

Oral health and dental well-being: testing a self-determination theory model

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The enhancement of people's well-being is a central goal of the World Health Organization (WHO). Human health is defined not simply as the absence of disease but as a resource that can be enhanced by disease prevention and health promotion (WHO, 1986). The aims of health promotion are to strengthen the positive factors for health both at the individual and the community level. This includes social and competence support enabling individuals and groups to identify their expectations and goals, to satisfy their needs, to develop their knowledge, competence, and understanding of health, and to be actively involved in cooperation with health-care professionals, so that they willingly initiate healthy activities for their own well-being (WHO, 1986).

A recent study tested a self-determination theory (SDT; Deci & Ryan, 2000) process model in relation to outcomes as oral self-care and dental clinic attendance (Halvari, Halvari, Bjørnebekk, & Deci, 2010). Based on the interesting results from this study, the aim of the present study was to test if a similar model predicts oral health and dental well-being. In this model, patients' perceptions of autonomy-supportive (relative to controlling) dental professionals were expected

Abstract

This study tested a self-determination theory (SDT) process model of oral health and subjective dental well-being. The results showed that: (1) patients' perceptions of autonomy-supportive dental professionals were significantly positively predictive of patients' psychological needs satisfaction in treatment; (2) needs satisfaction was significantly related to perceived dental competence (positive), autonomous motivation (positive), and controlled motivation (negative) for dental care; (3) perceived competence was significantly positively, and controlled motivation was significantly negatively associated with self-rated oral health and oral-health-related quality of life; (4) autonomous motivation for dental treatment was significantly positively associated with valuing continued dental treatment; and (5) the three oral-health-related variables were all significantly positively linked to subjective dental well-being. A structural equation model supported the SDT process model.

to be positively associated with patients' psychological needs satisfaction in treatment, which was expected to be positively related to autonomous motivation for dental treatment and perceived dental competence, and negatively related to controlled motivation for dental treatment. In turn, the three motivation variables were distinctively expected to be associated with specific oral-health-related variables, which were expected to be positively linked to subjective dental well-being.

Subjective well-being is defined as what makes experiences and life pleasant as opposed to unpleasant (Kahneman, Diener, & Schwarz, 1999). The attainment of positive affect and an absence of displeasure is a hedonic conception of well-being and defined as a specific *outcome* in research (Ryan, Huta, & Deci, 2008). In empirical research, the subjective well-being index has been used. This index reflects the presence of positive affect and life satisfaction, and the absence of negative affect (Diener & Lucas, 1999). In the present study, we used subjective dental well-being as an outcome measure. Such situation and domain-specific subjective well-being have been used in relation to specific tasks designed to elicit

positive and negative affects, as well as end-of-study overall satisfaction with this experience (Bjørnebekk, 2009; Updegraff, Gable, & Taylor, 2004). Situational- and contextual-based experiences and judgments as related to recent positive and negative events (Suh, Diener, & Fujita, 1996) and social comparisons (Lyubomirsky & Ross, 1997) reflect more of a “bottom-up” influence on subjective well-being than a “top-down” influence (e.g., personality factors). Thus, subjective dental well-being is supposed to reflect positive and negative dental health experiences and evaluation of them. According to the SDT model defined, motivation variables were expected to be indirectly linked to subjective dental well-being through three oral-health-related measures, namely (1) self-rated oral health; (2) oral-health-related quality of life (OHRQL); and (3) valuing continued dental treatment.

First, self-rated oral health is intended to reflect clinically assessed oral health factors (Atchison et al., 1993; Jamieson, Mejía, Slade, & Roberts-Thomson, 2009; Matthias, Atchison, Lubben, De Jong, & Schweitzer, 1995; Ostberg, Eriksson, Lindblad, & Halling, 2003; Pattussi, Olinto, Hardy, & Sheiham, 2007). Measures of well-being that have been linked to self-rated oral health are not only specific types of dental satisfactions and positive and negative affects, but also other indications of well-being such as distress, depression, anxiety, life functioning, emotional stability, and mental health. Self-rated oral health has been positively related to psychological well-being, life satisfaction, and self-esteem (Benyamini, Leventhal, & Leventhal, 2004; Locker, 2009; Locker, Clarke, & Payne, 2000), whereas life stress and depression have been negatively linked to self-rated oral health (Locker, 2009). Dental-related measures of well-being shown to be positively related to self-rated oral health are satisfaction with oral health status (Locker & Gibson, 2005), longitudinal change in satisfaction with dental appearance based on recovery from oral health problems (Meng, Gilbert, & Litaker, 2008), and satisfaction with chewing ability (Meng & Gilbert, 2007). In addition, impaired self-rated oral health status has been associated with affective and self-esteem instability, and anger (Dumitrescu, Dogaru, & Dogaru, 2008).

Second, OHRQL reflects people’s perception of the social impact of oral disorders on their well-being (Slade, 1997). This construct is also considered an important indicator of oral health because poor OHRQL is shown to be associated with missing teeth, untreated decay, periodontal attachment loss, and barriers to dental care (Jamieson et al., 2009; Slade, 1997; Slade & Spencer, 1994). A dental-specific measure of well-being used is happiness of dental appearance shown to be positively related to OHRQL (Tsakos, Bernabé, O’Brien, Sheiham, & de Oliveira, 2008). General indicators of subjective well-being linked to OHRQL are subjective well-being, life satisfaction, and mental health (positive) and depression (negative) (Baker, Pankhurst, & Robinson, 2007; Jensen,

Saunders, Thierer, & Friedman, 2008; Locker, Matear, Stephens, & Jokovic, 2002; Locker, Matear, Stephens, Lawrence, & Fayne, 2001; Masalu & Åström, 2002). OHRQL has also been positively associated with positive affect and negatively linked to negative affect (Brennan, Singh, Spencer, & Roberts-Thomson, 2006). One of the OHRQL subfactors is dental pain, which has been positively associated with affective distress and disturbances of daily life functioning and emotional instability (Edwards et al., 1999; Goes, Watt, Hardy, & Sheiham, 2008; Yan, McMillan, Wong, Jun, & Lam, 2007), and to dental-specific anxiety (Litt, 1996; Oliveira & Colares, 2009) and affective instability (Dumitrescu et al., 2008).

Third, dental treatment in most cases is not enjoyable or intrinsically motivated (Halvari et al., 2010) but can be endorsed freely and willingly (i.e., autonomously) by the patient, and engaging in dental health behaviors can be intrinsically valued (Ryan et al., 2008). Due to this, we chose to include a third health-related construct in the present study defined as intrinsically valuing continued dental treatment. The pursuit of such health-promoting behavior has been shown consistently to be positively associated with subjective well-being (Kasser & Ryan, 2001; Vansteenkiste, Lens, & Deci, 2006; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Patients’ positive values and beliefs toward dentists and dental treatment have been shown to be positively associated with specific satisfaction of dental care and visits (Chaffin, Chaffin, Mangelsdorff, & Finstuen, 2007; Skaret, Berg, Raadal, & Kvale, 2005). In other fields, positive treatment attitudes (i.e., values and expectations) have been robust in predicting intentions to seek treatment (Elhai, Voorhees, Ford, Sam Min, & Frueh, 2009), which may be a first step toward better well-being. This may be the case because more positive treatment values or attitudes, and a strong treatment alliance (including social support) between patients and clinicians, have been longitudinally associated with greater medication adherence, and subsequent improvements in health (e.g., reduced depression) and community functioning (Mohamed et al., 2009; Strauss & Johnson, 2006; Wenzel, Jeglic, Levy-Mack, Beck, & Brown, 2008).

Based on the above literature review, and clinical experience, patients express a wide range of different positive and negative affects, and judgment of satisfactions, in relation to their teeth. Clinical examples are patients who feel proud of their teeth, determined and active in relation to oral care, and who evaluate their teeth as being healthy and fine. On the other hand, people who experience dental pain, untreated dental decay, gum inflammation (periodontitis), dental treatment avoidance, or other dental problems often express negative affects as being distressed (Edwards et al., 1999; Yan et al., 2007), upset (Bae, Kim, Paik, & Kim, 2006), fearful or afraid (Chanpong, Haas, & Locker, 2005; Jamieson et al.,

2009), irritable, grumpy, and bad tempered (Bae et al., 2006; Pau, Croucher, & Marcenes, 2008), angry (Dumitrescu et al., 2008), guilty and ashamed (Trulsson, Engstrand, Berggren, Nannmark, & Brånemark, 2002), and anxious or nervous (Jamieson et al., 2009; Oliveira & Colares, 2009; Skaret, Berg, Kvale, & Raadal, 2007). Thus, dental experiences seem related to almost all negative affects as defined in the positive and negative affect schedule (PANAS) (Watson, Clark, & Tellegen, 1988).

Based on the SDT process model (Deci & Ryan, 2000; Ryan & Deci, 2000) described in the beginning of this introduction, we now review the literature related to the sequencing of variables in the model leading to the defined dependent health-related and well-being variables. We start with the autonomy-supportive clinic context and its links with subsequent variables. In the same manner, we continue with considering psychological needs satisfaction and motivation variables, and finalize the literature review by describing the integrated SDT process model with hypotheses.

Autonomy support (relative to a controlling style), needs satisfaction, motivation, health, and well-being

Autonomy-supportive contexts are defined as “ones in which significant others offer choice, provide a meaningful rationale, minimize pressure, and acknowledge the target individual’s feelings and perspectives” (Williams, Grow, Freedman, Ryan, & Deci, 1996, p. 117). According to SDT (Ryan & Deci, 2000), autonomy support is hypothesized to yield intrinsic needs satisfaction, which is expected to be important for human development, healthy functioning, and psychological well-being. Several studies attest to the importance of autonomy support for intrinsic needs satisfaction, autonomous motivation, and well-being among students (Downie et al., 2007; Kasser, Ryan, Zax, & Sameroff, 1995; Williams, Cox, Hedberg, & Deci, 2000) and young adults in dental treatment (Halvari, Halvari, Bjørnebekk, & Deci, 2012). In addition, an autonomy-supportive informational clinic intervention (Halvari & Halvari, 2006) increased patients’ perceived dental competence and autonomous motivation for dental treatment, improved dental health over a 7-month period, and resulted in a more positive affect at the end of the time period, which can be viewed as an indicator of well-being. Conversely, a cross-sectional study (Halvari et al., 2012) indicated that a perceived controlling style, relative to an autonomy-supportive style, provided by dental professionals was associated with low needs satisfaction in treatment, low scores on perceived dental competence and autonomous motivation for oral self-care, and low scores on self-rated oral health—which in the present study is modeled to predict subjective dental well-being.

Needs satisfaction, motivation, health, and well-being

Three basic psychological needs 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 are theorized to satisfy these needs, and provide nutrients for the development of more autonomous motivation through internalization and integration. Satisfaction of the need for competence results from effective behavior that leads to intended outcomes (e.g., White, 1959); satisfaction of the need for autonomy follows from experiences of choice and perceptions of self-initiation (e.g., de Charms, 1968); and satisfaction of the need for social relatedness is prompted by perceptions of being securely attached to and understood by others (e.g., Baumeister & Leary, 1995).

Several studies have yielded support for a direct positive link between psychological need satisfaction and various mental and physical health indications among employees in organizations (Baard, Deci, & Ryan, 2004; Deci et al., 2001), among young athletes in sport (Reinboth, Duda, & Ntoumanis, 2004), and among college students at the between-person level (Sheldon & Elliot, 1999; Sheldon & Niemiec, 2006) and the within-person level (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000). A recent oral health study indicated that need satisfaction among patients was linked to high perceived dental competence and autonomous motivation for oral self-care, and to high scores on self-rated oral health (Halvari et al., 2012).

Motivation for treatment, oral health, and well-being

According to SDT (Deci & Ryan, 2000), when people are autonomously motivated, they experience a sense of choice and volition in the regulation of their behavior, and they feel as though the behavior emanates from their sense of self. In the psychological tradition of attribution theory, the behavior is said to have an internal perceived locus of causality (de Charms, 1968). In contrast, when controlled in their motivation, people experience the behavior as being coerced or seduced by interpersonal or intrapsychic forces. Thus, the behavior has an external perceived locus of causality—that is, it is external to their sense of self.

A sample of studies has indicated that autonomous motivation was positively correlated with well-being among students (Huta & Ryan, 2006) and elite athletes (Solberg & Halvari, 2009). In addition, students making progress on goals pursued for more autonomous than controlled motivation led to increased well-being (Sheldon & Kasser, 1998). In line with this study, the effects of relative autonomous motivation for goals were shown to predict both concurrent and longitudinal changes in well-being (Sheldon, Ryan, Deci, &

Kasser, 2004). Other studies have attested longitudinally to the importance of autonomous types of motivation for changes in well-being among students (Sheldon & Elliot, 1999) and the general population (Ratelle, Vallerand, Chantal, & Provencher, 2004).

Regarding the intrinsic value of an activity (e.g., dental treatment), the research has consistently attested its positive links with both autonomous motivation and well-being (Chaffin et al., 2007; Vansteenkiste et al., 2004, 2006). Thus, autonomous motivation for dental treatment was expected to be positively associated with valuing continued treatment, which was expected to be positively linked to subjective dental well-being. The rationale for these expectations is research, indicating that well-being is enhanced most when valued behavior is concordant with relative autonomous motivation (Sheldon & Elliot, 1999).

Dental treatment may be negatively stressful and aversive, and the literature indicates that approach-motivated people (Updegraff et al., 2004) and those highly extraverted (Affleck & Tennen, 1996) may “find benefits” as a result of coping with negative events, which is related to greater well-being than those who do not (Davis, Nolen-Hoeksema, & Larson, 1998; Updegraff, Taylor, Kemeny, & Wyatt, 2002). These results may apply for autonomously motivated people as well, because extraversion is shown clearly linked to self-regulation defined as “a flexible autonomous, functional way of solving problems and getting over difficulties” (Grossarth-Maticek & Eysenck, 1995, p. 792). Autonomous self-regulation is further characterized by positive actions to solve problems and well-being seeking behavior among patients (Marqués, Ibáñez, Ruipérez, Moya, & Ortet, 2005), which may be reflected by valuing continued dental treatment because they “find benefits” in it. This health promotion type of self-regulation has been shown to be negatively associated with vulnerability to develop a disease among healthy people, and has prospectively been negatively linked to death among patients with cancer, coronary heart disease, and other diseases (Grossarth-Maticek & Eysenck, 1995). Regarding indications of well-being, autonomous behavior has been negatively associated with autonomic, cognitive, and state types of anxieties, alienation, physical exhaustion, depression tendencies, and state and trait anger (Grossarth-Maticek & Eysenck, 1995).

Regarding controlled motivation, we have not detected any studies of its relations with valuing dental treatment. However, controlled motivation involves both approach and avoidance behaviors. Examples are patients who feel that they have to visit the dentist in order to feel good (approach), or do it in order to avoid feelings of guilt and shame (avoidance). According to Updegraff et al. (2004), avoidance motivation seems to be linked to well-being through direct emotional reactivity to negative events (e.g., experience of dental pain). Both guilt and shame have been positively related to dental pain and other indications of poor OHRQL, and to bad

dental status (Trulsson et al., 2002). Thus, controlled motivation for dental treatment may be indirectly related to subjective dental well-being through self-rated oral health and OHRQL. Simultaneous feelings of guilt and low autonomy, which may indicate controlled motivation, have been related to pain (Johansson, Almay, Von Knorring, Terenius, & Aström, 1979). Further, indicators of external control of dental behaviors have been positively linked to dental and gum inflammation (Borkowska, Watts, & Weinman, 1998) and dental plaque (i.e., bacteria; Wolfe, Stewart, & Hartz, 1991). Other studies have shown that goals pursued for more controlled than autonomous reasons predicted decreases in well-being (Sheldon & Kasser, 1998; Sheldon et al., 2004). These studies may therefore support hypotheses of negative correlations between controlled motivation and, respectively, OHRQL, self-rated oral health, and dental well-being.

The SDT motivation variable called perceived competence has been strongly positively associated with self-rated oral health (Dumitrescu, Toma, & Lascu, 2009; Halvari et al., 2012). A study among students has shown that a broad school-based dental competence-related education program reduced dental plaque and improved oral health (Luis et al., 2008). Perceived competence is theoretically described by feelings of confidence in mastery of target activities (Deci & Ryan, 2000). Therefore, perceived dental competence may involve perceived control over aversive treatment events, which has been shown to influence the level of acute pain experienced during stressful clinical procedures (Gedney & Logan, 2007), and toothache experiences (Dumitrescu et al., 2009) that are conceived as an OHRQL subfactor. Perceived competence-related constructs have also negatively predicted loss to follow-up in long-term periodontal treatment (Kakudate et al., 2010) and, positively predicted patient completion of periodontal treatment (Kakudate, Morita, & Kawanami, 2008), which is supposed to be associated with valuing continued dental treatment.

Thus, there are research-based reasons to expect perceived competence to be positively linked to self-rated oral health, OHRQL, and valuing dental treatment. Controlled motivation is expected to be negatively linked to the two health evaluation measures (i.e., self-rated oral health and OHRQL), whereas autonomous motivation is expected to be positively associated with valuing continued dental treatment.

The SDT process model of oral health and well-being

In order to illustrate research on the SDT oral health and well-being process model, we present some studies linking autonomy support, autonomous motivation, and perceived competence to improvements in various health behavior and outcomes. Although well-being is not always studied directly in these studies, goal progress on activities performed for

autonomous reasons has consistently been shown to lead to psychological well-being (Sheldon & Elliot, 1999; Sheldon & Kasser, 1998; Sheldon et al., 2004). Research has highlighted the importance of autonomy-supportive patient care for (1) increases in autonomous motivation and perceived competence for participating in a weight-loss program, which affected better attendance and subsequent long-term maintained weight loss (Williams et al., 1996); (2) facilitating autonomous motivation for taking medications, which in turn led to patients' medication adherence (Williams, Rodin, Ryan, Grolnick, & Deci, 1998); and (3) enhancement of autonomous motivation and perceived competence for diabetes self-management and improved glycemic control for patients with type 2 diabetes (Williams, McGregor, Zeldman, Freedman, & Deci, 2004). In addition, as already described above, a recent study in the dental field provided support for the SDT process model of change in motivation, behavior, and health (Halvari & Halvari, 2006).

In the present study, based on the literature reviewed, we used the SDT process model (Deci & Ryan, 2000; Ryan & Deci, 2000) and tested the following hypotheses: (1) patients' perceptions of autonomy-supportive (relative to controlling) dental professionals were expected to be positively associated with psychological needs satisfaction among patients in treatment; (2) psychological needs satisfaction was expected to be positively related to perceived dental competence and autonomous motivation for dental treatment, and negatively related to controlled motivation for dental treatment; (3) perceived dental competence was expected to be positively associated with the three dental health variables, namely self-rated oral health, OHRQL, and valuing continued dental treatment; (4) controlled motivation was expected to be negatively associated with self-rated oral health and OHRQL; (5) autonomous motivation for dental treatment was expected to be positively related to valuing continued dental treatment; (6) the three dental health variables were expected to be positively associated with the subjective dental well-being outcome, and finally, as a theoretical consequence; and (7) the motivational variables were expected to be indirectly related to subjective dental well-being through dental health-related variables. The seventh hypothesis was based on work by Ryan et al. (2008) which conceived subjective well-being as an outcome variable, and was supported by many studies in the introduction literature review indicating positive links between the three oral-health-related variables and well-being.

Method

Participants

Students at the University of Oslo and at the Police University College of Oslo were contacted after various classes and asked

if they could participate in the survey. A total of 357 questionnaires were handled out and 208 were returned (58.3%). Participants' ages ranged from 20 to 36 years ($M = 25.4$, $SD = 3.5$). More women than men responded to the questionnaire (female = 76.9%). These participants are the same as used in a recent study (Halvari et al., 2010), but the present article extends previous work by adding four new oral-health-related and dental well-being variables. More information about the sample is given elsewhere (Halvari et al., 2010).

Assessment of perceived autonomy support and control at the clinic

Perceived autonomy support was measured with the six-item short version of the Health-Care Climate Questionnaire (HCCQ; Williams et al., 1996). Before the participants responded to the items in the HCCQ, and other items in the questionnaire package, they were introduced to their own clinic context by 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 demographic-related questions about this dental professional (a dental hygienist or a dentist, female or male), the number of visits to this dental professional, type of clinic (private or public), time since last visit, and number of visits during the last 2 years. Then they read, "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." The HCCQ assesses participants' perceptions of the degree to which their dental professionals were autonomy supportive at the clinic. They responded to the items on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale. A sample item is: "I feel that my dental professional has provided me choices and options." The reliability coefficient for the HCCQ was acceptable ($\alpha = .89$). For more HCCQ psychometric information, see Halvari et al. (2010).

Perceived controlling style was measured with the 14-item Perceived Controlling Style at the Dental Clinic Questionnaire (Halvari et al., 2012). Sample items are: (1) "I feel that the dental professional will do what he/she wants and not listen to me when I sit in the chair" (threatened autonomy); (2) "When my teeth are being examined, I feel underestimated and humiliated" (threatened competence); and (3) "My dental professional does not see me as a person, he/she sees only the teeth" (threatened social relatedness). Participants responded to the items on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale. The reliability coefficient was .93. In a recent study, this scale yielded good internal consistency, and its correlations with intrinsic needs satisfaction, and

both motivational and oral-health-related variables were as expected according to SDT (Halvari et al., 2012).

Assessment of basic psychological needs at the clinic

Basic psychological needs satisfaction was measured with the Basic Psychological Need Satisfaction in Exercise Scale (Vlachopoulos & Michailidou, 2006), adapted to the dental clinic domain by Halvari et al. (2010). It consists of nine items intended to measure satisfaction of the three basic needs for competence, autonomy, and social relatedness, with three items each. Participants responded to the items following this stem: "When you are in dental treatment, how untrue or true are the following statements?" Sample items are: "I feel that I associate with my dental professional in a friendly/pleasant way" (relatedness need); "I feel that I can manage with the requirements of my dental treatment" (competence need); and "I feel that having the treatment or examination of my teeth is definitely an expression of my wishes" (autonomy need). Participants indicated how true each item was for them on a 7-point scale varying 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. The reliability coefficient for total needs satisfaction was .91. Recently, two studies in Norway indicated good psychometric attributes for this scale among elderly people participating in a physical activity trial (Solberg, Halvari, & Ommundsen, 2009) and among young adults in an oral health study (Halvari et al., 2010).

Assessment of autonomous and controlled motivations for treatment

Motivation for treatment was measured with the Self-Regulation Questionnaire for Dental Treatment (SRQDT; Halvari et al., 2010). The scale comprises six items for each of the subscales for autonomous and controlled motivations for treatment. Participants responded to the items following two stems: "I decided to enter treatment at my dental professional because: . . ." and "If I remain in treatment it will probably be because: . . ." using a 7-point scale ranging from 1 (*not true at all*) to 7 (*very true*). Two sample items for autonomous motivation are: (1) "Going to treatment has become a natural habit for me," and (2) "I experience going to treatment as personally important." Sample items for controlled motivation are: (1) "I'll feel bad about myself if I don't do it" and (2) "I don't want my dental professional to tell me how badly I care for my teeth." Items were averaged within subscales to reflect autonomous and controlled motivations. Reliabilities were good for autonomous ($\alpha = .93$) and controlled ($\alpha = .86$) motivations. For more psychometric SRQDT information, see Halvari et al. (2010).

Assessment of perceived dental competence

Perceived dental competence was measured with the Perceived Competence Scale (PCS), 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 1 (*strongly disagree*) to 7 (*strongly agree*) scale. 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. The internal consistency coefficient was .89. More psychometric information for the PCS is presented elsewhere (Halvari et al., 2012; Williams, Freedman, et al., 1998).

Assessment of self-rated oral health

Self-rated oral health was measured with two questions. The first is from the 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?" Participants responded to the questions on a 5-point scale ranging from 1 (*bad*) to 5 (*excellent*). The items were averaged to reflect self-rated oral health. The reliability coefficient was .90. More psychometric information about this scale is given by Halvari et al. (2012).

Assessment of OHRQL

Dimensions of OHRQL were assessed using the 21-item oral health impact profile (John et al., 2004). Participants were asked how frequently they had experienced each of several impacts during the last year. Examples of impacts are: "less tolerant of others" and "unable to work" (psychosocial factor); "toothache" and "painful gums" (pain factor); and "problems affected my appearance" and "worried about appearance" (appearance factor). The participants responded to each impact on a 5-point scale with the following alternatives: 5 (*never*), 4 (*almost never*), 3 (*sometimes*), 2 (*quite often*), and 1 (*very often*). High scores reflect a high OHRQL (i.e., low impacts). The items were averaged within subscales to reflect OHRQL and its subdimensions. The internal consistency coefficient was .85 for the total OHRQL score.

Assessment of valuing continued dental treatment

Intrinsically valuing continued dental treatment was measured with three questions related to the following stem: "If I continue in treatment it will probably be because . . ." using a 7-point scale ranging from 1 (*not true at all*) to 7 (*very true*). Two sample items are: (1) "Because I have good feelings in relation to continuing" and (2) "Because I like to have my

teeth cleaned/cared about.” The items were averaged to reflect the intrinsic value of improving one’s health. The alpha coefficient was .85.

Assessment of subjective dental well-being

Subjective well-being was assessed using the 20-item PANAS (Watson et al., 1988) and six items from the Students Life Satisfaction Scale (SLS; Huebner, 1991) adapted to the dental domain. In the PANAS, participants responded to positive mood adjectives such as “proud” and “interested” and to negative mood adjectives such as “distressed” and “upset.” A sample item for SLS is: “My teeth are absolutely fine.”

The PANAS was administered with the instruction: “Regarding your teeth, to what degree have you felt each of the following during the last 4 weeks?” Each adjective was responded to on a scale ranging from 1 (*not at all*) to 7 (*very much*). The SLS was administered with the instruction: “How often during the last 4 weeks have you been thinking each of the following?” Each statement was responded to by using a scale ranging from 1 (*never*) to 5 (*almost always*). The items for each factor were summed and divided by the number of items to reflect the variables: dental satisfaction, positive dental affect, and negative dental affect. Finally, we reduced the well-being data by creating a set of aggregate subjective well-being measures (Brunstein, 1993). In this procedure, the three well-being scores were standardized and then we subtracted negative dental affect ($\alpha = .94$) from the sum of positive dental affect ($\alpha = .92$) and dental satisfaction ($\alpha = .91$).

Results

Factor analysis of items in oral-health-related and subjective dental well-being variables

An *a priori* maximum likelihood factor analysis with oblique rotation of the 20 positive and negative affect items and the six dental satisfaction items revealed high cross-loadings between the negative affect factor and two negatively worded (reversely coded) dental satisfaction items. These two items were omitted and the next factor analysis yielded three factors: dental satisfaction, and positive and negative dental affects.

Many of the items in the OHRQL scale were highly positively skewed. Due to this, we accepted a somewhat higher skew and omitted four items with a skewness value higher than 4.0, a cut-point used by Kline (2005), and log transformed each of the remaining items. This procedure resulted in more acceptable skew results (see Table 2), which were used in subsequent analyses. An *a priori* factor analysis yielded two item loadings lower than .40, and three items with high cross-loadings, which were omitted. The next factor

analysis of the remaining 12 items revealed three factors: psychosocial, appearance, and pain impacts.

Because the oral-health-related and dental well-being variables have been significantly intercorrelated in previous research (Acharya, Bhat, & Acharya, 2009; Brennan et al., 2006; Jamieson et al., 2009), a factor analysis was conducted in order to test their convergent and divergent validity. The factor solution is presented in Table 1. Total explained variance was 64.75%. The analysis yielded eight factors as expected: (1) negative dental affect; (2) positive dental affect; (3) psychosocial impacts (quality of life); (4) dental satisfaction; (5) valuing treatment; (6) pain impacts (quality of life); (7) appearance impacts (quality of life); and (8) self-rated oral health.

Descriptive statistics and reliability

Table 2 shows the means, standard deviations, ranges, skewness values, and reliabilities for all variables. The scores for controlling style and negative dental affect are distributed around a low mean ($SD = 1$ below scale midpoint), whereas the scores for OHRQL are distributed around a high mean ($SD = 1$ above scale midpoint). The scores for other variables are distributed around a moderate mean. Relatively high levels of internal consistency (Cronbach’s alpha) emerged.

Correlations for SDT- and oral-health-related variables and dental well-being measures

Self-rated oral health and subjective dental well-being were both significantly correlated with all SDT-related variables, except there was one nonsignificant correlation between autonomous motivation for treatment and self-rated oral health (see Table 3). Total OHRQL was also significantly associated with all SDT-related variables, except the nonsignificant correlations with autonomy support and autonomous motivation. Valuing continued dental treatment was significantly correlated with autonomy support, needs satisfaction, and motivation variables, but it was not significantly associated with a perceived controlling style. All predicted associations were significant in the expected direction.

Hypothesis testing of relations in the SDT process model

Theoretical model

The hypotheses concerned the relations among variables summarized at the end of the introduction, including mediated processes that appear in Figure 1. The relevant results begin with a correlation matrix (Table 3) among all variables. The zero-order correlations are all in line with the hypotheses. Next, we examined the SDT process model (Figure 1) using structural equation modeling (LISREL). We subsequently examined mediations.

Table 1 Oral-Health-Related and Dental Well-Being Items and Their Primary and Secondary Factor Loadings ($n = 208$)

Items	Factor							
	1 NDA	2 PDA	3 P-S QL ^a	4 DS	5 Valuing treatment	6 Pain quality ^a	7 Appearance quality ^a	8 S-ROH
1. Distressed	.71					-.19		
2. Upset	.74	.17						
3. Guilty	.71			-.23				
4. Scared	.81			-.19				
5. Angry	.68	.20						
6. Irritable	.74					-.16		
7. Ashamed	.66						-.23	
8. Nervous	.77					-.14		
9. Jittery	.75		-.22					
10. Afraid	.75		-.24					
11. Interested		.52			.36			
12. Excited		.59			.32			
13. Strong		.67			.29			
14. Enthusiastic		.67			.29			
15. Proud		.67		.24				
16. Ready/Concentrated	.23	.69						
17. Inspired	.19	.71						
18. Determined		.81			.10			
19. Attentive	.18	.76						
20. Active		.84					-.08	
21. Less tolerant of others			.72			.24		
22. Irritable with others	-.22		.76					
23. Difficulty doing jobs	-.20		.84					
24. Unable to function	-.26		.70					
25. Unable to work	-.17		.61					
26. It goes well with my teeth	-.22			.83				
27. My teeth are absolutely fine	-.21			.83				
28. I feel well with my teeth	-.19			.75				
29. I have the teeth I want		.19		.73				
30. . . .glad to continue treatment		.28			.78			
31. . . .like to have my teeth cleaned		.34			.73			
32. . . .like to continue treatment		.29			.70			
33. Painful aching	-.21					.81		
34. Toothache	-.19					.70		
35. Painful gums	-.18					.51		
36. Sore gums	-.19					.48		
37. Problems affected appearance			.34				.59	
38. Worried about appearance	-.40						.77	
39. Uncomfortable about appearance	-.40						.78	
40. Self-rated dental health "now"	-.34							.69
41. Dental health related to others	-.31							.79
Eigenvalue	6.72	5.59	3.34	3.09	2.21	2.14	1.99	1.46
Explained variance, R^2 (%)	16.38	13.63	8.16	7.52	5.40	5.22	4.86	3.57

Note. NDA = negative dental affect; PDA = positive dental affect; P-S QL = psychosocial quality of life; DS = dental satisfaction; S-ROH = self-rated oral health. Primary factor loadings are in bold. The stem for DS is: "How often during the last 4 weeks have you been thinking?" The stem for PDA and NDA is: "Regarding your teeth, to what degree has you felt during the last 4 weeks?" The stem for QL-items is: "How often during the last year have you experienced the following impact due to your teeth, gums or mouth condition?"

^aLow scores = high negative psychosocial, pain, and appearance impacts.

Table 2 Descriptive Statistics for Social-Contextual, Motivation, Oral-Health-Related, and Dental Well-Being Measures ($n = 208$)

Variables	<i>M</i>	<i>SD</i>	Observed range	Skew ^a	Cronbach's alpha
Autonomy-supporting style	4.78	1.24	2.0–7.0	–0.15	.89
Controlling style	2.00	1.05	1.0–6.6	1.36	.93
Competence need	4.67	1.24	1.0–7.0	–0.34	.75
Autonomy need	5.08	1.25	2.0–7.0	–0.22	.88
Social relatedness need	5.27	1.38	1.0–7.0	–0.57	.88
Total need satisfaction in treatment	5.01	1.12	2.0–7.0	–0.34	.91
Perceived dental competence	5.05	1.25	1.3–7.0	–0.49	.89
Autonomous motivation for treatment	3.75	1.38	1.0–6.7	0.03	.93
Controlled motivation for treatment	2.48	0.90	1.0–5.0	0.54	.86
Self-rated oral health	3.35	0.91	1.0–5.0	–0.09	.90
OHRQL ^b :RLONI, pain	4.41	0.60	1.8–5.0	–1.20/–0.72	.75
OHRQL ^b :RLONI, appearance	4.54	0.81	1.0–5.0	–2.40/–1.49	.85
OHRQL ^b :RLONI, psychosocial	4.79	0.45	1.6–5.0	–3.48/–2.55	.86
OHRQL ^b :RLONI, total	4.58	0.46	2.2–5.0	–2.31/–1.72	.85
Value treatment	3.80	1.33	1.0–6.9	0.11	.85
Dental satisfaction	2.57	0.88	1.0–4.0	0.10	.91
Positive dental affect	2.68	1.07	1.0–5.8	0.44	.92
Negative dental affect	2.17	1.14	1.0–6.6	1.32	.94
Subjective dental well-being	0.06	2.60	–8.0–5.8	–0.35	—

Note. ^aSkew values for OHRQL measures after slash are based on log-transformed items.

^bHigh scores on OHRQL and its subfactors indicate low negative impacts, as exemplified by this 5-point scale: 5 (*never experienced the last year*), 4 (*almost never*), 3 (*sometimes*), 2 (*quite often*), and 1 (*very often experienced the last year*).

OHRQL = oral-health-related quality of life; RLONI = relative lack of negative impacts.

Structural equation modeling

We examined the SDT process model (Figure 1) using structural equation modeling (LISREL). Due to the large number of indicators (items) in relation to the sample size, the SDT process model was tested on the basis of a combination of one observed variable and eight latent variables. The latent variables were represented by indicators representing the construct, or items having the highest factor loadings and the lowest error correlation magnitudes for each construct (see factor loadings in Figure 1). The error variance for the observed variable subjective dental well-being was set to 15% of the squared standard deviation for the variable. The latent composite variable of autonomy supportive relative to controlling styles reflects the averaged sum of six autonomy support items minus the averaged sum of 14 controlling items. Because the three psychological needs were highly correlated we used them as indicators of total need satisfaction. OHRQL was composed of psychosocial, appearance, and pain impacts. In the evaluation of fit indices we used the chi-square likelihood ratio (X^2), the root mean square error of approximation (RMSEA), the comparative fit index (CFI), the incremental fit index (IFI), and the standardized root-mean-square residual (SRMR), as recommended for evaluating 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 the RMSEA, a value close to or lower than

.08 for the SRMR, and a value close to or higher than .95 for the CFI and IFI. However, values for RMSEA lower than .10 and for CFI and IFI above .90 are considered acceptable (Browne & Cudeck, 1993). Hu and Bentler (1999) compared all fit indices and found that the SRMR is most sensitive to misspecification in both simple and complex models and less sensitive to sample size and violations of distributional assumptions. In the evaluation of 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 at small sample size (<250) and thus is less preferable for the sample size of 208 in the present study (Hu & Bentler, 1999).

Empirical models

Before we tested the structural model, the measurement model was tested with all variables and indicators depicted in Figure 1 and found to fit the data well for the SRMR, CFI, and IFI, whereas the RMSEA was borderline, $X^2(df = 174, n = 208) = 533.45, p < .001$; SRMR = .071; CFI = .93; IFI = .93; RMSEA = .10. Modification indices suggested improvements of this measurement model by adding error covariances between an item for self-rated oral health and respectively autonomy support (positive) and subjective dental well-being (positive), between an autonomous motivation item and respectively a controlled motivation item (negative) and the psychosocial dimension of oral health

Table 3 Pearson Correlations Among Variables (*n* = 208)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1. Autonomy-support	—																			
2. Controlling style	-.57	—																		
3. Competence need	.47	-.50	—																	
4. Autonomy need	.65	-.60	.64	—																
5. Social relatedness need	.63	-.62	.49	.75	—															
6. Total needs satisfaction	.68	-.67	.81	.92	.88	—														
7. Perceived competence	.36	-.38	.65	.43	.37	.55	—													
8. Autonomous motivation	.17	.03	.44	.30	.17	.35	.23	—												
9. Controlled motivation	-.14	.34	-.14	-.15	-.16	-.18	-.25	.37	—											
10. Self-rated oral health	.21	-.24	.48	.27	.18	.35	.56	.08	-.26	—										
11. OHRQL:RLONI, pain	.06	-.21	.21	.09	.13	.16	.32	-.09	-.22	.30	—									
12. OHRQL:RLONI, appearance	.05	-.26	.17	.15	.14	.18	.29	-.09	-.24	.29	.30	—								
13. OHRQL:RLONI, psychosocial	.10	-.16	.07	.18	.15	.15	.16	-.03	-.09	.24	.27	.55	—							
14. OHRQL:RLONI, total	.09	-.29	.21	.18	.19	.22	.35	-.08	-.25	.36	.72	.81	.75	—						
15. Value treatment	.18	-.09	.36	.35	.23	.36	.19	.58	-.20	.20	-.12	-.11	-.05	-.12	—					
16. Dental satisfaction	.18	-.22	.38	.25	.21	-.32	.42	.12	-.11	.46	.11	.24	.08	.20	.29	—				
17. Positive dental affect	.09	-.04	.40	.22	.10	.27	.28	.39	.18	.31	-.07	-.05	-.15	-.11	.50	.33	—			
18. Negative dental affect	-.12	.32	-.27	-.22	-.20	-.26	-.47	.05	.40	-.45	-.39	-.58	-.45	-.63	-.03	-.32	.18	—		
19. Subjective dental well-being	.19	-.29	.52	.35	.25	.42	.59	.24	-.16	.62	.21	.38	.19	.36	.41	.84	.59	-.57	—	

Note. $r > .13, p < .05; r > .18, p < .01; r > .23, p < .001$; two-tailed tests.

*High scores on OHRQL and its subscores indicate low negative impacts, as exemplified by this 5-point scale: 5 (never experienced the last year), 4 (almost never), 3 (sometimes), 2 (quite often), and 1 (very often experienced the last year).

OHRQL = oral-health-related quality of life; RLONI = relative lack of negative impacts.

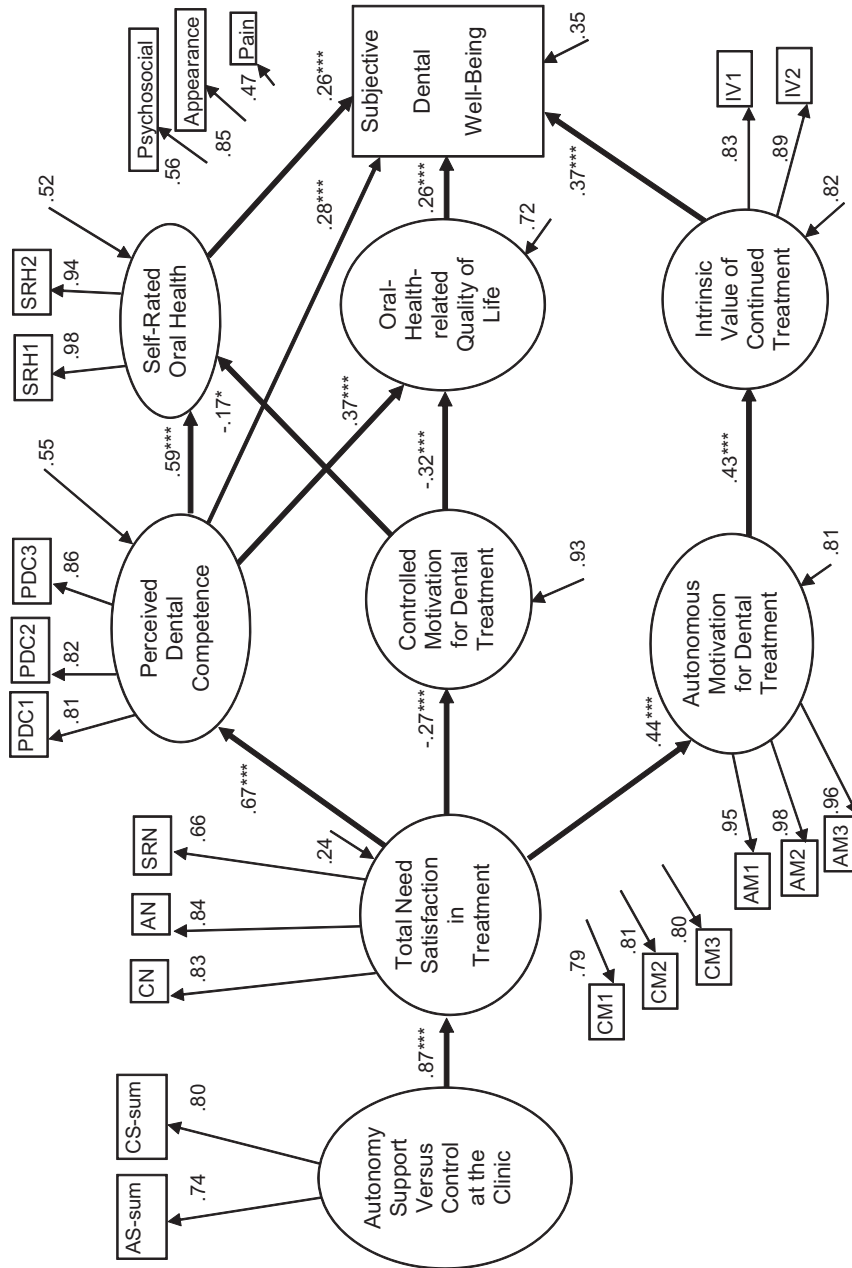


Figure 1 Standardized parameter (regression) estimates depicting the relations in the structural SDT process model of oral health and dental well-being. LISREL analysis with a combination of eight latent and one observed variables, $\chi^2(df = 196, n = 208) = 467.62, p < .001$; SRMR = .078; CFI = .95; IFI = .95; RMSEA = .082. * $p < .05$. *** $p < .001$. AS = autonomy support; CS = controlling style; CN = competence need; AN = autonomy need; SRN = social relatedness need.

quality of life (positive), and finally between the autonomy need and respectively the relatedness need (positive) and an autonomous motivation item (positive). We added these covariances suggested by the modification indices because they seemed theoretically meaningful. With these re-specifications the final measurement model yielded a good fit, $X^2(df=174, n=208) = 391.51, p < .001$; SRMR = .062; CFI = .95; IFI = .95; RMSEA = .078. The structural model was tested with this measurement model included.

The results of the *a priori* structural equation modeling analysis yielded that the SDT process model of well-being fit the data relatively well, $X^2(df=197, n=208) = 536.55, p < .001$; SRMR = .084; CFI = .93; IFI = .93; RMSEA = .091. This model included all paths hypothesized in the theoretical model. However, there was room for improvement of this model. In the *a priori* model, perceived dental competence was not significantly correlated with valuing treatment. In addition, modification indices suggested adding a positive link from perceived dental competence to subjective dental well-being, as well as adding positive error covariances between the competence need and two items for perceived dental competence, and between autonomous and controlled motivations. In the final test of the model, we omitted the mentioned nonsignificant link and added the link and the covariances suggested by the modification indices because they seemed theoretically meaningful. After these re-specifications the structural model improved and fit the data well, $X^2(df=196, n=208) = 467.62, p < .001$; SRMR = .078; CFI = .95; IFI = .95; RMSEA = .082. The standardized parameter estimates are shown in Figure 1.

Analyses of indirect associations

Because no other links than those depicted in Figure 1 were significant, most of the variables in the model are indirectly related, through a subsequent variable, to variables located more ahead in the model. An exception is that perceived dental competence is directly related to subjective dental well-being, in addition to being involved indirectly to well-being through self-rated oral health and OHRQL.

There were four occasions in the model where two “mediation”¹ variables were significantly associated with both the independent and dependent variables. We tested the relative strength of these indirect links by the bootstrapping procedure (see Table 4) described by Preacher and Hayes (2008). The results indicated that all four contrasts were significantly supported because the bias-corrected 95% confidence intervals (for the bands of products of coefficients after *n* resamplings) did not include zero or oppositely valued coefficients, i.e., did not yield negative coefficients for contrasts 1–2, 4–5,

¹With cross-sectional data full or partial mediations cannot be tested (Cole & Maxwell, 2003) and it is more appropriate to describe them as indirect associations. We comment on this under limitations in the Discussion.

Table 4 Tests of Contrasts for Double Indirect Associations Emerging in Figure 1

IV	M	DV	Point estimate	SE	Z	a*b-path		Bootstrapping BC 95% CI	
						Lower	Upper	Lower	Upper
1.	Needs satisfaction →	Perceived competence	0.23	0.04	5.73****	0.17	0.31		
2.	Needs satisfaction →	Controlled motivation	0.02	0.01	1.78*	0.004	0.051		
3.	Contrast 1–2		0.21	0.04	4.95****	0.14	0.29		
4.	Needs satisfaction →	OHRQL	0.08	0.02	3.86****	0.04	0.13		
5.	Needs satisfaction →	Controlled motivation	0.01	0.008	1.86*	0.01	0.03		
6.	Contrast 4–5		0.06	0.02	2.88***	0.02	0.12		
7.	Perceived dental competence →	Subjective well-being	0.38	0.07	5.24****	0.25	0.55		
8.	Perceived dental competence →	OHRQL	0.09	0.04	2.56**	0.03	0.18		
9.	Contrast 7–8		0.29	0.08	3.39****	0.13	0.47		
10.	Controlled motivation →	Subjective well-being	-0.29	0.08	-3.57****	-0.46	-0.14		
11.	Controlled motivation →	OHRQL	-0.12	0.04	-2.76***	-0.23	-0.05		
12.	Contrast 10–11		-0.17	0.09	-1.90*	-0.34	-0.002		

Note. BC = bias corrected; 5,000 bootstrap samples. a-path = IV → M; b-path = M → DV. DV = dependent variable; IV = independent variable; M = mediator; OHRQL = oral-health-related quality of life. **p* < .10. ***p* < .05. ****p* < .01. *****p* < .001.

and 7–8, and did not yield a positive coefficient for contrast 10–11: (1) perceived dental competence was more strongly than controlled motivation involved in the relation between needs satisfaction and self-rated oral health; (2) perceived dental competence was more strongly than controlled motivation involved in the relation between needs satisfaction and OHRQL; (3) self-rated oral health was more strongly than OHRQL involved in the relation between perceived dental competence and subjective dental well-being; and (4) self-rated oral health was more strongly than OHRQL involved in the relation between controlled motivation and subjective dental well-being.

Discussion

The SDT social-contextual and motivation variables worked well in testing an oral health and dental well-being model in the dental field. 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 perceived dental competence and autonomous motivation for treatment, and negatively associated with controlled motivation for treatment. In turn, perceived dental competence was positively, and controlled motivation for dental treatment was negatively, linked with self-rated oral health and OHRQL. Autonomous motivation for dental treatment was positively associated with valuing continued treatment. Finally, the three health-related variables and perceived dental competence were all positively linked to the subjective dental well-being outcome. In addition to these significant paths, the fit indices indicated that the overall model fit the data well.

This is the first study showing that SDT social-context and motivation variables are linked to well-being in the dental field. In addition, the findings are important because the strength of the correlations indicates that 48%, 28%, and 18% of the variance is explained in self-rated oral health, OHRQL, and valuing treatment, respectively, whereas 65% of the variance in subjective dental well-being is explained. Thus, what happens to patients in treatment may substantially increase their motivation for dental treatment and strongly affect their perceived health and well-being. This reasoning is supported by indirect relations among variables as reflected in bootstrapping analyses (see Table 4).

The relations among the three motivation variables, the clinic-context variables such as autonomy support and need satisfaction in treatment, and the health and well-being outcomes are further supported by two studies of other health-related outcomes in the dental field (Halvari & Halvari, 2006; Halvari et al., 2012). The SDT process model findings in the present study are also buttressed by studies of psychological well-being during a 1-year behavioral obesity treatment in

women (Vieira et al., 2010), physical activity and weight change over 3 years in women (Silva, Markland, Carraca, Vieira, Cautinho, Minderico, et al., 2011), participation in a weight-loss program and weight loss over 23 months (Williams et al., 1996), diabetes self-management and improved glycemic control (Williams et al., 2004), and an intervention to promote tobacco cessation (Williams et al., 2006).

This is the first study linking perceived competence and controlled motivation to both self-rated oral health and OHRQL, and demonstrating that perceived competence is more strongly positively involved than controlled motivation is negatively involved in the relation between need satisfaction and the two oral health measures (see Table 4). Furthermore, self-rated oral health demonstrated a stronger positive indirect link than OHRQL, in the relation between perceived competence and the subjective dental well-being outcome. Finally, self-rated oral health proved to be more strongly involved than OHRQL in the negative indirect relation between controlled motivation for dental treatment and subjective dental well-being. Thus, in order to facilitate dental well-being among patients, dental professionals would do well to maximize support of patients' need for competence in particular, as well as their need for social relatedness and autonomy, and to minimize their controlling language and behavior (Ryan & Deci, 2000; Williams et al., 2000). These recommendations are reasonable because the four SDT-related variables most strongly bivariate correlated with subjective dental well-being are satisfaction of the need for competence and autonomy at the clinic, and perceived dental competence (positive *rs*), whereas a negative correlation is found for a perceived controlling clinic style (see Table 3). Further, regarding subcomponents of dental well-being: (1) positive affect is most strongly positively correlated with autonomous motivation and satisfaction of the competence need; (2) negative affect is most strongly positively correlated with controlled motivation and a perceived controlling clinic style, and most strongly negatively correlated with perceived dental competence; and (3) dental satisfaction is most strongly positively linked to satisfaction of the competence need at the clinic and perceived dental competence.

Clinical experience, research reviewed, and results in the present study indicate that the specific positive and negative moods in the PANAS (Watson et al., 1988), which was used to measure positive and negative affects, are experienced among dental patients. In particular, in the literature reviewed, dental health problems were linked to most of the negative moods as defined by PANAS (e.g., distressed, upset, afraid, irritable, angry, guilty, ashamed, and nervous). Further, the three subcomponents of subjective dental well-being are differentiated from three subfactors of OHRQL, valuing continued dental treatment, and self-rated oral health. The factor analysis extracted the 2 affect well-being variables as number 1 and 2 of 8 factors, explaining 30% of a total variance of 65%,

which indicate that positive and negative moods are prevalent in relation to patients' recent dental experiences.

Perceived dental competence and controlled motivation for dental treatment were both significantly bivariately linked with the intrinsic value of continued treatment (zero-order $r_s = .19$ and $-.20$, $p_s < .01$, respectively). However, in the model tested (Figure 1), these links were not significant. It is likely that this is due to a combination of the shared variance between the motivation variables, and in particular the strong correlation between autonomous motivation for dental treatment and valuing continued treatment (zero-order $r = .58$, $p < .001$) that account for most of the explained variance.

Autonomous motivation was not predicted to be related to self-rated oral health or OHRQL, and the bivariate correlations were nonsignificant. A recent SDT model test yielded a similar nonsignificant direct link between autonomous motivation for dental home-care and self-rated oral health. This relation was indirect through perceived competence (Halvari et al., 2012). Thus, perceived competence and controlled motivation seem more strongly linked to health evaluations, whereas autonomous motivation is more strongly related to valuing continued dental treatment. Furthermore, in a previous article (Halvari et al., 2010), autonomous motivation was more strongly related to dental health behaviors as flossing, brushing, and dental clinic attendance, whereas controlled motivation was not. In other words, autonomous motivation seems to be linked to health promotion activities, whereas controlled motivation seems to undermine health evaluations and well-being, but is not significantly linked to performance.

These results lead to a speculation about the distinction between two health concepts in the "Ottawa Charter of Health Promotion," where human health is defined as a resource that can be enhanced by *disease prevention* and *health promotion* (WHO, 1986). Compared to autonomous motivation, a low controlled motivation and a high perceived competence are more strongly linked to self-evaluations of oral health and disease (i.e., lack of negative oral health impacts). Conversely, compared to controlled motivation and perceived competence, autonomous motivation may be more strongly oriented toward health promotion than disease due to its significant positive associations with intrinsic valuing dental treatment, its nonsignificant link with negative oral impacts, and another finding of a relatively strong positive correlation between autonomous motivation and dental clinic attendance (Halvari et al., 2010).

The zero-order correlation between perceived competence and autonomous motivation was $.23$ ($p < .001$). However, we did not specify a path between these variables in Figure 1

because the empirical literature is unclear about the direction of the link, which may be bidirectional. Some research indicates that autonomous motivation would lead to perceived competence (Kennedy, Goggin, & Nollen, 2004; Williams et al., 2006), whereas other research indicates the opposite direction of the link (Halvari & Halvari, 2006; Palmeira et al., 2007; Silva et al., 2010; Teixeira et al., 2006). Furthermore, in the present study, autonomous motivation is related to a treatment context, whereas perceived competence is related to "dental care," which also includes a self-care context. Due to this, trans-contextual models of motivation (Hagger & Chatzisarantis, 2007) might be used to design future studies aimed at better understanding the direction between these variables. A recent study revealed that perceived competence for physical activity in a leisure time context strongly mediated the links between autonomous motivation for physical education (in a school context) and both physical activity effort in a leisure time context and well-being in general among students at upper secondary school (Bagøien, Halvari, & Nesheim, 2010). However, the present cross-sectional design does not allow us to address the question of direction between these two motivational variables well. Future research will be needed to answer this question.

Strengths and limitations

In addition to supporting SDT (Deci & Ryan, 1985, 2000), this is the first study that shows that SDT-specified clinic-context and motivation variables are linked to well-being in the domain of dental health. Although the study has the limitations associated with being cross-sectional, the strength of the correlations does convey their importance. Still, correlation strength is not enough to infer causality. It is important to note that the use of mediation data analysis or structural equation modeling does not imply that we test mediations or cause-effect links. More appropriate terms, which we have used, are indirect associations or links for the cross-sectional data set. According to Cole and Maxwell (2003), tests of partial and full mediations require two and three waves of data, respectively.

All data are based on self-report, which have been criticized for a number of reasons, but perhaps the most important is that observed associations might be artificially inflated because all provided information comes from one single informant. Based on these limitations, future research should strengthen designs by longitudinal waves of data and/or randomized controlled trials, with observed or clinically assessed dependent behavior or health variables, in order to test the SDT hypotheses and probably extend their implications in the dental field.

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