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Predicting dental attendance from dental hygienists' autonomy support and patients' autonomous motivation: A randomised clinical trial

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Objective: To test the hypothesis that a Self-Determination Theory (SDT) intervention designed to promote oral health care competence in an autonomy-supportive way would predict change in caries competence relative to standard care. Further, to test the SDT process path-model hypotheses with: (1) the intervention and individual differences in relative autonomous locus of causality (RALOC) predicting increases in caries competence, which in turn would positively predict dental attendance; (2) RALOC negatively predicting dental anxiety, which would negatively predict dental attendance; (3) RALOC and caries disease referred to the dentist after an autonomy-supportive clinical exam directly positively predicting dental attendance; and (4) the intervention moderating the link between RALOC and dental attendance.

Design: A randomised two-group experiment was conducted at a dental clinic with 138 patients ($M_{\text{age}} = 23.31$ yr., $SD = 3.5$), with pre- and post-measures in a period of 5.5 months.

Results: The experimental model was supported. The SDT path model fit the data well and supported the hypotheses explaining 63% of the variance in dental attendance.

Conclusions: Patients personality (RALOC) and hygienists promoting oral health care competence in an autonomy-supportive way, performance of autonomy-supportive clinical exams and reductions of anxiety for dental treatment have important practical implications for patients' dental attendance.

Keywords: self-determined motivation; personality; caries competence; autonomy-supportive oral health care; anxiety for dental treatment; and dental attendance

Regular, preventive dental attendance is a contributor to the oral health status for people of all ages (Luzzi & Spencer, 2008). Regular dental attendance results in less untreated decay, a lower rate of tooth loss and a higher number of functioning teeth (Sheiham, Maizels, Cushing, & Holmes, 1985). In addition, regular dental attendance predicts

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increased frequency of tooth brushing and use of dental hygiene products, and to lower visible bacterial dental plaque which is the cause of caries, gingivitis and periodontitis (Hill, Chadwick, Freeman, O'Sullivan, & Murray, 2013). Studies have also shown that regular dental attendance leads to gains in quality of life among people, for instance by improving their ability to eat and speak, improving their social life, work functioning, daily activities and interpersonal relationships and increasing survival (Mc Grath & Bedi, 2001).

Research indicates that a substantial proportion of young adults, similar to those included in the present study, do not attend regular dental check-ups (Health Education Authority, 1996; Hill et al., 2013; Scheutz & Heidmann, 2001). Why do young adult patients not attend the dental clinic regularly as recommended? Both patient personality factors and interpersonal qualities of the dentists and hygienists are believed to impact dental attendance by affecting patients' motivation, but no randomised trial has yet demonstrated how motivation improves this dental outcome. Self-Determination Theory (SDT; Deci & Ryan, 2000) is a general theory of human motivation that distinguishes between autonomous and controlled types of motivation. Autonomous motivation involves doing an activity with a full sense of willingness and volition because the individual either finds the activity interesting and enjoyable or values it deeply. When autonomously motivated, people perceive the locus of causality of the behaviour to be internal or autonomous, and they persist longer at health-behaviour change and report greater well-being (Williams et al., 2006). In contrast, controlled motivation involves behaving with the experience of pressure and obligation, for example, from an external threat of punishment or offer of a reward or from an internal threat of guilt for not doing the behaviour or of self-aggrandisement for doing it. When people are controlled in their motivation, they perceive the locus of causality of their behaviour to be external or controlled, and they tend to persist less long and display lower wellness.

SDT also gives attention to the interpersonal context within which a target activity is examined. It uses the concepts of autonomy-supportive and controlling as contextual variables that also influence people's outcomes such as dental attendance. Accordingly, SDT proposes and substantial research has confirmed that, when a treatment such as an oral health care intervention is done in an autonomy-supportive way positive outcomes will be more likely (e.g. Ng et al., 2012).

Herein, we examine an autonomous locus of causality, perceived caries competence and dental anxiety of the patients, as well as an autonomy-supportive competence-promoting clinical intervention performed by a dental hygienist as possible important motivational factors.

Relative autonomous locus of causality

The RALOC indexes the degree to which the regulation of an extrinsically motivated behaviour has been internalised so that the behaviour will be autonomously enacted rather than controlled. As such, RALOC is a personality factor at a domain-specific level (i.e. health behaviour). Patients high on RALOC tend to be motivated to engage in activities within a health care or learning environment that are of high personal importance to them, and they tend to take a high level of responsibility for themselves in carrying out the behaviours autonomously. Research has previously shown that an autonomous locus of causality positively predicted changes in autonomous motivation

for oral health care, perceived oral health competence and oral self-care behaviour (Halvari, Halvari, Bjørnebekk, & Deci, 2012b). We therefore suggested that RALOC would positively predict change in caries competence and dental attendance for they are expected to take greater responsibility for their health behaviour.

According to SDT (Deci & Ryan, 2000) authority figures such as practitioners who are autonomy supportive tend to provide clear informational and competence-enhancing rationales for pursuing dental health behaviours and goals; nonjudgmental, informational effectance-enhancing feedback on how to reach one's goals; optimal challenge (not too easy or too difficult to accomplish); and no pressure but personal support related to their feelings, thoughts and behaviours. In contrast, people who are strongly controlled in their causality would have a lower level of RALOC. The lowest RALOC would be for those who are strongly impersonal in causality, feel unable to attain desired outcomes (Deci & Ryan, 2000), and thus have virtually no autonomous motivation.

The intervention provided in this study was an autonomy-supportive, competence-promoting treatment, and was hypothesised to have a stronger positive effect on dental attendance for patients who are high in autonomous orientation than for those who were high in impersonal orientation and thus lacking in motivation. That is, the intervention would moderate the link between the RALOC and dental attendance. Finally, RALOC was hypothesised to negatively predict dental anxiety because a high RALOC implies having greater perception of wanting to attain the outcomes for oneself (autonomy) and thus leading to feeling more confident (competence) in attaining the oral health outcomes (Deci & Ryan, 2000; Liddell & Locker, 1997).

Perceived caries competence

SDT (Deci & Ryan, 2000) further suggests that effective behaviour change not only requires people to feel autonomous in doing their behaviour, they need also to perceive themselves as competent to enact the requisite behaviours in order to yield desired outcomes. In the present study, caries competence is defined as having knowledge about bacterial dental plaque as a cause of caries development and being able to use this knowledge on a regular basis in order to remove plaque and promote their health. In the dental field, an autonomy-supportive intervention (relative to standard care) yielded increases over 7 months in the motivation variable perceived oral health competence, which enhanced oral self-care behaviours and oral health (Halvari & Halvari, 2006). Thus, in the current study, the intervention designed to promote this oral health competence in an autonomy-supportive way, relative to standard care, was expected to positively predict change in caries competence. Further, change in caries competence was expected to predict dental attendance.

Anxiety for dental treatment

A central variable when examining dental attendance is anxiety for dental treatment. Dental anxiety is defined as fear of dental treatment or certain aspects of it (ter Horst & de Wit, 1993). Dental anxiety has been inversely related to dental clinic attendance in diverse populations (Hill et al., 2013). Thus, in the present study, we considered dental anxiety as an important predictor of dental attendance, together with the SDT motivational constructs.

The current study and the dental hygienist autonomy-supportive exam and intervention

The current clinical trial randomised patients to an usual care control group and an intervention group. Patients in both groups met with a dental hygienist (DH) for an oral exam (45 min) and subsequently had a tooth cleaning (45 min). During the exam, the DH measured dental plaque, gingivitis, periodontitis and caries. The exam and the cleaning was provided in an autonomy-supportive way, that is, the DH was responsive to patient questions, acknowledging and reflective of patients perspectives, provided a rationale when a recommendation was made, and emphasised choice in both groups. If caries requiring treatment were detected, the patient was encouraged, in an autonomy-supportive way, to attend the dentist appointments. Thus, detection of *caries* was hypothesised to positively predict dental attendance.

The intervention session also lasted about 45 min and was given by the DH to the experimental group between their examination and teeth cleaning (see Figure 1). The intervention focused on providing meaningful competence information provided in an autonomy-supportive way concerning oral health and disease; offering rationales for oral self-care behaviours that are known to promote healthy teeth and gingiva and therefore to prevent plaque-related diseases; and fostering oral care skills with education, demonstrations and practice. Thus, it was hypothesised that intervention patients would report higher levels of perceived autonomy support and greater change in caries competence because the major part of the intervention (100 of 107 lines, 93.5%, Halvari et al., 2012b) was related to knowledge and skills training for oral self-care behaviours that are effective in preventing plaque-related diseases (e.g. caries). However, we did not predict patients in the intervention group to visit their dentist more frequently than patients in the control group because, due to ethical reasons, most of the content regarding encouraging dental attendance (29 of 37 lines, 78.3%, Halvari et al., 2012b) was given to both groups during the oral exam. Hence, we hypothesised that the intervention would predict dental attendance indirectly through change in caries competence, and would moderate the link between RALOC and dental attendance.

The SDT process model of dental attendance

Based on the theory and research considered above, we hypothesised that: (1) the autonomy-supportive intervention and the RALOC would both positively predict changes in perceived caries competence, which would positively predict dental attendance; (2) RALOC would also negatively predict dental anxiety, which, in turn, would negatively predict dental attendance; (3) RALOC and caries disease would positively and directly predict dental attendance; (4) the intervention would have a greater appeal to patients high in RALOC than to those low in RALOC and, hence, moderate the RALOC – dental attendance link; and finally (5) gender would predict anxiety for dental treatment, because women have universally reported more dental anxiety than men (Hill et al., 2013; ter Horst & de Wit, 1993; Liddell & Locker, 1997).

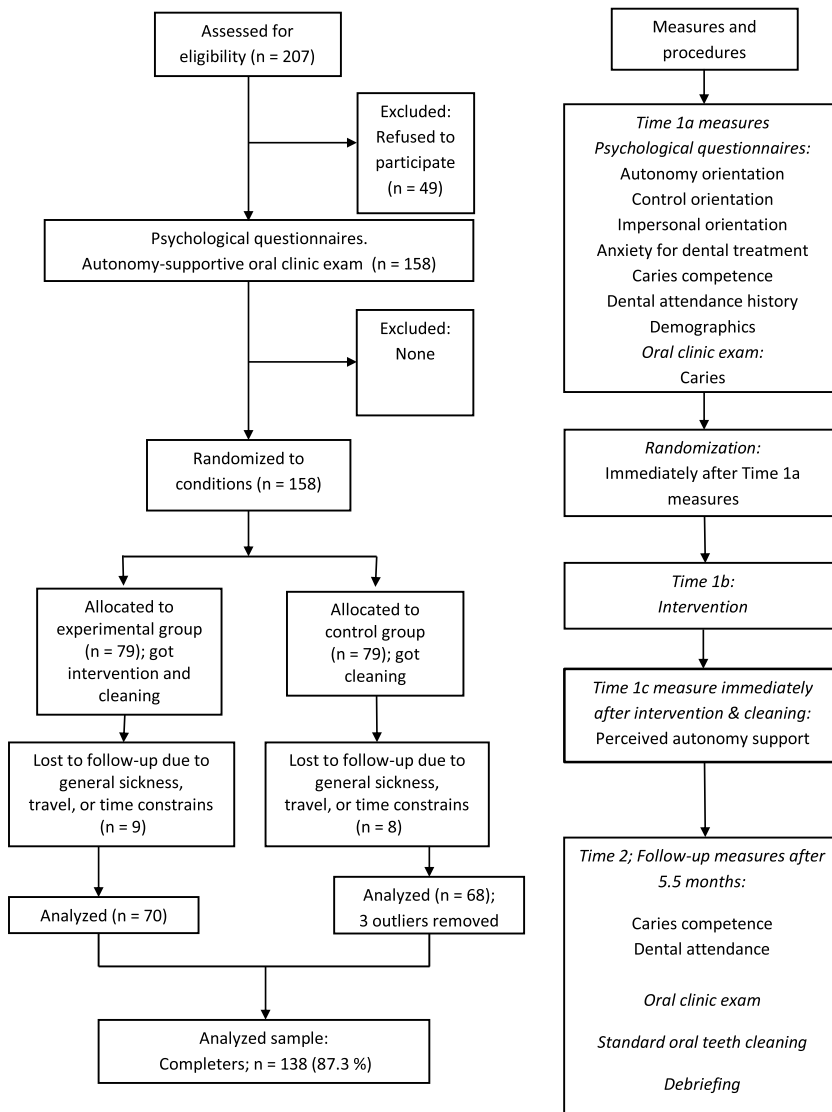


Figure 1. Study flowchart and time line for measures and procedures.

Method

Participants

Patients were 138 students ($M_{\text{age}} = 23.31$ yr., $SD = 3.5$) from the University of Oslo who did not have periodontal pockets ≥ 4.0 mm, did not have significant additional diseases, were not pregnant, understood Norwegian and gave informed consent. For additional information about participants, power analysis, inclusion/exclusion criteria, completers/dropouts and a full description of the experimental procedure, see Halvari

et al., 2012b). In the present article, all variables included are original and new, except that autonomy support used as a manipulation check was also used in the previous study (Halvari et al., 2012b). The trial is registered in the South-East Regional Committee for Medical and Health Research Ethics in Norway, and in the Norwegian Social Science Data Services.

Questionnaire assessments

Motivation variables were found reliable in past research: for autonomous, controlled and impersonal orientations (α 's = .70, .65 and .68, and test-retests over 2 months = .73, .77 and .71, respectively, Rose, Markland, & Parfitt, 2001; α 's = .74, .69 and .74, and test-retest over 2 months = .75, .71 and .78, respectively, Deci & Ryan, 1985); autonomy support (α = .96, Williams, Grow, Freedman, Ryan, & Deci, 1996); dental anxiety (α = .87); and for perceived caries competence (α = .85, Halvari, Halvari, Bjørnebekk, & Deci, 2010, 2012a).

Relative autonomous locus of causality (RALOC) (T1a). Assessed with the Dental Care Causality Orientations Scale adapted in the present study from the Exercise Causality Orientations Scale (Rose et al., 2001) and the General Causality Orientations Scale (Deci & Ryan, 1985). One of the five scenarios with questions is: 'Imagine: You are at your oral health care professional's office and have been told that there is some damage from brushing. Your first reaction will probably be': (a) 'I will talk to my oral health care professional to find out what I can do to take care of my oral health in the best way in future' (Autonomous); (b) 'I will have a guilty conscience and feel that I have to improve how I brush my teeth' (Controlled); (c) 'It is difficult to do something about it, what has happened has happened' (Impersonal). Responses were from 1 (very unlikely) to 7 (very likely). The items were averaged within each subscale.

Based on theory and research, we estimated RALOC with a dimensional approach using the following formula: $RALOC = (Autonomy\ orientation \times 2) - ((Control\ orientation \times 1) + (Impersonal\ orientation \times 1))$. An advantage of the dimensional approach is that it acknowledges that people are likely to function some of the time in an autonomous manner, sometimes in a controlled manner, and sometimes in an impersonal manner (Deci & Ryan, 1985). Compared to the autonomous orientation, the controlled orientation was weighted negatively because it tends to reflect an internally controlling type of motivation (Koestner, Bernieri, & Zuckerman, 1992). In addition, the impersonal orientation is considered to be an important personality factor explaining who does not attend target activities as recommended (Koestner & Zuckerman, 1994).

Perceived Autonomy Support (T1c) was a manipulation check to be sure that those in the intervention group experienced their interaction with the oral health care professionals as more autonomy supportive than did those in the control group. It was measured with the six-item version of the modified Health Care Climate Questionnaire (Williams et al., 1996), which was adapted to oral health care. An item is: 'I feel that my oral health care professional has provided me choices and options'. Responses could vary from 1 (strongly disagree) to 7 (strongly agree).

Anxiety for Dental Treatment (T1a) was measured by the Dental Anxiety Scale (Corah, 1969). Of the four items, a sample item is: 'When you are waiting in the oral health care professional's office for your turn in the chair, how did you feel?' Participants responded on a five-point scale ranging from 1 (Relaxed), to 2 (A little uneasy),

3 (Tense), 4 (Anxious), 5 (So anxious that I sometimes break out in a sweat or almost feel physically sick).

Perceived Caries Competence (T1a and T2). This was assessed by two items from the Oral Health Promotion Scale (Halvari et al., 2010). A sample item: 'I have knowledge about caries development and I can use this knowledge to promote my dental health'. Responses were: 1 (not true at all) to 7 (very true).

Clinical assessments

Caries disease (T1a) referred to the dentist after the autonomy-supportive oral exam was indexed according to the classification system developed by Møller and Poulsen (1973) and consist of primary clinical assessment of caries (secondary: X-rays) at two locations, that is, at 'pits and fissures' (mostly at the chewing surface of the tooth) and at 'vestibular and lingual smooth surfaces' (surfaces close to the face and the tongue). In addition, at the third location of 'proximal surfaces' X-rays are the primary tool for assessment (secondary: clinical). (The X-ray apparatus used was a Sirona, 7 mA 60 kV DC, with Digora phosphor plate systems and a Digora Scanner. Beam dose: 1 micro Sievert / picture). The clinical and X-ray observations of caries disease were related to the guidelines for codes to be observed and codes to be subject to treatment. Hence, the following graduation of caries disease was assessed for each participant by the dental hygienist in collaboration with dentists: no caries [score 0]; observation [score 1; Decay (D) from the outer enamel surface to the enamel-dentin border], treatment [score 2; D in dentin from the enamel-dentin border to 2/3 into the dentin]; and, acute treatment [score 3; D is observed in the inner 1/3 of the dentin and into the pulpa (i.e. the nerve in the tooth)]. Patients with score 2 and 3 were referred to their dentists for further observation or treatment.

Dental Attendance (T2) was assessed by a question at Time 2, which was verified for correctness by actual clinic attendance, and clinical exam of change in fillings, the last 5.5 months. Score 1 = no attendance; score 2 = attendance. All of those who attended the clinic for treatment ($n = 51$) got at least 1 new filling (range: 1–4 fillings; $M = 2.2$; $SD = 1.03$).

Background assessments (T1a)

Was indicated by responses to the following questions: 'How long has it been since your last visit to a dental clinic?' with responses from 1 (last ½ year), over 2 (abt. 1 year ago), 3 (2–3 years ago), 4 (4–5 years ago), to 5 (6 or more years ago); and personal economy was assessed with the question 'Imagine that you got a dentist bill of 2000 kr (approx. \$300 USD). How difficult would it be for you personally to pay a bill like this?' Responses were rated on a four-point scale ranging from 1 (not at all difficult) to 4 (very difficult). Gender was indicated as 1 for female and 2 for male, while age was indicated in years.

Experimental procedure

A randomised two-group trial was conducted in a dental clinic. When participants first arrived at Time 1a (T1a; see Figure 1 for the time line of measures), they completed a

survey assessing causality orientations, perceived caries competence, anxiety for dental treatment, time since last dental clinic visit, personal finances and demographics such as age and gender.

The standard oral examination (T1a). The exam lasted about 45 min. The DH was trained to be autonomy supportive during the examination. She addressed: an exam introduction (5 min.); measures of dental plaque and gingivitis on all teeth surfaces (20 min.); clinical and X-ray exam for caries (5–10 min.); and pocket exam (5 min.). The final dialogue lasted about 10 min and included information on how caries looks and how to detect it on patients' own X-rays and in their own mouth; and the importance of choice and self-initiation regarding treatment options in order to promote an informed basis for patient choice and decision-making. Patients with caries disease (see measure above) were referred to treatment at their dentist.

Randomisation: After the exam, 79 participants were randomly assigned to each condition. Immediately thereafter a 45-min *intervention* took place for the experimental group, whereas the control-group participants went directly to a 45-min standard teeth cleaning (see description below). The cleaning in both groups was done in an autonomy-supportive way.

The intervention at T1b (45 min) was designed to promote oral health care competence in an autonomy-supportive way. Based on an initial conversation with the patient the contents of the intervention were: (i) education in plaque-related diseases such as gingivitis, periodontitis and caries; (ii) demonstrating effective brushing and flossing, with participants practicing them and receiving positive feedback and corrections; (iii) giving health promotion and disease preventive information and offering rationales for the oral health and/or oral hygiene behaviours by explaining the relations of behaviours to disease prevention and health; (iv) giving information about the value of fluorides and regular meals; and (v) offering choice concerning their oral self-care.

The standard teeth cleaning at T1c. This 45-min cleaning (removing calculus and stain, and finally polishing the teeth) was given to the control group after the exam and to the experimental group after the intervention. Finally at T1c, all participants responded to a questionnaire assessing perceived clinic autonomy support.

At T2 (after 5.5 months), 138 participants responded to the same questionnaires completed before the oral exam at T1a, except causality orientations, dental anxiety, and demographics which were not included. Dental attendance the last 5.5 months was registered.

Data analysis

The following data analysis procedures were performed: (1) intervention effects was analysed with repeated measures analysis of variance (ANOVA) to examine the hypothesis for perceived caries competence, with the intervention vs. control groups as the between-group factor crossed with the T1a and T2 assessments as the repeated-measures factor; (2) For the hypothesised moderator effect of the intervention on the RALOC – dental attendance path, we used hierarchical logistic regression. Note that the pseudo R square is the improvement from the null model to the fitted model. (3) LISREL (Version 8.72) was used to test the path model illustrated in Figure 2. Due to sample size limitations in relation to the number of variable indicators we tested a simplified model. In this model, anxiety for dental treatment was represented by 2 parcels,

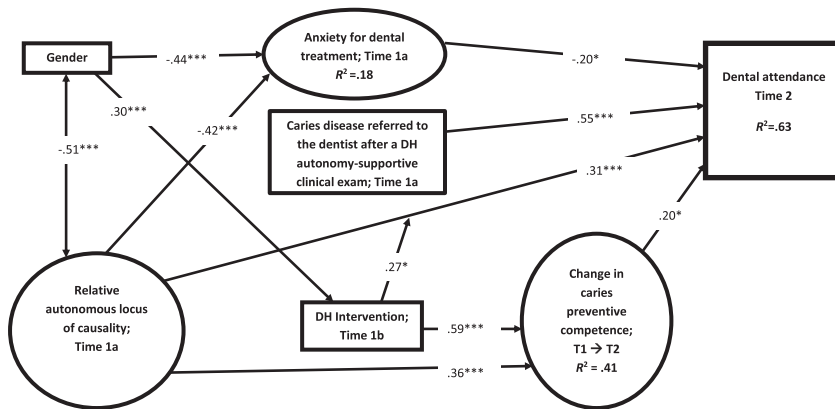


Figure 2. Standardised Parameter Estimates in the Path Model of Dental Attendance, controlling for the correlation between gender and the intervention. DH = dental hygienist. For gender value 1 = females and value 2 = males. For the intervention, the observed values are 1 for the control group and 2 for the experimental group. For caries disease referred to the dentist, the observed values are: 0 = no caries; 1 = observation; 2 and 3 = treatment and acute treatment, respectively, referred to the dentist. $*p < .05$; $**p < .01$; $***p < .001$.

each with 2 items. Residual change in perceived caries competence was included as an observed variable, as well as the four single-item measures (i.e. gender, the intervention, caries disease and dental attendance). RALOC was represented by its three orientations. Traditionally, maximum likelihood is used to estimate the chi-square when data are normally distributed. Because none of the measured variables in the present study have significant skewness (see Table 2), we used a maximum likelihood procedure in testing the path model. As recommended for evaluating model fit in covariance structure analyses, a good fit should have values for the RMSEA and SRMR close to or lower than .06 and .08, respectively, accompanied by values for CFI and IFI close to or higher than .95 (Hu & Bentler, 1999); and (4) Due to the categorical variables included we tested the indirect links in Figure 2 by a nonparametric bootstrapping procedure (Preacher & Hayes, 2008).

Results

History of dental attendance and health

Table 1 shows the means and standard deviations for variables at T1 and T2. In addition, participants' answers at baseline on questions concerning their history of dental clinic attendance indicated that 58.7% reported that they had been at the dental clinic during the last year; 27.5% reported that it had been 2 to 3 years since their last visit; and for 13.8% of the participants their last visit had been as long as 4 or more years ago. Concerning oral health, a major proportion of participants had caries (see measures of caries disease above). As many as 65.2% (90 participants) were diagnosed with caries scores 2 and 3 and recommended to visit their dentist for further observation or treatment, 19.6% (27 participants) were diagnosed with caries to be observed (score 1),

Table 1. Means and standard deviations for variables at time 1 and 2.

Variable	<i>M</i>	SD	<i>M</i>	SD
	Autonomy support (T1c)			
Control group ^a	4.15	1.72		
Intervention group	6.60	.47		
	Dental anxiety (T1a)			
Control group	2.05	.84		
Intervention group	1.99	.78		
	Relative autonomous locus of causality (T1a)			
Control group	8.14	3.66		
Intervention group	7.61	3.97		
	Caries disease; RD A-S DE (T1a)			
Control group	1.67	.94		
Intervention group	1.67	.93		
	Caries competence (T1a)		Caries competence (T2)	
Control group	4.47	1.27	4.62	1.10
Intervention group	4.31	1.27	5.28	0.81
			Dental attendance (T2)	
Control group			1.38	.49
Intervention group			1.36	.48

^aControl group: *N* = 68; Intervention group: *N* = 70. RD A-S DE = Referred to the Dentist after Autonomy-Supportive Dental Exam.

and only 15.2% (21 participants) were diagnosed with no caries (score 0). Of the 90 participants who were referred to their dentist, only 51 of them (57%) actually visited their dentist in the 5.5 months period between the oral examination and the Time 2 follow-up.

Intervention manipulation check

Participants in the intervention group experienced greater autonomy support ($M = 6.60$, $n = 70$, $SD = .47$) than those in the control group ($M = 4.15$, $n = 68$, $SD = 1.72$); ($t = 11.27$, $df = 136$, $p < .001$; $M_{\text{difference}} = 2.45$, $SE = .22$; 95% CI [2.02, 2.88]; Effect Size, Cohen's $d = 1.38$, 95% CI for d [1.14, 1.62] Cohen, 1992), thus indicating that the intervention was experienced as having been more autonomy-supportive and that the intervention was consistent with the principles of SDT.

Intervention effects

The autonomy-supportive intervention at T1b was hypothesised to increase perceived caries competence from T1a to T2. In the repeated measures ANOVA, gender was used as a covariate and was not significant as a main effect [$F(1,135) = 2.13$, $p > .10$] or interaction [$F(1,135) = .002$, $p > .10$]. Because it was not significant, gender was not included in the final ANOVA, which yielded two main effects and one interaction. For condition, $F(1,136) = 2.56$, $p > .10$; for time, $F(1,136) = 26.82$, $p < .001$; and for the

interaction of condition by time $F(1,136) = 14.08, p < .001$. The effect was moderate for the interaction of condition by time. This confirms the hypothesis that the intervention, relative to the control group, would result in an increase of perceived caries competence from T1a to T2 (see Table 1. Effect Size, $ES = .64$ using Cohen's d , Cohen, 1992). The change among participants in the intervention group was significant [$F(1,136) = 6.18, p < .001$; $ES = .76$], whereas there was no change observed in the control group [$F(1,136) = 1.03, p > .10$; $ES = .12$].

Correlations

The second hypothesis concerned expected links within the SDT-based path model. As hypothesised, the zero-order correlations (see Table 2) indicate that the intervention condition was positively correlated with change in perceived caries competence, which was positively linked to dental attendance at Time 2. In addition, RALOC and caries disease were positively related, whereas anxiety was negatively related, to dental attendance. Finally, as expected, dental anxiety was negatively associated with RALOC and gender (1 = females and 2 = males).

Moderator effects

It was hypothesised that the intervention would moderate the RALOC – dental attendance path. We used hierarchical logistic regression to test this hypothesis. In block 1, dental attendance was regressed onto the centred RALOC and the intervention. The model was significant ($X^2_{2, 136} = 9.11, p < .01$; pseudo $R^2 = .089$) and RALOC predicted dental attendance ($B = .15, SE = .05, Wald = 8.09, p < .01$), whereas the intervention did not ($B = -.05, SE = .37, Wald = .02, p > .10$). Block 2 yielded an additional pseudo R^2 of 7.2% after entering the interaction of RALOC and the intervention ($X^2_{3, 136} = 17.03, p < .001$, pseudo $R^2 = .161$; pseudo $X^2_{\text{Change}1, 136} = 7.92, p < .01$). This confirms the hypothesis that the intervention moderated the relation between RALOC and dental attendance (Cohen, Cohen, West, & Aikin, 2003), with the relation between RALOC and attendance being stronger in the experimental group ($B = .34, SE = .10, Wald = 11.62, p < .001$) than in the control group ($B = .02, SE = .07, Wald = .09, p > .10$). The estimated regression lines are illustrated in Figure 3. This moderator effect was included in the path model.

To tease out whether these results are attributable to an autonomous orientation, a controlled orientation, or an impersonal orientation, we regressed dental attendance onto the orientations and the intervention (block 1) and their interactions (block 2). The interaction of autonomous orientation and the intervention increased the pseudo R^2 in dental attendance by 4.3% (pseudo $X^2_{\text{Change}1, 136} = 4.93, p < .05$; Slope of Gradient, SG, in control group: $B = .03, SE = .25, Wald = .02, p > .10$; SG in intervention group: $B = .80, SE = .27, Wald = 8.88, p < .001$). In addition, the interaction of impersonal orientation and the intervention increased the pseudo R^2 by 3.8% (pseudo $X^2_{\text{Change}1, 136} = 4.04, p < .05$; SG in control group: $B = .00, SE = .26, Wald = .00, p > .10$; SG in intervention group: $B = -.75, SE = .29, Wald = 6.98, p < .01$). The interaction of the controlled orientation and the intervention was not significant. Hence, a high autonomous orientation and a low impersonal orientation strongly predicted dental attendance

Table 2. Correlations^a and descriptive statistics among variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. RALOC (T1a)	–														
2. Autonomy orientation (T1a)	.84	–													
3. Control orientation (T1a)	–.20	.25	–												
4. Impersonal orientation (T1a)	–.69	–.45	–.08	–											
5. Anxiety for dental treatment (T1a)	–.25	–.18	.13	.13	–										
6. Caries competence (T1a)	.25	.21	–.07	–.11	–.09	–									
7. Caries disease referred to the dentist (T1a)	.01	–.02	–.01	–.06	.13	–.02	–								
8. Intervention (T1b) ^a	–.04	–.06	–.13	.11	–.04	–.06	.00	–							
9. Perceived autonomy support (T1c)	.05	.00	–.09	–.02	–.02	.00	.07	.70	–						
10. Caries competence (T2)	.29	.28	–.05	–.15	–.15	.34	.09	.32	.34	–					
11. Change in caries competence (T1 → T2)	.23	.23	–.03	–.12	–.13	.00	.10	.36	.36	.93	–				
12. Dental attendance (T2) ^a	.26	.18	–.09	–.22	–.17	–.03	.39	–.02	.05	.22	.24	–			
13. Gender ^a	–.31	–.33	–.15	.29	–.17	–.10	.03	.21	.08	–.04	–.01	–.07	–		
14. Age	–.03	–.02	.04	.00	.07	.06	.06	.13	.00	.06	.04	–.02	.11	–	
15. Personal economy	.13	.11	–.03	–.05	–.15	.14	–.04	–.05	–.04	.06	.02	.09	.22	.06	–
Mean	4.6	5.4	4.1	2.0	2.0	4.4	1.7	1.5	5.3	4.9	.0	1.4	1.3	23.3	2.7
Standard deviation	2.4	.9	1.0	.9	.8	1.3	.9	.5	1.8	1.0	1.0	.5	.5	3.5	1.0
Skewness	–.1	–.3	–.3	1.2	1.0	–.4	–.4	.1	–1.1	–.8	–.5	.5	1.0	–.6	–.2
Reliability (α)	–	.76	.69	.71	.81	.76	–	–	.96	.66	–	–	–	–	–

Notes: $r \geq .17$, $p < .05$; $r \geq .22$, $p < .01$; $r \geq .27$, $p < .001$; two-tailed tests. N varies from 135 to 138 due to some missing cases for variables. Gender: 1 = females; 2 = males. Intervention: 1 = control group; 2 = experimental group. Change scores (standardised residuals) were created by regression of T2 measures onto T1 measures.
^aPearson correlations, except Spearman's point bi-series correlations involving categorical variables.

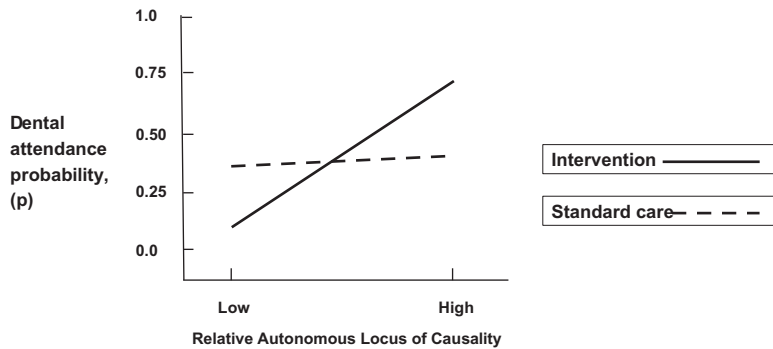


Figure 3. Simple Regression Lines Depicting the Relationship Between the Intervention and Dental Attendance at Specified Values of RALOC. Inverse logit transformation was used to transform regression logodds of dental attendance to probability values between 0 and 1.

among participants who received the intervention, but being high in the controlled orientation did not predict dental attendance in the intervention group.

The SDT process path model

We tested the SDT path model in which we controlled for the gender link on the intervention because of the unequal assignment of females and males to the two conditions, and we let gender and RALOC co-vary because of the significant correlation (see Table 2). The path model yielded good fit indices: [χ^2 (df = 45) = 53.41, p = .183; χ^2 /df = 1.19; CFI = .97; IFI = .97; SRMR = .065; RMSEA (90% CI) = .035 (.00 .067)], and explaining 63% of the variance in dental attendance. All hypothesised links were supported. This path model is illustrated in Figure 2. The moderator effect of the intervention on the RALOC – dental attendance link is illustrated in Figure 3.

Tests of indirect associations in Figure 2

The indirect links were tested by a nonparametric bootstrapping procedure (Preacher & Hayes, 2008). The results indicated that 4 indirect links were significantly supported because the bias-corrected 95% Confidence Intervals (CI's, for the bands of products of coefficients after 5000 re-samplings) did not include zero or oppositely valued indirect effects, and 2 links were marginally significant. These indirect effects are: (1) Compared to males, females have a higher RALOC that affected their anxiety negatively (Indirect Effect, IE = .11, SE = .05, 95% CI [.03, .24]). (2) RALOC negatively affected anxiety, which negatively affected attendance (IE = .09, SE = .07, 95% CI [−.01, .28]), i.e. marginally significant. (3) Females have a higher dental anxiety than males affecting their dental attendance negatively (IE = .17, SE = .13, 95% CI [.00, .50]), i.e. marginally significant. (4) Compared to females, males have a lower RALOC that reduces their attendance (IE = −.23, SE = .13, 95% CI [−.04, −.56]). (5) RALOC affected positive change in caries competence that affected dental attendance (IE = .11, SE = .07, 95% CI [.02, .28]). (6) The intervention affected dental attendance through change in caries competence (IE = .49, SE = .19, 95% CI [.19, .96]).

Discussion

The present study aimed to test the following hypotheses: (1) the autonomy-supportive intervention and the RALOC would both positively predict changes in perceived caries competence, which would positively predict dental attendance; (2) RALOC would also negatively predict dental anxiety, which, in turn, would negatively predict dental attendance; (3) RALOC and caries disease would positively and directly predict dental attendance; (4) the intervention would have a greater appeal to patients high in RALOC than to those low in RALOC and, hence, moderate the RALOC – dental attendance link; and finally (5) compared to males, females would report higher anxiety for dental treatment.

These hypotheses were supported. The DH intervention designed to promote oral health care competence in an autonomy-supportive way, relative to standard care, positively affected change in caries competence, which, in turn, positively predicted dental attendance after 5.5 months. Further, RALOC also directly predicted dental attendance (positively), as did caries disease referred to the dentist (positively), and dental anxiety (negatively). In addition, the intervention strongly moderated the link between RALOC and attendance, as RALOC strongly positively predicted dental attendance among participants who received the intervention, whereas this result was non-significant among participants in the control group. Together, these five predictors explained 63% of the variance in dental attendance.

This is the first study emphasising the significance of dental hygienist autonomy-supportive education of patients and its interplay with patients' personality (RALOC) in predicting dental attendance. In addition, the relation of the autonomy-supportive dental hygienist oral exam and referral strongly predicted dental attendance.

The effect of the autonomy-supportive competence-building intervention moderating the effect of the RALOC on dental attendance, and the intervention predicting change in dental attendance through caries competence, are considered causal because the study was designed as a randomised controlled trial and these hypotheses were confirmed. These results are important because research indicates that a majority of patients who visit their dentists report that they are not sufficiently informed about gingivitis and caries, which are the two most common oral diseases, and not educated in how to prevent these diseases in order to stay healthy in the future. These factors were on the top of the quality gap list ranked by patients, followed by dentists' lack of time disposed to show interest, to listen, and to learn about patients' dental problems (Karydis, Komboli-Kodovazeniti, Hatzigeorgiou, & Panis, 2001). Hence, the time used on the autonomy-supportive competence intervention in the present study is supposed to be of significance in predicting dental attendance indirectly through change in caries competence. These results are supported by a similar intervention predicting oral self-care behaviours and health (Halvari & Halvari, 2006). Research in other fields has identified the causal effect of early education on health-related behaviours and health later in life (Conti & Heckman, 2010). Thus, autonomy-supportive oral health competence promotion among young adults may have a cumulative positive effect on their oral health.

Personality is another causal factor that affects health-related behaviours and health (Conti & Heckman, 2010). As mentioned, in the present study, RALOC predicted dental attendance directly, and it also predicted it indirectly through change in caries competence. Similarly, autonomous personality also predicted attendance in a weight-loss

programme (Williams et al., 1996). In addition, the current intervention moderated the RALOC – dental attendance link. This interaction implies that the intervention has a great appeal to participants high in RALOC (viz., high in autonomy orientation and low in impersonal orientation) and motivates them to visit their dentist, whereas those low in RALOC (viz., high impersonal and low autonomous) were not motivated to visit their dentist (see Table 2 and Figure 3). Not only do people high in impersonal not motivate themselves, but they are also difficult to motivate.

The question remains, how can patients low in autonomy/high in impersonal (i.e. low RALOC) be motivated to see their dentist regularly? Due to relatively long recall intervals for oral health check-ups this is likely to be a difficult task for dental hygienists and dentists. However, frequent dental visits giving competence in an autonomy-supportive way, may over time stimulate patients to internalise a value for the oral health behaviours that result in better quality outcomes. This process of internalisation may take up to 2–3 years before desired changes in behaviour and achievement are attained (Gambone, Klem, Summers, Akey, & Sipe, 2004). Hence, in the process patients are likely to become more self-initiating of and responsible for their oral health behaviours (i.e. more autonomously motivated) and less amotivated when they experience their health behaviours actually affect desired outcomes (Deci & Ryan, 2000).

In addition to RALOC significantly predicting change in caries competence, and dental attendance, it was also shown for the first time to be associated with lower dental anxiety. In turn, low anxiety for treatment was linked to a higher probability of dental attendance. Having a greater RALOC, which provides patients with greater interest in oral self-care and more autonomous regulation of their oral health behaviours, may be an important target of treatment that can result in lower dental anxiety and increase in dental attendance.

In the present study, females were found to be higher in autonomous and lower in impersonal locus than males – that is, females had higher RALOC scores than males. Thus, females are likely to be more autonomous for their oral health behaviour because they perceive them to be more personally important, interesting and positively challenging, and because they feel more personally responsible for their health. These positive indications of autonomous motivation in favour of females might be related to other research in which females, compared to males, have higher positive attitudes toward, and higher knowledge about, oral health behaviours (Buunk-Werkhoven & Dijkstra, 2014).

However, the negative link between gender and anxiety indicated that women had higher levels of dental anxiety than men, which is consistent with the literature (Hill et al., 2013). Because research indicates that men and women do not differ in the rates of having extreme or painful dental experiences, the differences in anxiety may result either from women having less tolerance for pain or from the men and women interpreting painful dental experiences differently. Women may have a higher desire for control over what happens in the dental situation combined with a lower perception of actual control when they are in the dental chair, which could prompt a higher level of dental anxiety (Liddell & Locker, 1997). It is thus interesting that women are higher in autonomy orientation and therefore regulate themselves more effectively but at the same time appear to be lower in perceived control over what happens to them in the dental situation. Further research might explore this matter more fully.

Patients having caries diagnosed during the autonomy-supportive oral exam strongly predicted keeping their appointment with their dentists. Dental hygienists do an important job at dental clinics with exams and oral cleaning by facilitating motivation for following through with treatment. If this work is done in an autonomy-supportive manner in which patients' are provided options for their own decision-making regarding possible treatment, patients will tend to be more likely to feel responsible for their oral health. As a consequence, a larger proportion of them would have appointments with their dentist. This new finding is important for the collaboration between dental hygienists and dentists. Hence, autonomy-supportive dental hygienist exams are of great significance for patients' future oral health. This is particularly important for young adult patients, because their dental attendance usually decreases when they leave free public clinics and have to get their treatments at private pay clinics (Scheutz & Heidmann, 2001).

Autonomy-supportive competence-building interventions give us access to underlying motivational processes through which the interventions work. In the present study, the important motivational constructs concern the autonomy-supportive competence-building intervention stimulating patients with an autonomous personality to attend their dentist, in addition to influencing attendance through increases in caries preventive competence. An autonomous personality also predicted dental attendance directly, as well as indirectly through dental anxiety and change in caries preventive competence. Further, the autonomy-supportive clinical oral exam referring patients to treatment strongly predicted dental attendance.

Given that these motivational processes foster dental attendance and positive health-related outcomes, oral health care professionals should incorporate autonomy-supportive care in their standard instructions and practice to promote an increase in attendance and to promote internalisation of motivation for dental attendance. Longitudinal studies are called for to see whether the promotion of autonomy-supportive oral hygiene care does lead to increased internalisation and increased attendance in the end.

Conclusions

Compared to dentists, dental hygienists normally use significantly more time for each patient visit. Dental hygienists can use this time to fill the quality gap between expectations and perceptions of dental health care reported by patients, by supporting patients' autonomy and competence to care for their teeth and gums, and by providing an autonomy-supportive exam, makes more time available for dentists to use their specialised technical skills in treatment of oral diseases.

Disclosure statement

No potential conflict of interest was reported by the authors.

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