Motivation for Dental Home Care: Testing a Self-Determination Theory Model[1]

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The present research developed the Self-Regulation for Dental Home Care Questionnaire (SRDHCQ), based on self-determination theory (SDT; Deci & Ryan, 2000), and used it in an SDT process model of dental health behaviors and self-rated oral health. In this model, patients' perceptions of autonomy-supportive (relative to controlling) dental professionals were expected to positively predict patients' psychological needs satisfaction in treatment. Needs satisfaction was expected to be positively related to autonomous motivation for dental home care and perceived dental competence, which were expected to be positively associated with self-rated oral health and dental health behaviors. Confirmatory factor analysis of the 5-factor SRDHCQ model fit the data very well, and a structural equation model supported the hypothesized process model.

Dental caries (i.e., tooth decay) is a major oral health problem affecting the majority of people. Many people also have signs of gingivitis (i.e., inflammation, bleeding of gums); and among adults, gingivitis can lead to periodontal disease (i.e., bone destruction around the teeth). Severe periodontitis is prevalent among 5% to 15% of the population (Petersen, 2000). Self-rated oral health tends to reflect these clinically assessed oral health factors, in addition to missing teeth, need for treatment, and amount of dental care

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(Atchison et al., 1993; Jones et al., 2001; Lang et al., 1997; Matthias, Atchison, Lubben, De Jong, & Schweitzer, 1995).

Population studies have indicated, and international experts agree, that the most important factor associated with improved dental health is the use of fluoride toothpaste in the exercise of daily oral hygiene habits, followed by a reduced frequency of sugar intake and reduced amount of sugar intake (Touger-Decker & van Loveren, 2003), and by more dentists practicing less invasive criteria for fillings (Bratthall, Hänsel-Petersson, & Sundberg, 1996; Eriksen, Hansen, Bjertness, & Berset, 1996; Holst & Schuller, 2000; Holst, Schuller, Aleksejuniené, & Eriksen, 2001; Holst, Schuller, & Gimmestad, 2004; Schuller & Holst, 1998). Poor oral hygiene results in much plaque (i.e., bacteria) on the teeth. This plaque becomes more cariogenic in a synergistic way when sugar is added because this combination produces acids that begin the tooth demineralization (Kleemola-Kujala & Rasanen, 1982).

The importance of regular, professional plaque removal is underscored by the fact that caries, gingivitis, and periodontitis can be prevented in most people (for a review, see Axelsson, 1981; Axelsson & Lindhe, 1974; Willmann & Chaves, 1999). Unfortunately, however, the way self-performed mechanical plaque removal is typically done at home has not been very successful in preventing dental caries (Bellini, Arneberg, & von der Fehr, 1981; Koch, Arneberg, & Thylstrup, 1986). Typical dental home care by daily tooth brushing and flossing has had only modest or no preventive effects on plaque, gingivitis, and caries (Axelsson, 1994; Granath et al., 1979). Further, educational programs alone have not been sufficient in helping patients perform appropriate dental behaviors (Tinanoff, Daley, O'Sullivan, & Douglass, 1999; Weinstein, Harrison, & Benton, 2004) and yielding caries reductions (Downer, 1996; Sheiham, 1997). In oral-health promotion programs, it is common that oral self-care behaviors are not maintained over the long term (Kay & Locker, 1998; Lund & Kegeles, 1984; McCaul, Glasgow, & O'Neill, 1992).

Why is it that patients do not perform adequate dental home care and adhere better to dental-care programs? Herein, we examine patient motivation as a possible factor.

A Motivational Challenge

There has been very little research on the role of motivation in patient adherence to dental-care programs and to the prevention of oral disease. For the healthcare domain more generally, we know that nonadherence to behavioral regimens is a large problem (Horwitz & Horwitz, 1993), but that autonomous motivation for adherence to behavioral regimens and medica-

tion prescriptions can be promoted, resulting in improved health (Williams, McGregor, Zeldman, Freedman, & Deci, 2004). Further, evidence has also suggested that autonomous motivation for dental treatment and behavior change related to dental care can be facilitated, resulting in improved oral health outcomes (Halvari & Halvari, 2006). Regarding autonomous motivation for dental home care, there has been no research.

Autonomous motivation reflects a personal identification with and integration of the value or importance of an activity with other self-determined life goals held by the person (Deci & Ryan, 2000). Because the perceived importance of different oral health behaviors may be closely related to the identified regulation type of autonomous motivation for dental care, a study by Broadbent, Thomson, and Poulton (2006) of the perceived importance for health behaviors would suggest that autonomous motivation for dental home care may be related to oral health. In that study, the importance of avoiding sweet foods, using fluoride toothpaste, keeping the teeth and mouth clean, using dental floss, and visiting the dentist regularly were measured in a birth cohort at ages 15, 18, and 26 years. The results showed that those who rated more of those behaviors as important and stable over 11 years had a significantly lower prevalence of poor self-rated oral health, less gingivitis, fewer teeth extracted as a result of caries, lower plaque scores, and fewer filled teeth. Thus, autonomous motivation for oral home care may be important for oral health outcomes. The current research was designed, based on SDT (Deci & Ryan, 2000), to develop a motivation questionnaire for dental home care and to use it to examine autonomous dental home-care motivation in relation to other SDT motivation variables, dental home-care behaviors, and self-rated oral health.

Motivation for Dental Home Care

Dental home-care and treatment behaviors are for many people not enjoyable or intrinsically motivated, but are regulated by extrinsic types of motivation. Ryan and Connell (1989) described a continuum of four types of extrinsic motivation, ranging from external to introjected, identified, and integrated regulation, respectively. These regulations are differentiated by the degree of endorsement or autonomy of the regulated behaviors.

External regulation of behavior is not self-determined because it is controlled by specific external contingent consequences administered by other people. Externally regulated behavior is pursued in order to attain desired tangible rewards or to avoid a threatened punishment. Examples are dental-care behaviors pursued in order to avoid criticism from a dental professional, to get a reward, to avoid nagging from others, or to avoid subsequent painful dental treatment.

The next type of extrinsic motivation on the continuum is *introjected regulation*. With introjection, control of behavior comes from contingent consequences that are internal to and administered by individuals to themselves; for example, to attain contingent self-worth (pride) or to avoid guilt and shame (Deci & Ryan, 2000). Introjection represents partial internalization because external regulations are taken in by people, but are not assimilated or accepted as their own. Introjections about dental behaviors are experienced by people in terms of "having to do" them in order to feel worthy, and like others regard them highly.

The third type of extrinsic motivation is *identified self-regulation*, which is present when people recognize and accept the underlying value of a behavior. The internalization process is fuller than with introjection, and the regulated behaviors are more self-determined (Deci & Ryan, 2000). Examples are people who believe it is important to exercise dental home care regularly and vigorously for their own health and well-being. When behaviors are endorsed in the form of identifications, they are expected to be associated with higher commitment and better maintained performance.

The fourth and most self-determined type of extrinsically motivated behavior is *integrated*. Its value and regulation are integrated within the person's sense of self because the person finds the behavior consistent and in harmony with other related life goals and values. Therefore, people experience less conflict because they experience the behavior as having its origin in their own interests, values, and feelings. An example of integrated regulation would be parents who value and pursue dental care for their own health, as well as to model it for their children. According to Deci and Ryan (2000), "As such, what was initially external regulation will have been fully transformed into self-regulation, and the result is self-determined extrinsic motivation" (p. 236).

Among these four types of extrinsic motivation, the sum of external and introjected regulations is termed *controlled motivation* in the literature (Deci & Ryan, 2000), whereas the sum of identified and integrated self-regulation is termed *autonomous motivation*. When autonomously motivated, people experience volition and choice; and they feel as though the behavior emanates from their sense of self. In other words, the behavior has an internal perceived locus of causality (deCharms, 1968). In contrast, when controlled in their motivation, people feel like the behavior is coerced or seduced by interpersonal or intrapsychic forces. Thus, the behavior has an external perceived locus of causality.

Autonomous and controlled behavioral regulations are all intentional or motivated. In contrast, *amotivation* is a state in which people lack the intention to behave. It is characterized by a complete absence of behavioral self-determination. When amotivated, people do not behave because they

either believe they cannot effectuate the behavior successfully, or they per-
ceive that the behavior would not lead to desired outcomes.

Importance of Autonomy Support

Autonomy support facilitates internalization and integration of the regu-
lation for uninteresting activities (Deci, Eghrari, Patrick, & Leone, 1994).
Autonomy-supportive contexts are defined by Williams and colleagues as
"ones in which significant others offer choice, provide a meaningful rationale,
minimize pressure, and acknowledge the target individual's feelings and per-
spectives" (Williams, Grow, Freedman, Ryan, & Deci, 1996, p. 117).

SDT research has shown that providing health information in an
autonomy-supportive way is important for patients' to increase their autono-
mous motivation (Williams et al., 1996, 2004, 2006; Williams, Rodin, Ryan,
Grolnick, & Deci, 1998). When dental-care activities are perceived as tedious,
not enjoyable, not important, not valued, and not interesting in their own
right, the following elements of an autonomy-supportive conversation
between the dental professional and the patient become important: (a) lis-
tening to patients' perceived problems, encouraging their questions and being
responsive to them, acknowledging their feelings and perspectives, and
asking them what they want to achieve (i.e., what are their goals); (b) pro-
posing clear recommendations regarding patient-perceived problems and
goals, acknowledging that the patient does not have to accept the changes
that are being recommended; (c) in a non-controlling way, explaining in
terms of behavior-health contingencies why recommendations or prescribed
activities may be effective in solving perceived problems or attaining personal
goals (i.e., providing meaningful rationales); and (d) encouraging patients to
consider the different options and make their own choices about whether or
not to endorse them (also see Patrick et al., 2009).

These autonomy-supportive practitioner behaviors are important because
they convey the value of the target oral-health behaviors and provide patients
support for fully internalizing the behaviors (Deci et al., 1994; Gagné & Deci,
2005; Koestner & Losier, 2002). This is illustrated by research indicating that
autonomy support is important for both patients' internalization of more
self-determined motivation and for their subsequent initiation, improvement,
and maintenance of healthcare behaviors (Williams, Cox, Kouides, & Deci,
1999; Williams et al., 2004). Autonomy-supportive healthcare contexts are
very consistent with the biopsychosocial approach to patient care (Engel,
1977), in which healthcare practitioners are empathic, patient-centered, and
sensitive to patients' psychological and social needs in order to provide
high-quality patient care (Williams & Deci, 1996).

Functional Significance of Psychological Needs Satisfaction

Why does autonomy support lead people to become autonomously motivated to initiate and maintain uninteresting activities? SDT argues that the process of internalization toward more self-determined types of motivation arises out of psychological need satisfaction (Deci & Ryan, 1985, 2000; Ryan & Deci, 2000). There are three basic psychological needs that are hypothesized to be important for human development and healthy functioning: the needs for competence, autonomy, and social relatedness (Deci & Ryan, 2000; Ryan & Deci, 2000). Autonomy-supportive contexts, which have been shown to satisfy these needs, provide nutriments for the integrative process that underlies internalization. Satisfaction of the need for competence results from effective behaviors that lead to intended outcomes (e.g., White, 1959). The need for autonomy is satisfied by experiences of choice and perceptions of self-initiation (e.g., deCharms, 1968). And satisfaction of the need for social relatedness is prompted by a perception of being secure and safely attached to and understood by others (e.g., Baumeister & Leary 1995).

Research that has documented the positive relation between autonomy support and psychological need satisfaction includes studies by Baard, Deci, and Ryan (2004) and Vallerand (2001). In a Norwegian study of students (Ulstad, 2005), psychological needs satisfaction mediated the positive association between autonomy support and both autonomous motivation and perceived competence. These, in turn, mediated the positive links between psychological needs satisfaction and, respectively, effort, persistence, and performance in physical activity and sport. Regarding psychological needs satisfaction, studies in organizations (Deci et al., 2001) and sport (Reinboth, Duda, & Ntoumanis, 2004) support its direct positive link to different mental and physical health indications.

Threats to Psychological Needs Satisfaction

Controlling social contexts (i.e., those low in autonomy support) is hypothesized to undermine psychological needs satisfaction. According to Deci (1996), a main hypothesis in SDT states that

> to the extent social contexts do not allow satisfaction of all three basic psychological needs for competence, relatedness, and autonomy, they will tend to diminish motivation, impair the natural development process, and lead to alienation and to poorer quality of performance. (pp. 200–201)

SDT further claims that none of the three needs can be threatened, thwarted, or neglected without having significant negative consequences for people's healthy functioning (Deci & Ryan, 2000).

Experimental studies have indicated that controlling events—such as threats of punishment (Deci & Cascio, 1972), evaluations (Harackiewicz, Manderlink, & Sansone, 1984), and pressure to outperform others—lead to decreases in intrinsic or autonomous types of motivation, and that thwarting satisfaction of the need for autonomy mediates this effect (Reeve & Deci, 1996). The undermining effect of negative feedback has been shown to be mediated by thwarting of the competence need (Vallerand & Reid, 1984). The relatedness need may also be important for self-determined motivation, because a study by Anderson, Manoogian, and Reznick (1976) indicated that the presence of a significant other who ignored or neglected children's attempts to interact with them was very detrimental to the children's intrinsic motivation for an interesting task. Thus, controlling contexts seem to diminish autonomous motivations because they thwart psychological needs satisfaction.

Field studies in schools and organizations support these findings indicating that controlling contexts, relative to autonomy-supportive ones, are associated with less autonomous motivation, decreased satisfaction and commitment, and diminished well-being (Deci, Connell, & Ryan, 1989; Deci, Schwartz, Sheinman, & Ryan, 1981; Ryan & Grolnick, 1986). Examples of threatening events at the dental clinic can be (a) treatment that is not based on informed consent, and perceived difficulty in initiating a discussion about the recommended treatment relative to other options, which can threaten autonomy; (b) perceived negative feedback indicating that the dental professional underestimated the patient's dental care skills or efforts, which may leave patients feeling humiliated, guilty, or shameful and thus threaten competence; and (c) a critical atmosphere, nonfriendly treatment setting, disrespectful interactions, and inadequate time to ask questions and communicate difficulties, which can threaten relatedness. Thus, in testing the SDT process model, basic need satisfaction will be used as one of the mediating variables between perceived dental-clinic autonomy support (relative to control) and the variables of motivation for dental home care, perceived dental competence, dental behaviors, and oral health.

Self-Determination Theory Process Model

SDT argues that autonomy-supportive dental-care contexts will facilitate satisfaction of patients' basic psychological needs in relation to dental care, which would facilitate both autonomous motivation and perceived

competence for dental care, both of which are the critical prerequisites for initiation and long-term change of dental-health behaviors. Research has supported that medical students who perceived their instructors as more autonomy-supportive became more autonomous in their learning and perceived themselves to be more competent, which, in turn, led them to be more effective when they interviewed a simulated patient 6 months later (Williams & Deci, 1996).

Other research has highlighted the importance of autonomy-supportive patient care for (a) increases in autonomous motivation and perceived competence for attendance at a weight-loss program, which, in turn, affected higher attendance and subsequent long-term maintained weight loss (Williams et al., 1996); (b) facilitating autonomous motivation for taking medications, which, in turn, led to patients' medication adherence (Kennedy, Goggin, & Nollen, 2004; Williams, Rodin et al., 1998); and (c) enhancement of autonomous motivation and perceived competence for diabetes self-management and improved glycemic control for patients with Type 2 diabetes (Williams et al., 2004). The only study to date that has been designed to extend recent SDT healthcare research to the area of dental healthcare (Halvari & Halvari, 2006) tested the effectiveness of an autonomy-supportive approach to providing dental healthcare, relative to standard dental care, in a clinic setting. Thus, the standard biomedical approach to dental care was compared to the experimental approach in which the important elements of the biomedical approach were embedded within an autonomy-supportive interpersonal process that was attentive to patients' psychosocial concerns. This autonomy-supportive informational clinic intervention increased patients' perceived dental competence and autonomous motivation for dental treatment over a 7-month period, which decreased plaque and gingivitis over the same time period, and resulted in better dental self-care behavior and more positive dental-health attitudes and affect at the end of the time period.

In the current study, in line with the theoretical reasoning and research presented, we test the psychometric properties of an SDT-based model with five motivational subscales for dental home care. Further, we are testing an SDT process model for dental home care and hypothesize the following:

> *Hypothesis 1.* An autonomy-supportive style (relative to a controlling style) provided by dental hygienists and dentists will be positively correlated with patient psychological needs satisfaction in treatment.

> *Hypothesis 2.* Needs satisfaction in treatment will be positively associated with patients' autonomous motivation for dental home care and perceived dental competence.

Hypothesis 3. There will be a positive path from autonomous motivation to perceived dental competence.

Hypothesis 4. Autonomous motivation and perceived competence will both be positively associated with self-rated oral health and dental healthcare behaviors (i.e., effort and quality of dental home care, including tooth brushing and the use of dental floss and fluoride).

Autonomous motivation is modeled to lead to perceived competence in Hypothesis 3 (Kennedy et al., 2004; Williams et al., 2006). This sequencing is unclear in the empirical literature because other research has indicated the opposite; namely, that perceived competence predicts autonomous motivation (Halvari & Halvari, 2006; Palmeira et al., 2007; Teixeira et al., 2006). It is probable that this relation is bidirectional, so we tested the alternative in the model; namely, that perceived dental competence leads to relative autonomous motivation.

The SDT process model of dental behaviors and dental health will be tested, controlling for age, gender, and socioeconomic factors, such as students' working for income (hours per week), economic problems in general, difficulties paying the costs for dentistry, and highest completed education. All of these socioeconomic factors have been shown to have an impact on dental health (Bönecker, 2006; Burt & Eklund, 1992; Carmichael, Rugg, French, & Cranage, 1980; Sreebny, 1983). Dental health is better in high socioeconomic groups than in low socioeconomic groups.

Method

Participants

Students at the University of Oslo were contacted after various classes and were asked if they would participate in the survey. They were informed that the aim of the study was to better understand the issues related to dental clinic experiences, dental home care, and health. After providing their informed consent, some of the students responded to the questionnaire immediately. Most of the students took the questionnaires with them and delivered them shortly thereafter or returned them by mail (a stamped envelope was provided).

The participants were students of psychology, educational sciences, philosophy, sociology, history, medicine, music, statistics, pharmacy, mathematics, and physics. No incentives were offered for participation. A total of 373 questionnaires were distributed, and 210 (166 from females, 43 from

males, and 1 did not indicate gender) were returned (56.3% response rate). Participants' ages ranged from 19 to 34 years ($M = 23.7$ years, $SD = 3.2$). Considerably more females than males responded to the questionnaire (females = 79.4%).

Participants' answers on several questions concerning their dental history and clinic attendance indicated that they were relatively healthy. Self-reported answers to questions about fillings in their teeth were low ($M = 2.06$, $SD = 2.57$): 0 fillings were reported by 39.1% of participants; 1 to 4 fillings were reported by 48.9%; and 5 to 16 fillings were reported by 12.0%. Of the participants, 73.3% reported that they had been at the dental clinic during the last year; and 94.8% reported being there in the last 2 to 3 years. Participants were asked to recall the last visit to their dental professionals and to report whether this person was a dental hygienist or a dentist. Of the participants, 90.0% indicated that it was their dentist.

Assessment of Perceived Autonomy Support and Control at the Clinic

Perceived autonomy support was measured with the Health-Care Climate Questionnaire (HCCQ; Williams et al., 1996). Before the participants responded to the items in the HCCQ, they were introduced to their own clinic context with the following instructions and questions: "Think back to your last visit to a dental hygienist or dentist. It is important that you try to think about the treatment and your experiences with this dental professional." This introduction was followed by six questions:

1. Was this dental professional a dental hygienist or a dentist?
2. Was this dental professional a female or a male?
3. How many visits have there been to this dental professional?
4. What type of clinic was it (private or public)?
5. How long has it been since the last visit?
6. What is the number of visits during the last 2 years?

The participants were then told

> If you answered "dental hygienist" in Question 1, please have this person in mind and answer the following questions with reference to your dental hygienist. However, if you answered "dentist" in Question 1, please answer the following questions with reference to your dentist.

Participants were then given the HCCQ, which assesses participants' perceptions of the degree to which their dental professionals were autonomy-supportive at the clinic.

The participants responded to 15 items on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). A sample item is "I feel that my dental professional has provided me choices and options." Recently, this scale was tested in Norway among education students (Halvari, Ulstad, Bagøien, & Skjesol, 2009), patients in rehabilitation after heart disease (Svarstad, 2007), elite athletes (Solberg & Halvari, 2009), and patients in rehabilitation with the intention of going back to work after long-term diverse illnesses (Utistog, 2007). It yielded good internal consistency, as well as convergent and divergent validity.

Perceived Controllingness

We measured perceived controllingness with the Perceived Controlling Style at the Dental Clinic Questionnaire (PCSDCQ). A dental professional with long clinic experience and familiarity with SDT and an SDT researcher developed a pool of 19 items intended to reflect clinic conditions that may (a) threaten satisfaction of the need for autonomy, which means that people experience less choice and believe that their actions are other-initiated (de-Charms, 1968; e.g., "I feel that the dental professional will do what he/she wants and not listen to me when I sit in the chair"); (b) threaten fulfillment of the need for competence, which means that people experience that they are not capable of acting effectively to attain desired results (White, 1959; e.g., "When my teeth are being examined, I feel underestimated and humiliated"); and (c) threaten fulfillment of the relatedness need, which involves an experience of not being securely attached to and understood by others (Baumeister & Leary, 1995; e.g., "My dental professional does not see me as a person, he/she sees only the teeth").

Participants responded to the items on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). A factor analysis of autonomy support and controlling items yielded two factors. In this analysis, 1 of 15 autonomy support items and 6 of 19 controlling items were omitted as a result of unacceptable cross-loadings. Thus, 14 items for autonomy support and 13 items for a controlling clinic style were averaged for each factor (see the Appendix for the 13 controlling items).

Assessment of Basic Psychological Needs Satisfaction at the Clinic

We measured basic psychological needs satisfaction with an adaptation of items from two scales—Basic Psychological Need Scale–General (Gagné, 2003), and Basic Psychological Need Scale–In Relationship (La Guardia,

Ryan, Couchman, & Deci, 2000)—for the dental clinic domain. The adapted scale for the current study consists of nine items intended to measure satisfaction of the three basic needs for competence, autonomy, and relatedness, with three items each. Participants responded to items following the stem "When you are in dental treatment, how true or untrue are the following statements?" Sample items are "I really like my dental professional" (relatedness need); "When I am with my dental professional, I often feel very capable" (competence need); and "With my dental professional, I generally feel free to express my ideas and opinions" (autonomy need).

Participants indicated how true each item was for them on a 7-point scale ranging from 1 (*not at all true*) to 7 (*very true*). The items were averaged within subscales to reflect the needs for autonomy, competence, and relatedness. Because SDT (Deci & Ryan, 2000) predicts the three needs, we performed a confirmatory factor analysis in order to test its psychometric properties. The measurement model of the three basic psychological needs, with three items each, yielded a very good fit, $\chi^2(24, N = 210) = 42.00$, $p = .013$ (comparative fit index [CFI] = .99; incremental fit index [IFI] = .99; root mean square error of approximation [RMSEA] = .06; standardized root mean square residual [SRMR] = .024). Recently, the Basic Psychological Need Scale–General (Gagné, 2003) was tested in Norway among education students (Ulstad, 2005), and a factor analysis yielded the three separate needs proposed by SDT. Other research has yielded acceptable reliability and validity indications for the Basic Psychological Need Scale (Baard et al., 2004; Gagné, 2003).

Development of the Self-Regulation Questionnaire for Dental Home Care

The initial test version of the Self-Regulation Questionnaire for Dental Home Care (SRQDHC) was comprised of 45 items. These items were formulated after inspection of items in (a) original versions of the Self-Regulation Questionnaire (Ryan & Connell, 1989) used in different domains (e.g., academic, exercise); (b) the Treatment Self-Regulation Questionnaire, which was used first for weight loss in morbidly obese patients (Williams et al., 1996) and later for glucose control among patients with diabetes (Williams, Freedman, & Deci, 1998) and smoking cessation (Williams et al., 1999); and (c) the Regulation of Eating Behavior Scale developed by Pelletier, Dion, Slovenic-D'Angelo, and Reid (2004). Participants responded to the items following two stems: "I do my dental home care because . . . ," and "I plan to do my dental home care regularly because . . .". Responses were rated on a 7-point scale ranging from 1 (*not true at all*) to 7 (*very true*).

The final items appear in Table 1. The items and their meaning correspond well to previous versions of the Self-Regulation Questionnaire used in other domains. For each of the five motivational regulations shown in Table 1, the items were averaged within the subscale. In line with SDT (Deci & Ryan, 2000), an autonomous motivation score was calculated by summing integrated and identified regulations, while a controlled motivation score was estimated by summing introjected and external regulations.

Assessment of Perceived Dental Competence

We measured perceived dental competence with the Perceived Competence Scale (PCS), which was adapted to the dental domain from scales used in diabetes self-care (Williams, Freedman et al., 1998) and learning among medical students (Williams & Deci, 1996). Students responded to four items on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Each item asked the students how skilled or effective they felt in their dental care. A sample item is "I feel confident in my ability to manage my dental care." The items were averaged to reflect perceived dental competence. This scale was tested in Norway among upper secondary school students (Bagøien & Halvari, 2005) and education students (Halvari et al., 2009), and it demonstrated good internal consistency, as well as convergent and divergent validity.

Assessment of Dental Health Behaviors

Use of dental floss. We measured the use of dental floss with the following questions: (a) "Do you use dental floss?" which was answered either *No* (1) or *Yes* (2); (b) "I use dental floss vigorously every day," which was rated on a 7-point scale ranging from 1 (*not at all true*) to 7 (*very true*); and (c) "How often do you use dental floss in the areas between your teeth?" which was rated on a 5-point scale ranging from 1 (*never*) to 3 (*once a week*) to 5 (*daily*). Because different scales were used here, the three "dental-floss scores" were standardized before they were added to form the total score.

Frequency of sugar intake. We measured frequency of sugar intake with the following questions: (a) "How often do you eat between meals?"; (b) "How often do you eat sweets between meals (candies, cakes, and the like)?"; and (c) "Do you eat more than 5 times a day?" Participants rated their responses on a 5-point scale ranging from 1 (*never*) to 5 (*very often*). Inter-item correlations for these three items were .49, .43, and .44 ($ps < .001$), respectively, in the current data.

Table 1

Self-Regulation for Dental Home Care Items

I do my dental home care because . . .	Factor				
	Integ	Ident	Intro	Ext	Amot
1. It has become a natural part of my everyday life.	.75 **.90**	.38			
2. It feels quite natural for me to do it.	.68 **.93**	.47			
3. To do my home care regularly has become a natural habit for me.[a]	.70 **.85**	.28			
4. It is important to me personally.		.64	.19		
5. It is a personal choice I feel responsible for.		.61	.20		
6. I am interested in helping myself.	.11	.57			
7. I want to have control over my dental health.		.67 **.83**	.21		
8. I think it is the best for me, and it is my interest to do so.	.34	.66 **.92**			
9. It is important to me.	.17	.59 **.76**			
10. I'll feel bad about myself if I don't do it.			.65 **.81**	.28	
11. I'll be frustrated if I don't do it.		.29	.74 **.89**		
12. My conscience will bother me if I don't do it.		.27	.81 **.86**		
13. I'll feel guilty if I don't do it.			.64	.27	
14. I'll have a bad conscience if I don't do it.[a]			.77	.18	
15. I want the dental professional to be satisfied with me.		.19		.83	

Table 1   *Continued*

I do my dental home care because . . .	Factor				
	Integ	Ident	Intro	Ext	Amot
16. I want my dental professional to be satisfied with me.[a]			*.19*	*.83*	
				.86	
17. I want my dental professional to think that I am a dutiful patient.[a]			*.24*	*.86*	
				.94	
18. I am afraid of bad feedback from my dental professional.[a]			*.25*	*.81*	
				.87	
19. My dental professional should not dislike me.[a]				*.63*	*.28*
20. I don't really know if it means anything to me.				*.17*	*.80*
					.84
21. I don't know, I really don't want to do as much dental care.		*−.22*			*.64*
					.85
22. I'm not sure any longer why I should do my dental home care, and whether it will have any meaning for me.[a]		*−18*			*.58*
					.75
Eigenvalue	1.86	3.19	3.02	3.44	1.83
Explained variance, R^2 (%)	8.5	14.5	13.7	15.7	8.3

Note. $N = 210$. Primary and secondary loadings from exploratory factor analysis appear in italics. Loadings from confirmatory factor analysis appear in bold beneath the italicized loadings. Integ = integrated; Ident = identified; Intro = introjection; Ext = external; Amot = amotivation.
[a]The stem for these items is "I plan to do my dental home care regularly because . . .".

Use of fluoride. We measured use of fluoride with the following questions: (a) "Do you use fluoride (tablets or mouth rinse with fluoride)?" which was rated *No* (1) or *Yes* (2); (b) "Do you use toothpaste with fluoride?" which was rated *No* (1) or *Yes* (2); (c) "How often do you use toothpaste with fluoride?" which was rated on a 5-point scale ranging from 1 (*never*) to 3 (*once a week*) to 5 (*daily*); and (4) "How often do you use mouth rinse with fluoride or fluoride tablets?" 1 (*never*) to 3 (*once a week*) to 5 (*daily*). The four item scores were standardized before being summed.

Effort and quality of dental home care. We measured participants' effort and quality of dental home care with five items that were adapted to dental care from Kuvaas (2006a, 2006b). Sample items are "I brush my teeth as well as possible," and "I work very hard in the care of my teeth." Responses were rated on a 7-point scale ranging from 1 (*does not suit me at all*) to 7 (*suits me very well*).

Self-reported need for treatment. We measured self-reported need for treatment with the question "Thinking about your own dental condition, how much treatment do you believe you need?" Responses were rated on a 5-point scale ranging from 1 (*no treatment*) to 3 (*some treatment*) to 5 (*very much treatment*).

Assessment of Self-Rated Oral Health

We measured self-rated oral health with two questions. The first question is from the Short Form Health Survey (SF-36; Ware & Sherbourne, 1992): "How would you say your dental health is now?" The second question is from a Swedish study (Femia, Zarit, & Johansson, 2001): "How would you evaluate your dental health in relation to others of your own age?" Responses were rated on a 5-point scale ranging from 1 (*bad*) to 5 (*excellent*). The items were averaged to reflect self-rated oral health.

Self-rated measures similar to those used in the present study have been found to be reliable and valid indicators of physical health in general (Idler & Benyamini, 1997; Krause & Jay, 1994), and clinical assessments of oral health (Atchison et al., 1993; Brunswick & Nikias, 1975; Jones et al., 2001; Kallio, Nordblad, Croucher, & Ainamo, 1994; Lang et al., 1997; Matthias et al., 1995; Ostberg, Eriksson, Lindblad, & Halling, 2003; Pattussi, Olinto, Hardy, & Sheiham, 2007; Reisine & Bailit, 1980). In a study among students (Pattussi et al., 2007), the prevalence of poor self-rated oral health was very high for those with dental caries, as compared to those without. Further, in a prospective cohort study (Locker, Clarke, & Payne, 2000), self-rated oral health was found to predict general well-being and life satisfaction 4 years later.

Assessment of Control Variables

Gender was indicated as 1 for female and 2 for male, while age was indicated in years. Work for income was measured with the question "How many hours per week do you work for income?" to which participants responded by filling in a blank. Problems with personal finances were

assessed with the question "How would you describe your financial situation at the moment?" which was rated on a 5-point scale ranging from 1 (*very good*) to 3 (*have to be careful*) to 5 (*very difficult*). Difficulty paying a 2000 kr (approx. $300 US) dentist bill was assessed with the question "Imagine that you got a dentist bill of 2000 kr. How difficult would it be for you personally to pay a bill like this?" Responses were rated on a 4-point scale ranging from 1 (*not at all difficult*) to 4 (*very difficult*). Finally, participants rated their highest completed level of education using the following categories: 1 = *junior high school*; 2 = *senior high school*; 3 = *vocational education up to 3 years*; 4 = *university or university college up to 3 years*; 5 = *university or university college up to 5 years (master)*; or 6 = *university or university college education of more than 5 years*. In the current data, 2 students answered *junior high school*, which indicates that they were enrolled in university courses as a result of specific talents or competence.

Results

Factor Analysis of Self-Regulation of Dental Home Care Items

Preliminary analyses of item scores yield some non-normal distributions (−2.0 > skewness > 2.0), some items with low convergent factor loadings (< .50), and some items with low discriminant validity attributes (difference between primary and secondary loading < .20). These items were removed. The results of an exploratory maximum likelihood factor analysis of the 22 remaining items, with varimax rotation, appears in Table 1 and reveals a five-factor solution. Total explained variance was 61%.

Because SDT (Deci & Ryan, 2000) predicts the five types of regulations, we performed a confirmatory factor analysis in order to reduce the 22 items to 15, with 3 items for each of the 5 types of regulation. Model fit indexes were the chi-square likelihood ratio, RMSEA, CFI, IFI, and SRMR. Researchers recommend the use of these different indexes in order to evaluate model fit in covariance structure analyses (Bollen, 1989; Hu & Bentler, 1999). A good fit should have a value close to or lower than .06 for RMSEA, a value close to or lower than .08 for SRMR, and a value close to or higher than .95 for CFI and IFI. Hu and Bentler compared all fit indexes and found SRMR to be most sensitive to misspecification in both simple and complex models, and less sensitive to sample size and violations of distributional assumptions. In evaluating the model fit, we relied more on the values for SRMR and CFI than the RMSEA because the latter tends to over-reject true-population models with a small sample size (< 250), and thus would be less preferable here (Hu & Bentler, 1999).

The a priori model with all 22 items yields an acceptable fit, $\chi^2(199, N = 210) = 581.46$, $p < .001$ (CFI = .94; IFI = .94; RMSEA = .096; SRMR = .075), except for an RMSEA slightly above the recommended value. In the process of reducing the number of items from 22 to 15, we examined the modification indexes and looked for items with high error uniqueness correlations. We omitted indicators that had both the highest error values and the lowest factor loadings and those with sizable error correlation magnitude and low factor loadings, until 15 items remained. The final model of the 15-item Self-Regulation of Dental Home Care Questionnaire yields a very good fit, $\chi^2(80, N = 210) = 149.39$, $p < .001$ (CFI = .98; IFI = .98; RMSEA = .064; SRMR = .046). Factor loadings for items in the final confirmatory factor analysis are presented in Table 1 (loadings in bold). Thus, the 15-item scale was used in subsequent analyses.

Self-Regulation Continuum

The results indicate very good levels of internal consistency for the five types of regulation (see Table 2). Correlations between the five regulation types show a very good, simplex-like pattern, with regulation types closer to each other correlating more positively with each other; and those farther from each other correlating less positively or more negatively.

Descriptive Statistics and Reliability

Table 3 shows the means, standard deviations, ranges, skewness values, and reliabilities for all variables. Relatively high levels of internal consistency (Cronbach's alpha) emerged, except for frequency of sugar intake and use of fluoride, which were borderline acceptable.

Correlations Between Motivational Regulations and Other Study Variables

Additional support for the SDT/self-regulation continuum can be found in the correlations (Table 4) between the five regulation types and SDT variables and health-related variables, respectively. To illustrate, integrated and identified regulations for dental home care were significantly correlated in the expected direction with autonomy support, controlling style, basic needs satisfaction, perceived dental competence, and all dental health-related behaviors, except for the correlation between integrated regulation and the use of dental floss. Conversely, the opposite pattern of

Table 2

Descriptive Statistics for Self-Regulation for Dental Home Care Subscales, Pearson Correlations, and Reliability Coefficients

Regulations	M	SD	Observed range	Skewness	1	2	3	4	5
1. Integrated	6.37	0.95	2.0–7.0	−1.83	(.84)				
2. Identified	6.13	0.87	2.7–7.0	−1.04	.61	(.81)			
3. Introjected	5.07	1.55	1.0–7.0	−0.74	.23	.41	(.86)		
4. External	2.99	1.63	1.0–7.0	0.45	−.05	.05	.39	(.89)	
5. Amotivated	1.79	1.03	1.0–6.0	1.65	−.39	−.47	−.03	.17	(.76)

Note. $N = 210$. $r = .13$, $p < .05$ (two-tailed). Cronbach's alphas appear in parentheses.

Table 3

Descriptive Statistics for Socioeconomic, SDT, Dental Behaviors, and Dental Health Variables

Variable	*M*	*SD*	Observed range	Skewness	α
Gender	1.21	0.41	1.0–2.0	1.47	—
Age	23.7	3.2	19–34	1.50	—
Work for income (hrs/wk)	8.06	8.05	0.0–45.0	1.58	—
Problems with private economy	2.84	0.66	1.0–5.0	−0.22	—
Difficulty paying a 2000 kr dentist bill	2.49	1.04	1.0–4.0	0.10	—
Education (highest completed)	3.74	1.32	1.0–6.0	−0.13	—
Autonomy support	4.97	1.27	1.3–7.0	−0.36	.96
Controlling style	2.14	1.07	1.0–4.9	0.75	.94
Need for competence	4.83	1.39	1.0–7.0	−0.28	.90
Need for autonomy	4.86	1.50	1.0–7.0	−0.36	.87
Need for social relatedness	4.88	1.48	1.0–7.0	−0.38	.87
Total needs satisfaction	4.88	1.29	1.7–7.0	−0.30	.93
Perceived dental competence	5.25	1.15	1.5–7.0	−0.68	.88
Autonomous motivation	6.25	0.82	2.3–7.0	−1.52	.86
Controlled motivation	4.03	1.32	1.0–7.0	−0.08	.84
Amotivation	1.79	1.03	1.0–6.0	1.64	.76
Use of dental floss (Std)	0.01	1.81	−2.6–2.7	−0.13	.93
Frequency of sugar intake	2.44	0.66	1.0–4.3	0.45	.64
Use of fluoride (Std)	0.04	0.68	−2.1–0.9	−1.05	.67
Effort and quality of dental home care	5.10	1.04	2.0–7.0	−0.33	.87
Self-reported need for treatment	2.61	0.77	1.0–5.0	0.27	—
Self-rated oral health	3.44	0.84	1.0–5.0	−0.09	.90

Note. $N = 210$. SDT = self-determination theory; Std = score based on the sum of standardized items.

correlations emerged for amotivation, although the correlations were somewhat weaker. In addition, the correlations for both introjection and external regulations with SDT and health variables were generally close to zero.

Table 4

Pearson Correlations Between the Subscales for Self-Regulation of Dental Home Care, Other SDT-Relevant Variables, and Health-Related Variables

Variable	Gender	Age	Integ	Ident	Introj	Ext	Amot
Gender	—	.01	−.06	**−.27**	−.10	−.04	.12
Age	.01	—	−.01	.00	**−.15**	−.09	−.05
Autonomy support	**−.19**	.08	**.25**	**.31**	**.14**	.12	−.11
Controlling style	**.14**	−.04	**−.25**	**−.30**	.04	.04	**.18**
Need for competence	**−.19**	−.11	**.32**	**.34**	.05	.10	−.12
Need for autonomy	−.09	.09	**.24**	**.27**	.08	.10	−.10
Need for social relatedness	−.06	.10	**.22**	**.25**	.09	.12	−.07
Total needs satisfaction	−.12	.04	**.29**	**.31**	.06	.12	−.12
Perceived dental competence	−.09	−.04	**.52**	**.53**	.10	−.06	**−.28**
Autonomous motivation	**−.18**	−.01	**.90**	**.89**	**.36**	.00	**−.48**
Controlled motivation	−.09	**−.14**	.11	**.27**	**.82**	**.85**	.08
Use of dental floss	**−.18**	.05	.03	**.20**	−.04	.07	−.11
Frequency of sugar intake	−.03	−.11	**−.19**	**−.15**	−.06	−.06	.10
Use of fluoride	**−.19**	−.01	**.25**	**.31**	.09	.09	**−.22**
Effort and quality of dental home care	−.09	**−.16**	**.30**	**.50**	**.17**	**.16**	**−.18**
Need for treatment	**.13**	.07	**−.20**	**−.20**	−.07	.04	**.16**
Self-rated oral health	**−.13**	−.10	**.31**	**.34**	**.18**	.03	**−.20**

Note. $N = 210$. $rs \geq .13$, $p < .05$ level (two-tailed), appear in boldface. Point biserial correlations are presented between gender and other variables. Gender: 1 = female, 2 = male. SDT = self-determination theory; DHC = dental home care; Integ = integrated; Ident = identified; Intro = introjection; Ext = external; Amot = amotivation.

Correlations Between SDT-Related Variables and Dental Behavior Variables

Table 5 reveals that autonomy support at the clinic was significantly positively correlated with all SDT-related variables, except amotivation. A perceived controlling style was significantly negatively correlated with the same variables, except for a nonsignificant link with controlled motivation and a significant positive correlation with amotivation. In addition, autonomy support and control styles were significantly correlated with most of the measures of dental health-related behaviors in the expected direction.

Next, all three types of needs satisfaction were significantly positively correlated with autonomous motivation for dental behavior and perceived dental competence, and were also significantly associated in the expected direction with all measures of dental behaviors. Furthermore, autonomous motivation for dental home care and perceived dental competence were all significantly associated in the expected direction with all measures of dental behaviors, except for the correlations between perceived dental competence and frequency of sugar intake, and the correlation between autonomous motivation and use of dental floss. It is also observed that controlled motivation and amotivation did not explain much variance in home care behaviors or dental health. Thus, we omitted them from the SDT process model test.

Testing Hypotheses in the SDT Process Model

Theoretical model. The hypotheses concerned the relations among variables summarized at the end of the introduction. The zero-order correlations that emerged in Table 5 were all in line with the hypotheses, except for the null relations between perceived dental competence and sugar intake, and between autonomous motivation and use of dental floss. We then examined the SDT process model (Figure 1) using structural equation modeling (LISREL). In doing this, we did not use need for treatment in the model because it was so strongly negatively associated with self-rated oral health that the concepts had substantial overlap.

Structural equation modeling. Because of the large number of indicators (items) in relation to the sample size, we tested the SDT process model on the basis of a combination of observed variables and latent variables represented by three or four items having the highest factor loadings for each construct (see factor loadings in Figure 1). The error variance for each observed variable was set to 15% of the squared standard deviation for each variable. The latent composite variable of autonomy-supportive, relative to controlling, styles reflects the sum of two autonomy-supportive items minus two

Table 5

Pearson Correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Autonomy support	—														
2. Controlling style	-.68	—													
3. Need for competence	.52	-.55	—												
4. Need for autonomy	.76	-.72	.61	—											
5. Social relatedness need	.79	-.73	.60	.87	—										
6. Total needs satisfaction	.77	-.77	.82	.93	.93	—									
7. Perceived dental competence	.38	-.45	.59	.44	.42	.54	—								
8. Autonomous motivation	.31	-.30	.37	.29	.26	.33	.59	—							
9. Controlled motivation	.16	.04	.09	.10	.11	.11	.02	.21	—						
10. Amotivation	-.11	.18	-.12	-.10	-.07	-.12	-.28	-.48	.08	—					
11. Use of dental floss	.17	-.09	.22	.15	.10	.15	.38	.12	.02	-.11	—				
12. Frequency of sugar intake	-.14	.15	-.23	-.13	-.13	-.18	-.09	-.19	-.07	.10	.09	—			
13. Use of fluoride	.17	-.14	.19	.15	.14	.17	.27	.31	.12	-.22	.27	-.06	—		
14. Effort and quality of dental home care	.22	-.17	.42	.23	.19	.31	.55	.44	.20	-.18	.46	-.10	.28	—	
15. Need for treatment	-.20	.32	-.51	-.29	-.23	-.39	-.44	-.22	-.02	.16	-.11	.15	-.15	-.23	—
16. Self-rated oral health	.26	-.29	.54	.24	.23	.37	.56	.36	.13	-.20	.21	-.14	.18	.33	-.55

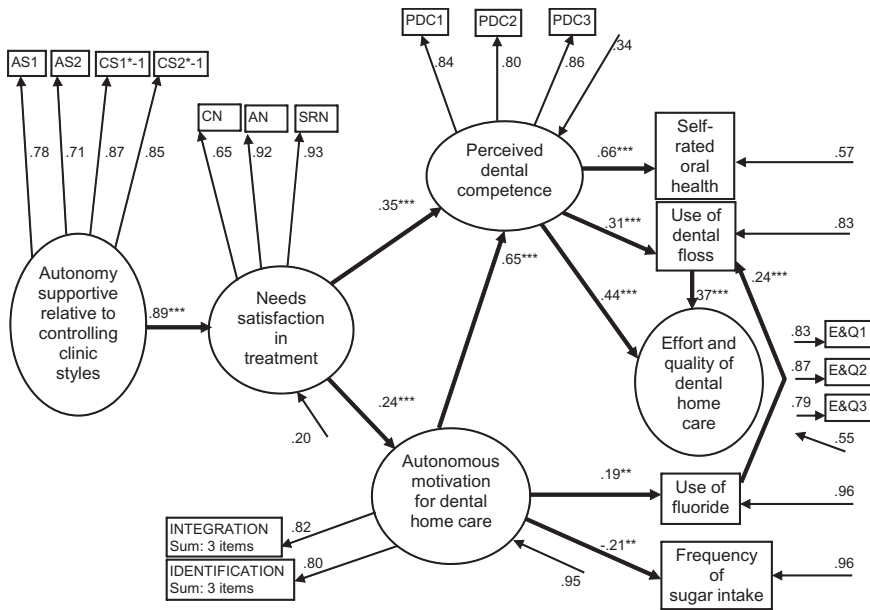*Note.* *rs* > .13, *p* < .05 (two-tailed), appear in boldface.

Figure 1. Standardized parameter (regression) estimates depicting the relations in the structural self-determination theory process model of dental health behaviors and dental health. $\chi^2(145, N = 210) = 281.37, p < .001$; SRMR = .079; CFI = .96; IFI = .96; RMSEA = .067. AS = autonomy support; CS = control style; CN = competence need; AN = autonomy need; SRN = social-relatedness need; PDC = perceived dental competence; E&Q = effort and quality. **$p < .01$. ***$p < .001$.

controlling items. Because the three psychological needs were highly correlated, we used them as indicators of total need satisfaction. In the evaluation of fit indexes, we used the same cutoff values as in the measurement model tested previously for the Self-Regulation for Dental Home Care Questionnaire (SRDHCQ).

Empirical models. Before we tested the structural model in Figure 1, we tested the a priori measurement model and found that it fit the data well, $\chi^2(120, N = 210) = 250.91, p < .001$ (SRMR = .063; CFI = .96; IFI = .96; RMSEA = .072). Modification indexes suggested adding positive error covariances between competence need and one perceived competence item, respectively, and self-rated oral health. These suggestions were evaluated as theoretically meaningful because they are expected, according to SDT (Deci & Ryan, 2000).

After adding the two links, the fit of the final measurement model became very good, $\chi^2(120, N = 210) = 217.05, p < .001$ (SRMR = .063; CFI = .97;

IFI = .97; RMSEA = .062). We tested the structural model with this measurement model included. The a priori structural equation modeling analysis for the SDT process model of dental behaviors fit the data relatively well, $\chi^2(144, N = 210) = 309.67, p < .001$ (SRMR = .087; CFI = .96; IFI = .96; RMSEA = .074). This a priori structural model included all paths hypothesized in the theoretical model.

All paths were significant, except for the paths from perceived dental competence to frequency of sugar intake and use of fluoride; and the paths from autonomous motivation to self-rated oral health, use of floss, and effort and quality of dental home care. The latter nonsignificant paths in the model were bivariately significant, which indicates that perceived competence mediated the positive relations between autonomous motivation and the three dental health-related outcomes (see Mediation Analyses).

In testing the final model, we omitted the nonsignificant paths from the model. In addition, we added two links suggested by modification indexes between the dependent dental behavior variables (viz. a link from use of dental floss to the effort and quality of dental home care, and a link from use of fluoride to use of dental floss). These respecifications yielded a very good fit for the final structural model, $\chi^2(145, N = 210) = 281.37, p < .001$ (SRMR = .079; CFI = .96; IFI = .96; RMSEA = .067). The standardized parameter estimates are shown in Figure 1.

We also tested an alternative model, because the literature is not consistent about the direction of influence between autonomous motivation and perceived competence. Thus, we changed the direction of influence in the model with perceived dental competence leading to autonomous motivation. This did not change the fit of the overall model.

Mediation Analyses

Mediations tested in the model appearing in Figure 1 were done by the bootstrapping procedure described by Preacher and Hayes (2008). The results indicate that 10 of the 11 mediations (see Table 6) were significantly supported because the bias-corrected 95% confidence intervals (for the bands of products of coefficients after *n* re-samplings) did not include zero or oppositely valued coefficients. Mediation 11, which tested the indirect effect of needs satisfaction on frequency of sugar intake through autonomous motivation, was marginally significant. One of the tests reveals partial mediation; that is, needs satisfaction still affected perceived competence after entering autonomous motivation as a mediator (see Figure 1). This is expected, because SDT proposes that needs satisfaction influences both perceived competence and autonomous motivation (Deci & Ryan, 2000).

Table 6

Tests of Mediations for Links Emerging in Figure 1

Independent variable (IV) → Mediator (M) → Dependent variable (DV)	Point estimate	SE	a*b path Z	Bootstrapping BC 95% confidence interval	
				Lower	Upper
1. Autonomy supportive relative to controlling style → NS → Autonomous motivation	0.21	0.06	3.31***	0.09	0.34
2. Autonomy supportive relative to controlling style → NS → PC	0.53	0.09	6.18***	0.36	0.72
3. NS → Autonomous motivation → PC	0.17	0.04	4.73***	0.11	0.25
4. NS → PC → Self-rated oral health	0.19	0.03	5.58***	0.12	0.26
5. Autonomous motivation → PC → Self-rated oral health	0.32	0.06	5.80***	0.22	0.45
6. NS → PC → Use of dental floss	0.31	0.07	4.35***	0.20	0.45
7. Autonomous motivation → PC → Use of dental floss	0.63	0.13	4.95***	0.42	0.89
8. NS → PC → Effort and quality of home care	0.24	0.04	5.56***	0.16	0.33
9. Autonomous motivation → PC → Effort and quality of home care	0.34	0.07	5.19***	0.21	0.48
10. NS → Autonomous motivation → Use of fluoride	0.06	0.02	3.01***	0.02	0.12
11. NS → Autonomous motivation → Frequency of sugar intake	−0.03	0.01	−1.79†	−0.08	0.00

Note. a-path = IV → M; b-path = M → DV. BC = bias corrected, 5000 bootstrap samples; NS = needs satisfaction; PC = perceived competence

†$p < .10$. ***$p < .001$.

All 10 of the other mediations were full; that is, for each mediation, the effect of the independent variable on the dependent variable changed and was reduced from significant to nonsignificant when the mediator entered the model. This was also the case for the 11th indirect effect in Table 6, although it was only marginally significant. Regarding the discussion about what comes first in the model (i.e., autonomous motivation or perceived competence), the indirect links between autonomous motivation and three of the dependent measures (i.e., self-rated oral health; use of dental floss; effort and quality of dental home care) through perceived competence were all significantly supported (see Table 6, Items 5, 7, and 9).

Control for Age, Gender, and Socioeconomic Variables

The SDT model, which appears in Figure 1, was also tested while controlling for age, gender, and the four socioeconomic variables described. All correlations between these variables and the dental health-related variables were nonsignificant, or weak in strength although significant. In the test of the model, the correlation coefficients between SDT variables and oral health and dental health behaviors, respectively, remained the same after simultaneously including the control variables in the model. The additional significant links were that work for income was negatively correlated with self-rated oral health ($r = -.18$, $p < .05$); that females use dental floss and report a higher effort and quality of dental home care than do males ($r = -.21$, $p < .01$, and $-.15$, $p < .05$, respectively), and that students' highest completed education was negatively correlated with frequency of sugar intake ($r = -.23$, $p < .01$).

Discussion

The results yield support for the SDT-based five-factor model of motivation for dental home care. This model includes integrated and identified types of autonomous motivation, introjection and external types of controlled motivation, as well as amotivation. The autonomous regulation subscale of this new scale worked very well in testing the SDT process model of dental health behaviors and self-rated oral health. Patients' perceptions of autonomy-supportive (relative to controlling) dental professionals at the clinic were positively associated with patients' psychological needs satisfaction in treatment, which was positively related to autonomous motivation and perceived dental competence for dental home care. Autonomous motivation, in turn, positively predicted perceived dental competence and was significantly directly related to the outcomes of fluoride use (positively) and

frequency of sugar consumption (negatively). In addition, autonomous motivation was also significantly indirectly positively linked—through perceived dental competence—to the use of dental floss, effort and quality of dental home care, and self-rated oral health. In addition to these significant paths, the fit indexes show that the overall model fit the data well.

The present sample is the second one in which self-regulation scales for dental behavior have shown the five-factor model of motivation types. In another sample (Halvari, Halvari, Bjørnebekk, & Deci, 2010), self-regulations for dental clinic treatment were tested. The two self-regulation scales were found to have similar factor structures, and the correlations among the five regulations in the two samples yielded the same simplex-like pattern. Future research should obtain a second sample of the SRDHCQ data to perform confirmatory factor analyses and to examine predictive validity in relation to SDT variables and dental behaviors.

One can see from the structural model that perceived competence significantly predicted three outcomes—namely, self-rated oral health, use of floss, and quality of home care—whereas autonomous motivation significantly predicted use of fluoride and frequency of sugar intake. No outcome was predicted significantly by both key motivation variables, as conveyed by a significant path coefficient from only one motivation variable to each outcome. It is likely that this is a result, at least in part, of the fact that there was a substantial amount of shared variance between these two motivation variables ($r = .59$). Further, Table 5 shows that three of the five outcomes were significantly correlated with both perceived competence and autonomous motivation, implying that some of the pattern of path coefficients in the structural model from motivation to outcome variables may be caused by suppression.

Still, some of the pattern may represent meaningful results. Specifically, only autonomous motivation was related (negatively) to sugar intake. It may very well be that substantially reducing sugar intake does, in particular, require the type of valuing and commitment that is represented in autonomous motivation, as it is a difficult task for many people to carry out, so not fully endorsing its importance would likely result in failure. In contrast, flossing regularly may depend primarily on feeling able to work it into one's life, and remembering to do it on a regular basis. Regular flossing may require less of the resolve that is represented by a direct effect of autonomous motivation, because one can build it into a daily routine, whereas controlling sugar is an ever-present challenge, which requires ongoing attention and resolve. Autonomous motivation may be important in developing the competence necessary to carry out dental flossing, but may not be as essential when the routine has been formed. The results indicate that this may be the case, because the bootstrapping procedure supported a significant indirect

effect of autonomous motivation on regular flossing through perceived competence (see Table 6, Item 7).

Autonomous motivation for dental home care partially mediated the positive link between needs satisfaction in treatment and perceived dental competence. The results indicate that autonomy-supportive dental professionals were important for patients' autonomous motivation for dental home care and, in turn, their perceived competence. This finding is supported by two other studies; namely, an intervention study for tobacco cessation (Williams et al., 2006), and an SDT process model test regarding glycemic control through diabetes self-management (Williams et al., 2004).

In the model, autonomous motivation led to perceived competence. This direction of influence between the two variables is also supported by other research (Kennedy et al., 2004; Williams et al., 2006). However, some research has supported the opposite direction for this link. Halvari and Halvari (2006) found that an autonomy-supportive intervention simultaneously predicted both perceived competence and autonomous motivation (with the link to perceived competence being stronger), and that perceived competence mediated the link between autonomy support and autonomous motivation. Other intervention studies have indicated that perceived-competence-related constructs changed first and affected change in motivation and behavior, with autonomous motivation playing the stronger role in long-term change (Palmeira et al., 2007; Teixeira et al., 2006).

These findings may be related to what are the more active components of the interventions; namely, contents intended to enhance either learning/competence or autonomous motivation. Theoretically, it may be difficult to develop competence without (self-)initiation of an activity. Conversely, it may be as problematic to choose and initiate an activity without knowing what to do or having the necessary competence. Thus, we tested the bidirectionality of this link in the present cross-sectional study, and the data continued to fit the model well. Future research should evaluate which parts of interventions are the more salient; specifically, whether they related to autonomy, competence, or relatedness. This may be a first step toward clarifying this controversy.

Autonomous motivation and perceived competence are most strongly correlated with SDT and behavior variables in the expected direction, whereas controlled motivation is weakly—and, in most cases, nonsignificantly—correlated with the same variables (see Table 5). Thus, perceived dental competence and autonomous motivation are the most important mediators of the links between need satisfaction in treatment and dental behaviors. In sum, the findings suggest that future interventions should focus more on autonomous than controlled types of regulations, because autonomous motivation is strongly correlated with other SDT-

related variables and dental behaviors. In addition, it seems important for treatments to focus on facilitating perceived dental competence.

Support for patient autonomy is a core goal in biomedical ethics (Beauchamp & Childress, 2001), in the process of informed decision making (Woolf et al., 2005), and in clinical medicine (American Board of Internal Medicine, 2002). SDT makes it possible to study autonomy support empirically in order to support this important goal. Zero-order correlations show that perceived clinic autonomy support and autonomous motivation for dental home care were each significantly correlated, in the expected direction, with all SDT-related variables and most dental-behavior and oral-health variables. A longitudinal study by Pelletier et al. (2004) supported these findings for relative autonomous motivation for eating and its prediction of healthy eating behaviors, including 26-week follow-up measures of calorie consumption from fat, blood cholesterol and triglycerides, and body weight. Thus, the present results and various other studies indicate that autonomy support, as opposed to control, matters greatly for improved oral health and related health issues.

In order to safeguard dental health, important, though tedious, dental behaviors must be correctly repeated at least twice a day, including using toothpaste with fluoride and dental floss; the frequency of sugar consumption must be regulated; and plaque and caries should be examined regularly, and perhaps treated by a dental professional. The results of the current study indicate that a controlling dental clinic context is strongly associated with thwarted satisfaction of patients' basic needs in treatment. This context is characterized by dental professionals who do not listen to their patients, relate to patients' teeth while not seeing the patients as people, and communicate teeth examination results to patients in a way that feels underestimating and humiliating. In turn, thwarted need satisfaction is related to diminished autonomous motivation and perceived dental competence, both of which are associated with lower scores on healthy dental behaviors and oral health.

Thus, if dental professionals were trained to be more autonomy-supportive and less controlling in delivering patient care and to better understand the importance of self-determination for dental-health behaviors, they could contribute to improved dental behaviors and development of oral health among their patients. In fact, Williams and Deci (1996) found that it is possible to train health professionals to be more autonomy-supportive. In a longitudinal field study, Halvari and Halvari (2006) found that when dental professionals were more autonomy-supportive, their patients were more autonomously motivated and felt more competent with respect to treatment, and evidenced better oral health outcomes. It is important to ally this to preventive dental work as well.

Some have argued that socioeconomic factors are more important for population health than are access to medical services, genetics, behavioral factors, or individual risk (e.g., Sreebny, 1983). This viewpoint has received some support from a literature review of 40 studies of children, in which 33 studies reported the most caries in low socioeconomic groups, 5 studies reported no differences in disease experience between the socioeconomic groups, and 2 studies reported a lower disease experience in low socioeconomic groups than in high socioeconomic groups (Carmichael et al., 1980). However, among students who pursue important educational life aspirations at the university, socioeconomic factors tend to be less important than in normal populations. Thus, in the present study, socioeconomic factors were of minor impact.

In addition to supporting SDT (Deci & Ryan, 1985, 2000), this is the first study to link autonomy support (relative to control) at the dental clinic to motivation for dental home care, dental behaviors, and oral health. Although the study has limitations associated with being cross-sectional, the strength of the correlations does convey the importance of these relations. Still, correlation strength is not enough to infer causality. Rather, it is important for there to be additional longitudinal studies using control variables or randomized controlled trials in the dental field.

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Appendix

Perceived Controlling Style at the Dental Clinic Questionnaire

1. When my teeth are being examined, I feel underestimated and humiliated.   **.73** (−.10)
2. My dental professional does not see me as a person; he/she sees only the teeth.   **.68** (−.29)
3. When I sit in the chair with my dental professional, I feel helpless.   **.57** (−.28)
4. I feel that the dental professional will do what he/she wants and does not listen to me when I sit in the chair.   **.66** (−.45)
5. I do not trust that my dental professional always does the best for me.   **.69** (−.37)
6. When I am with my dental professional, I feel a distance between us.   **.70** (−.36)
7. When I am with my dental professional, I often feel insufficient.   **.66** (−.21)
8. My dental professional is trying to change me, even if I don't want it.   **.68** (−.23)
9. I find that my professional decides too much.   **.73** (−.18)
10. I feel that my dental professional undervalues me/ignores me as a person.   **.67** (−.41)
11. At the dental office, I do not ask questions related to my own dental health (I keep pretty much to myself).   **.65** (−.22)
12. My dental professional does not speak to me in a nice way.   **.59** (−.42)
13. My dental professional does not safeguard my interests.   **.67** (−.40)

Note. A factor solution (maximum likelihood extraction and varimax rotation) of items intended to measure perceived controlling (13 items) and autonomy-supporting styles (14 items) at the clinic loaded on two factors. Total explained variance was 57.7%. The first factor was comprised of autonomy-support style items (eigenvalue after rotation = 8.65; explained variance = 32.0%), while the second factor was comprised of controlling style items (eigenvalue after rotation = 6.94; explained variance = 25.7%). Primary factor loadings for each control style item are presented in bold, along with its secondary factor loading on autonomy support in parentheses. Items 2 through 5 are similar to items in the Getz Dental Beliefs Survey (Smith, Weinstein, Milgrom, & Getz, 1984), but the scale used is different.