfast or in the morning at all. Such uncertainties might hinder their behavior.

Interviewee G5: … should we brush before or after the breakfast?

Interviewee G3: Well, you might think that nothing happens during the night to your teeth, so why do they need to be cleaned?

It is evident that the few knowledge-related barriers to brushing can easily be overcome with simple, clear communication. Although it is acceptable to brush either before or after breakfast, from the point of view of communicating good behavior, it may be

better simply to promote brushing before breakfast and to convey an understanding of the mechanics of tooth brushing to tackle the "what happens during the night" issue.

Many of the students wanted confirmation that they were doing a proper job of cleaning their teeth. Thus, concretizing the fact is something that should be considered.

3.1.3. Opportunities: physical and social opportunities

Neither physical opportunities (time) nor social opportunities provided much support for tooth brushing but nor did they prevent it. As the descriptions of morning routines indicate, adolescents were busy in the morning and prioritized other activities over tooth brushing.

Regarding social opportunities, tooth brushing was clearly something that was done in private and strongly perceived as a person's own business. It was thought acceptable not to brush one's teeth as long as bad breath did not offend other people. However, being in a relationship with someone who did not take proper care of their dental hygiene was deemed to be "disgusting". Tooth brushing was not something that was talked about with friends or even with family members. Thus, the norm to perform the behavior seems not be very compelling and social cues to perform behavior seem to be missing. Adolescents felt that their parents and the dentist would have the most influence on their tooth-brushing behavior. When asked whether they would wish their parents to remind them, they replied that it was unnecessary, as they were old enough to make their own decisions.

3.2. ***Habit formation and supporting the creation of stable tooth-brushing habits***

The descriptions of routines and discussions revealed that tooth brushing does not have a settled place in adolescents' morning routines and can readily be skipped. In

thinking about the “habit loop”, it could be suggested that adolescents brush their teeth in the same place within the routine, for example straight after they first visit the toilet. In this case, the if–then sentence would be: “I will brush my teeth straight after going to the toilet when I wake up and before I get dressed.” Integrating tooth brushing into the morning routine would create a higher potential for it to become an automatic habit (Judah et al., 2018).

According to habit theory, a tooth-brushing routine can be tricked by time and visual cues, in this case brushing straight after waking up and going to the toilet (time-based cue) and placing the toothbrush and toothpaste where they can be seen from the toilet (visual cue). To create a reward that would be pleasurable, immediate, and intrinsically valued (Judah et al., 2018) could be difficult. It might be suggested that adolescents consciously assess how their teeth feel directly after brushing. The participants in this study stated that a clean feeling was an important benefit of brushing.

Figure 1. Habit formation and supporting the creation of stable tooth-brushing habits

<insert figure 1 here>

The value proposition that brushing your teeth keeps your breath fresh now and for some time and you will not be shunned by your peers could have appeal for adolescents. Failing to understand why it is beneficial to brush before breakfast is a concern that requires addressing. To fill the knowledge gap, it is also important to convey the fact that mints and chewing gum are not enough to keep bad breath away in the longer term. To create more supportive opportunities for brushing, the behavior should be made visible. A communication campaign enhancing discussion within the media that adolescents follow and normalizing the behavior might be beneficial, as might finding ways to get parents to support the behavior better. However, it is important to note that

adolescents do not wish their parents to remind them directly; thus more subtle strategies should be employed, such as parents setting an example or making the tooth-brushing equipment more visible.

4. Discussion and conclusions

This paper brings together previously unconnected discussions about how to create tooth-brushing habits (see, e.g., Aunger, 2007; Sniehotta et al., 2007; Judah et al., 2013; Judah et al., 2018; Pakpour et al., 2016) and understanding about adolescents' motivations for brushing (see, e.g., Stoker et al., 2006; Tolvanen et al., 2012; Maida et al., 2015). Furthermore, this paper has demonstrated how to create theory-guided interventions, which are suggested to be more effective than conventional instructions for tooth cleaning (Aleksejūnienė & Brukienė, 2018). Specifically, the paper has shown how the COM-B model (see Michie et al., 2011) can be used to analyze adolescents' tooth-brushing behavior and to identify issues related to their motivation (especially automatic motivation), capabilities (knowledge), and opportunities (social norms) that need to be tackled in order to get adolescents to brush their teeth more regularly.

The identified enablers and barriers are well in line with previous studies examining adolescents' tooth-brushing behavior and their motivation to do so (see, e.g., Stoker et al., 2006; Tolvanen et al., 2012; Maida et al., 2015), but by utilizing COM-B model as basis, this approach provided a more systematic framework for understanding different aspects. In contributing to previous knowledge, the results of this study highlighted the role of automatic motivation in creating a stable place for tooth brushing within morning routines. Similarly, the theory of habit formation (see, e.g., Wood & Rünger, 2016) was used to draw together identified aspects. The study also demonstrates how the COM-B model (see Michie et al., 2011) and the theory of habit formation (see, e.g., Wood & Rünger, 2016) can complement each other.

This study has made several suggestions for supporting adolescents to brush their teeth twice a day. It also emphasized the importance of understanding the target audience and hearing their views before planning any actions. Certain underlying aspects that need attention were identified, especially aspects related to knowledge that is relevant to adolescents (e.g., why it is important to brush one's teeth on waking after a night's sleep) and delivered in a way that chimes with their perspectives. For example, it may be worth framing advice not as something related to personal hygiene but as something that makes one feel good in the morning. Lack of time and tiredness were identified as important reasons why adolescents did not brush their teeth. Thus, providing them with a toothpaste that would "burst with energy and brightness for the new morning" might be an inducement for some. As for the perception that brushing the teeth before breakfast made the food taste bad might benefit toothpaste that would not make this happen. It is important to remember that in some instances it may be better to offer solutions than to argue the facts – especially when dealing with adolescents.

Like all studies, this study has its limitations that need to be taken into account when interpreting the findings. First, the collected data from this study come just from one country, one area, and one school. The participants mostly came from average families and were accustomed to brushing their teeth at least once a day. In further research, it would be useful to include adolescents with different backgrounds, as well as different tooth-brushing behaviors, to see whether there are differences and similarities. This may allow more effective communication to be developed. There has been discussion in previous studies of gender differences in tooth-brushing behavior, but it would be useful to consider other possible differentiators also. Other limitations relate to the method used, namely group interviews. A projective technique was used and discussion flowed freely within the groups, but, at this age, the group situation

affects how the participants talk. They may answer normatively or they may exaggerate. Some of this type of behavior was also identified during the interviews, although this was taken into account when analyzing the data and interpreting the findings. The same researchers conducted the interviewees and performed the analysis, and results and interpretations were thoroughly discussed among the team. In future studies, other methods, such as narratives or personal interviews, might provide other kinds of answers.

Furthermore, within this study, providing unambiguous information, i.e., whether to brush before or after breakfast, was seen as a helpful way of simplifying the message. It should be remembered that providing overly prescriptive advice may hinder rather than promote a tooth-brushing habit (see Trubey et al., 2015). Future research could look into this aspect further to better understand which approach would work under what circumstances.

References

Aleksejūnienė, J. & Brukienė, V. (2018). A cluster randomized theory-guided oral hygiene trial in adolescents—A latent growth model. *International Journal of Dental Hygiene*, *16*(2), pp. e23–e30.

Aunger, R. (2007). Tooth brushing as routine behavior. *International Dental Journal*, *57*(S5), 364–376.

Dubois, A. & Gadde, L-E. (2002). Systematic combining: an abductive approach to case research. *Journal of Business Research, 55*(7), 553 – 560.

Dubois, A., & Gadde, L. E. (2014). 'Systematic Combining'—A Decade Later. *Journal of Business Research, 67*(6), 1277–1284.

Einstein, G. O., & McDaniel, M. A. (2007). Prospective memory: An overview and synthesis of an emerging field. Thousand Oaks, CA: Sage.

Handley, M.A., Harleman, E. Gonzalez-Mendez E., Stotland, N.E., Althavale, P., Fisher, L., Martinez, D., Ko, J., Sausjord, I. & Rios, C. 2016. Applying the COM-B model to creation of an IT-enabled health coaching and resource linkage program for low-income Latina moms with recent gestational diabetes: the STAR MAMA program. *Implementation Science 11*(1), 73.

HBSC 2013/2014. Health behavior in School-aged children. World health organization collaborative cross-national survey. Available online: http://www.hbsc.org/

Honkala, S., Vereecken, C., Niclasen, B. & Honkala, E. (2015). Trends in toothbrushing in 20 countries/regions from 1994 to 2010. *European Journal of Public Health*, *25*(2), 20–23.

Judah, G., Gardner, B. & Aunger, R. (2013). Forming a flossing habit: An exploratory study of the psychological determinants of habit formation. *British Journal of Health Psychology*, *18*(2), 338–353.

Judah, G., Gardner, B., Kenward, M. G., DeStavola, B. & Aunger, R. (2018). Exploratory study of the impact of perceived reward on habit formation. *BMC psychology*, *6*(1).

Labrecque, J. S., Wood, W., Neal, D. T. & Harrington, N. (2017). Habit slips: when consumers unintentionally resist new products. *Journal of the Academy of Marketing Science*, *45*(1), 119–133.

Maida, C. A., Marcus, M., Hays, R. D., Coulter, I. D., Ramos-Gomez, F., Lee, S. Y., McClory, P. S., Van, L. V., Wang, Y., Shen, J., Cai, L., Spolsky, V. W., Crall, J. J. & Liu, H. (2015). Child and adolescent perceptions of oral health over the life course. *Quality of Life Research*, *24*(11), 2739–2751.

Mattos-Silveira, J., Matos-Lima, B. B., Oliveira, T. A., Jarroug, K., Rego, R. V., Reyes, A., Ferreira, F. R., Imparato, J. C. & Braga, M. M. (2017). Why do children and

adolescents neglect dental flossing? *European Archives of Paediatric Dentistry*, *18*(1), 45–50.

Michie, S., van Stralen, M. M. & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6(1).

Pakpour, A. H., Updegraff, J. A., Dombrowski, S. U., Yekaninejad, M. S. & Sniehotta, F. F. (2013). The Effectiveness of Gain- Versus Loss-Framed Health Messages in Improving Oral Health in Iranian Secondary Schools: A Cluster-Randomized Controlled Trial. *Annals of Behavioral Medicine*, *47*(3), 376–387.

Sniehotta, F. F., Soares, V. A. & Dombrowski, S. U. (2007). Randomized controlled trial of a one-minute intervention changing oral self-care behavior. *Journal of Dental Research*, *86*(7), 641–645.

Stokes, E., Ashcroft, A. & Platt, M. J. (2006). Determining Liverpool adolescents' beliefs and attitudes in relation to oral health. *Health Education Research*, *21*(2), 192–205.

Tolvanen, M., Lahti, S., Miettunen, J. & Hausen, H. (2012). Relationship between oral health-related knowledge, attitudes and behavior among 1516-year-old adolescents - A structural equation modeling approach. *Acta Odontologica Scandinavica*, *70*(2), 169–176.

de Wit, S., & Dickinson, A. (2009). Associative theories of goal-directed behaviour: A case for animal- human translational models. *Psychological Research*, *73*(4), 463–476.

Wood, W. & Rünger, D. (2016). Psychology of Habit. *Annual Review of Psychology*, *67*(1), 289–314.

Funding

No funding sources.

A conflict of interest statement

None declared.

Table 1. Interview details

Group ID	Number of interviewees in group	Male	Female	Interviewer	Length (min)
G1	6	1	5	A	28.31
G2	6	6	0	B	25.41
G3	7	5	2	C	27.57
G4	5	3	2	A	33.44
G5	6	3	3	A	37.16
G6	6	6	0	B	33.52
G7	5	5	0	B	31.48
G8	5	3	2	C	28.42
G9	5	3	2	C	31.53

Table 2. Focus group analysis applying COM-B classifications to barriers and enablers affecting adolescents' tooth-brushing behavior

Motivation	Capability	Opportunity
"all those brain processes that energize and direct behaviour, not just goals and conscious decision-making. … includes habitual processes, emotional responding and analytical decision making" (Michie et al., 2011, p. 4). *Includes automatic processes and reflective processes (Michie et al., 2011).*	*"…having the necessary knowledge and skills" (Michie et al., 2011, p. 4).* *Includes physical and psychological capability to engage in the activity (Michie et al., 2011).*	*"all factors [that] lie outside the individual that make the behaviour possible or prompt it." (Michie et al., 2011, p. 4).* *Includes physical and social opportunity (Michie et al., 2011).*
Automatic motivation: • Tooth brushing is the last activity in the morning and something that is easily forgettable and dismissible – not a	Physical capability: • Not identified. Adolescents are able physically to brush their teeth.	Physical opportunities: • Time. Adolescents are "busy" in the mornings and other morning activities are prioritized.

significant part of morning routines. Tooth brushing is just a normal thing that needs to be done.		

Reflective motivation:
Enabling beliefs:
• Adolescents perceived tooth brushing as important for maintaining dental health, avoiding toothache or cavities (the latter were a concern because it was not pleasant to have to have repairs done).
• Good dental health was seen to promote a good appearance (the teeth look white).
• Tooth brushing was seen as leading to:
  • Fresh breath
	Psychological capability:
	• Knowledge: Adolescents felt they had enough information to take care of their teeth. However, several misunderstandings were identified such as:
	  • Whether to brush before or after breakfast (the role of acid attack).
	  • What happens during the night that makes brushing in the mornings necessary?
	• Skills: Adolescents felt they knew how to brush but seemed to be willing to get confirmation that
		Social opportunities:
		• Adolescents do not talk with one another about their dental health.
		• Tooth brushing behavior is not visible.
		• Tooth brushing is seen as an individual's own business and does not affect others unless he or she has bad breath.
		• Bad breath is an embarrassing thing, which even close friends cannot ignore.
		• Parents rarely remind adolescents to brush their teeth.

• No bad or musty taste in the mouth • No discomfort while chewing. • If one was dating, it was seen as disgusting if one's date did not brush his or her teeth. Inhibiting beliefs: • Tooth brushing was not on adolescents' priority list. • Adolescents do not feel like brushing, don't have the time, are too tired… • Adolescents see no point in brushing in the mornings because "nothing happens to your teeth during the night". • Brushing before breakfast makes food taste bad.	they were doing it properly.	• The dentist advises tooth brushing during the regular checks.

• One can have fresh breath by sucking a mint.		

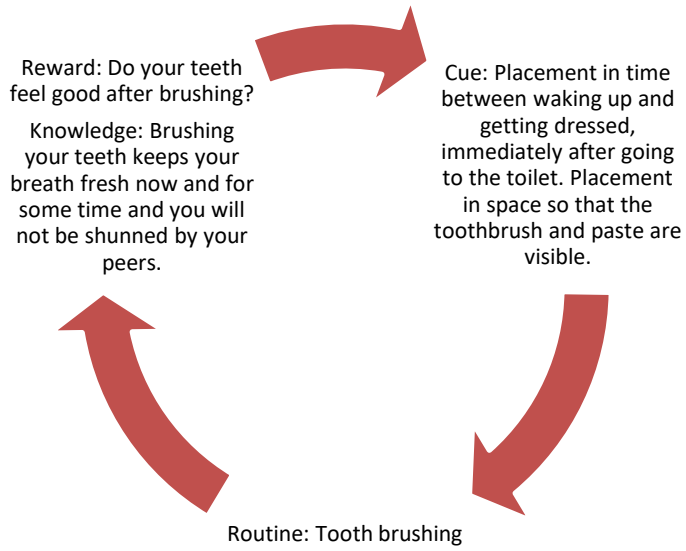

Figure 1. Habit formation and supporting the creation of stable tooth-brushing habits