

The theory of reasoned action and patient compliance during orthodontic treatment

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Abstract – *Objectives:* The aim of the present study was to investigate the potential of the theory of reasoned action (TRA) for the prediction and understanding of patients' intention to comply during orthodontic treatment and to analyze the effect of two additional variables in the model, namely perceived behavioral control and anticipated regret. Moreover, (the determinants of) intentions of orthodontic patients to comply during treatment were compared with (the determinants of) intentions of parents to stimulate this cooperation. Methods: A questionnaire was handed out to patients and parents visiting the Department of Orthodontics of the Academic Centre of Dentistry in Amsterdam. In both the patient and parent sample, independent-sample t-tests, correlation analyses and stepwise regression analyses were conducted. Variables in both samples were compared and tested. Results: The extended version of the TRA explained 20% of the variance in the patients' intention to comply. The patients' anticipated regret, attitude and motivation to comply were significant determinants of the patients' intention to comply. In addition, the parents' attitude toward compliance was a significant predictor. The role of parents in enhancing patients' intentions to comply cannot be neglected. Conclusion: Our findings suggest that patients' intentions to comply during orthodontic treatment are influenced by factors outside of the TRA. Therefore, it is recommended to develop a new model, in which factors of the TRA are included, which can be used specifically for the study of compliance in orthodontics.

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The theory of reasoned action (TRA) is one of the most frequently used models to explain human behavior (1). In this attitude–behavior model, it is assumed that a person's intention to perform a behavior is the key predictor of behavioral performance. Moreover, this person's intention to perform a certain behavior is assumed to be determined by the person's attitude, subjective norm, and behavioral and normative beliefs. In dental studies, this model has been used to predict and understand patients' behavior in dental attendance, tooth brushing and oral hygiene behavior (2–5).

The premise of the TRA is that most of people's actions are under volitional control (1). The theory has been criticized for its inability to account for

behaviors under incomplete control (6). In response to this criticism, an extended version of the model was proposed (7), known as the theory of planned behavior (TPB). In this extended model, the notion of perceived behavioral control was introduced. It was assumed that, next to people's attitude and subjective norm, also people's perceived behavioral control effected the intention to perform a certain behavior. Furthermore, it was asserted that perceived behavioral control can also affect behavior directly if there is some agreement between perceptions of control and the person's actual control over the behavior.

As the TPB seems to be rather unspecific about the role of effect, even though it has been suggested

that effect can predict behavior more than beliefs and evaluations (8, 9), researchers added anticipated regret as an additional variable to the theory of planned behavior (6, 10, 11). In regret theory, it is assumed that when people make decisions, they compare the outcome of a decision with what the outcome would have been, had a different decision been made. As people, in general, try to avoid negative emotions like regret and strive for positive emotions like rejoicing, anticipated regret is considered to be an important determinant of human decision making (11).

Evidently, in orthodontics, patients have to make many decisions. They have to wear their braces, to take care of their oral hygiene, to visit the orthodontist regularly, to maintain a diet, etc. Everyday, patients have to decide whether or not they will do what they are expected to do. Although the TRA seems to contain many factors that may contribute to the patients' intention to comply during orthodontic treatment, as far as our knowledge goes, this model was not used for the study of patient compliance in orthodontics so far.

Still, the extended version of the TRA seems an appropriate model to explain patient compliance during orthodontic treatment. However, as most orthodontic patients are children or adolescents, their intention to comply may not only be determined by their own attitudes and subjective norms, but may also be related to the intention of their parents to stimulate their child to comply during treatment. Therefore, it is considered worthwhile not only to examine the relation between attitude, subjective norms and the intention of patients to comply, but also to examine possible relations between these variables and the attitude, subjective norms, and intention of the parents.

The aim of the present study was to study the potential of the TRA for the prediction and understanding of patients' intention to comply with orthodontic treatment and to investigate the effect of two additional variables in the model, namely perceived behavioral control and anticipated regret. Furthermore, (the determinants of) intentions of orthodontic patients to cooperate during treatment were compared with (determinants of) intentions of their parents to stimulate this cooperation. It was hypothesized that the intention of parents to stimulate their son or daughter to cooperate was related to the intention of the patient to comply and that the attitude, beliefs and subjective norm of parents were related to the attitude, beliefs and subjective norm of patients. Finally, it was exploratively examined whether female and male parents differed with regard to their motivation to stimulate their childrens' compliance and their feelings of responsibility for their childrens' behavior.

Material and methods

Questionnaire for patients

From April 2003 to February 2004, a questionnaire was handed out to all patients visiting the Department of Orthodontics of the Academic Centre of Dentistry in Amsterdam immediately after discussing their treatment plan with an orthodontist. Following the suggestions of Ajzen and Fishbein (1), all items were generated for the study of compliance in orthodontics. The questionnaire consisted of 40 items based on the TRA, plus five items about perceived control and five items about anticipated regret, which were all answered on a five-point scale, and a few demographic questions. The extended TRA model is presented in Fig. 1.

In accordance with the TRA, intention to comply during orthodontic treatment was assessed by one item, 'I intend to follow up all the advice of the orthodontist', which was answered with endpoints 'yes, absolutely' to 'no, absolutely not'. The patients' attitude towards compliance was measured by five items, asking patients how important, efficient, useful, pleasant and easy they considered compliant behavior. A sum score was computed, so that one total attitude score was formed for each respondent (ranging from 5 to 25). The determinants of this attitude, i.e. the patients' behavioral beliefs and their evaluations of treatment outcomes were measured by 22 items. A sum score for patients' beliefs was computed by summing up scores on all 11 items which measured this concept (sum score ranging from 11 to 55). An example of such an item is 'If I comply, I will get healthy teeth'. Endpoints of the response scales were 'yes, absolutely' to 'no, absolutely not'. A sum score was also computed for the 11 items that measured the patients' evaluations of treatment outcomes. On this scale, patients were asked for example 'To get healthy teeth is....' The response scale ranged from very important to very unimportant. Subjective norm was assessed by asking subjects 'Most people who are important to me think I should comply with orthodontic treatment'. The response scale ranged from 'yes, I agree absolutely' to 'no, I don't agree at all'. The two determinants of this subjective norm, 'normative



*Perceived control and anticipated regret are added to the original TRA model as two extra variables.

Fig. 1. The TRA model (1) with two extra variables.

beliefs' and 'motivation to comply', each were measured by five items (e.g. 'My mother thinks I should comply' and 'Most of the time, I am willing to do what my mother wants me to do'). Sum scores on these scales varied from 5 to 25.

An example of the perceived control scale is 'I think I will be able to follow up the advice of the orthodontist'. Responses varied from 'yes, absolutely true' to 'no, absolutely not true'. On the anticipated regret scale, subjects were asked for instance 'I think I will regret it later if I don't comply during orthodontic treatment'. Endpoints of the response scales were 'I absolutely agree' to 'I absolutely don't agree'. Each scale contained five items and had a sum score varying from 5 to 25.

Originally, a low sum score with regard to, e.g. attitude would indicate that the patient had a positive attitude toward orthodontics. To make sum scores easier to interpret, all variables were recoded, except item 31, so that a high sum score does indicate a positive attitude, positive beliefs, positive evaluations of treatment outcomes and a high level of perceived control and anticipated regret. Item 31 was formulated negatively ('I think I will not have enough time to do everything the orthodontist asks me to do'), so evidently a high score on this item indicated a positive perception of personal control.

TRA questionnaire for parents

The parent or caretaker of the patient was also requested to complete a questionnaire. This

questionnaire contained 30 items based on the TRA model, plus five items about perceived control and five items about anticipated regret, and a few demographic questions. We added 15 extra items, in order to examine possible differences between male and female parents/caretakers with regard to their ideas about orthodontic treatment.

The same TRA-based statements and response scales were used as in the patient sample, although most statements were slightly reformulated, so that they were suitable for parents. For instance, instead of stating 'I intend to follow up the advice of the orthodontist', for parents it was stated 'I intend to stimulate my son/daughter to follow up the advice of the orthodontist'. Or, to give another example, instead of stating 'When I follow up the advice of the orthodontist, my teeth will look prettier after treatment', it was stated 'When my son/daughter follows up the advice of the orthodontist, his/her teeth will look prettier after treatment'. Again, all items, except item 31, were rescored.

Sample

A total of 157 patients and parents/caretakers completed the questionnaires. In the patient sample, 91 females (mean age 12.00, SD 1.58, range 9–17) and 66 males (mean age 12.44 years, SD 1.37, range 10–16) responded. In the parent/caretaker sample, 115 females (mean age 41.60 years, SD 6.34, range 18–60) and 40 males (mean age 45.68 years,

SD 6.23, range 36–68) participated. Two parents did not indicate their gender.

Statistical analyses

First the questionnaires were analyzed separately. After determining the scale characteristics of both questionnaires, it was decided to exclude item 6 ('I think it will be very difficult-very easy to comply during orthodontic treatment') from further analyses, as this item correlated negatively with the other attitude items. Thereby, the maximum sum score on the subscale attitude decreased from 25 to 20.

In both samples, all variables were compared for gender, using two-tailed independent-samples t-tests. Correlations between variables were examined, and in both samples a stepwise regression analysis was performed. In the patient sample, the patients' intention to comply was taken as criterion variable, in the parent sample, the parents' intention to stimulate their child to comply was the criterion variable. The explorative items for parents were analyzed on item level, and two-tailed independent samples t-tests were used to examine possible differences between male and female parents/caretakers. As recommended by Bonferroni, in order to reduce the type 1 error rate, in some cases the critical significance level was adjusted (12).

After analyzing the variables in both samples separately, the scores of both groups with regard to intention, attitude, behavioral beliefs, outcome evaluations, subjective norm, perceived control and anticipated regret were compared using two-tailed paired samples *t*-tests. Correlations between these variables in both samples were analyzed. Moreover, two additional stepwise regression analyses were performed. The predictive value of the

subscale sum scores in the patient sample was tested for the parents' intention to stimulate the child to comply, and the predictive value of the subscale sum scores of the parents was analyzed for the patients' intention to comply. Because of missing values, the number of respondents in the analyses is variant.

Results

Patient sample

The results of the two-tailed independent samples *t*-tests showed that female patients scored somewhat higher than male patients on the subscale 'normative beliefs' [mean score females (n = 89) 21.33, mean score males (n = 64) 19.72, t = -3.99, P < 0.01]. On all other subscales, no gender differences were found.

The intention of patients to comply during orthodontic treatment was significantly correlated with the patients' attitude, behavioral and normative beliefs, subjective norm, motivation to comply, perceived control and anticipated regret. In Table 1, the results of the correlation analysis are presented.

The results of the stepwise regression analysis showed that anticipated regret, attitude and motivation to comply were significant predictors for the patients' intention to comply [F(3,138) = 11.15, P < 0.001]. The TRA accounted for 20% of the variance in the patients' intention to comply. When anticipated regret was excluded from the analysis, the TRA explained 16% of the variance in patients' intentions [F(2,139) = 13.53, P < 0.001].

Parent sample

Two small but statistically significant differences in subscale sum scores were found between the male

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.00										
0.34*	1.00									
0.22*	0.46*	1.00								
0.15	0.12	0.40*	1.00							
0.30*	0.24*	0.30*	0.09	1.00						
0.31*	0.34*	0.42*	0.19	0.61*	1.00					
0.31*	0.23*	0.32*	0.19	0.44*	0.56*	1.00				
0.22*	0.34*	0.41*	0.10	0.32*	0.38*	0.17	1.00			
0.35*	0.43*	0.34*	0.23*	0.31*	0.40^{*}	0.28*	0.39*	1.00		
0.10	0.07	0.02	0.03	0.13	0.31*	0.10	0.07	0.08	1.00	
-0.04	-0.06	-0.09	-0.05	0.02	0.02	0.00	0.01	-0.04	-0.15	1.00
	$(1) \\ 1.00 \\ 0.34^* \\ 0.22^* \\ 0.15 \\ 0.30^* \\ 0.31^* \\ 0.31^* \\ 0.22^* \\ 0.35^* \\ 0.10 \\ -0.04 \\ (1)$	$\begin{array}{ccccc} (1) & (2) \\ \hline 1.00 \\ 0.34^* & 1.00 \\ 0.22^* & 0.46^* \\ 0.15 & 0.12 \\ 0.30^* & 0.24^* \\ 0.31^* & 0.34^* \\ 0.31^* & 0.23^* \\ 0.22^* & 0.34^* \\ 0.35^* & 0.43^* \\ 0.10 & 0.07 \\ -0.04 & -0.06 \end{array}$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$

Table 1. Results of correlation analysis in patient sample (n varies from 147 to 157)

*Correlation is significant at the 0.01 level (one-tailed).

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		
(1) Intention	1.00										
(2) Attitude	0.35*	1.00									
(3) Behavioral beliefs	0.04	0.30*	1.00								
(4) Outcome evaluations	-0.02	0.16	0.38*	1.00							
(5) Subjective norm	0.02	0.24*	0.44*	0.15	1.00						
(6) Perceived control	0.10	0.17	0.23*	0.01	0.10	1.00					
(7) Anticipated regret	0.25*	0.32*	0.33*	0.23*	0.19*	0.32*	1.00				
(8) Gender	0.07	0.22*	0.17	0.15	0.04	-0.13	0.22*	1.00			
(9) Age	-0.02	-0.04	-0.11	-0.09	-0.09	0.03	0.06	-0.27*	1.00		

Table 2. Results of correlation analysis in parent sample (*n* varies from 146 to 157)

*Correlation is significant at the 0.01 level (one-tailed).

and female parents/caretakers. On the subscale attitude, females scored somewhat higher than males [mean score females (n = 111) 18.37, mean score males (n = 40) 17.70, t = -2.74, P < 0.01] and on the subscale anticipated regret, females also scored somewhat higher [mean score females (n = 113) 23.35, mean score males (n = 39) 22.08, t = -2.70, P < 0.01]. The intention of parents to stimulate their child to comply was correlated with the parents' attitude and anticipated regret. The results of the correlation analysis are given in Table 2.

The stepwise regression analysis showed that parents' anticipated regret as well as parents'

attitude toward compliance were significant predictors for the intention of parents to stimulate their child to comply. The TRA accounted for 16% of the variance in the parents' intention to stimulate their child to comply during orthodontic treatment [F (2,135) = 12.85, P < 0.001]. When anticipated regret was excluded from the analysis, only 13% of the variance in parents' intentions was explained by the TRA [F(1,136) = 20.34, P < 0.001].

Finally, the 15 explorative items of the parents questionnaire were analyzed. In Table 3, mean scores, standard deviations and results of two-tailed independent samples *t*-tests on these items are presented.

Table	3.	Mean	values,	standard	deviations	(SD)	and	Student's	<i>t</i> -values	for	differences	between	item	scores	of	male
(n =	40) and f	emale (1	<i>n</i> varies fr	om 113 to 1	l 15) p	aren	its/caretake	ers							

	Females, mean (SD)	Males <i>,</i> mean (SD)	<i>t</i> -value	<i>P</i> -value
41. The orthodontist thinks I should stimulate my child to comply	4.59 (0.61)	4.33 (0.62)	-2.39	n.s
42. I will do my best to stimulate my child to comply	4.83 (0.40)	4.80 (0.41)	-0.35	n.s.
43. I care a lot about how people around me think about the compliant behavior of my child	2.42 (1.34)	2.95 (1.38)	2.15	n.s.
44. I do not care what others think about the orthodontic treatment of my child	4.06 (1.17)	3.98 (1.07)	-0.41	n.s.
45. I think it is important that my child is compliant	4.90 (0.33)	4.70 (0.46)	-2.87	n.s.
46. I will be able to stimulate my child to comply	4.60 (0.59)	4.60 (0.50)	0.00	n.s.
47. My child is able to comply independently of me; I do not need to stimulate this behavior	3.36 (1.14)	3.33 (1.29)	-0.17	n.s.
48. If I stimulate my child to comply, this will affect the treatment result	4.46 (0.73)	4.25 (0.71)	-1.55	n.s.
49. It is not relevant for the treatment result whether or not I stimulate compliant behavior in my child	2.27 (1.23)	2.25 (1.35)	-0.08	n.s.
50. I won't be able to stimulate my child to be compliant	1.88 (1.13)	2.05 (1.22)	0.81	n.s.
51. It will not cause me any trouble to stimulate my child to comply	4.10 (1.09)	3.90 (1.13)	-0.97	n.s.
52. If my child gets a better occlusion because of the orthodontic treatment, I will not feel regret that I did stimulate his/her compliant behavior	4.87 (0.39)	4.75 (0.44)	-1.63	n.s.
53. If my child will not get a good treatment result because of noncompliant behavior, I will feel regret because I didn't stimulate him/her better to comply	4.56 (0.80)	4.25 (0.78)	-2.11	n.s.
54. I consider myself to be responsible for the stimulation of my childs' compliance during orthodontic treatment	4.76 (0.52)	4.45 (0.55)	-3.22	< 0.01

Although females scored slightly higher than males on almost every single item (except item 43, 46 and 50), only one small but significant difference between item scores of male and female caretakers was found. Females, more often than males, consider themselves to be responsible for the stimulation of their child's compliance during orthodontic treatment (item 54).

Interestingly, of all parents, 61 (39%) had undergone orthodontic treatment themselves, but no differences in item or sum scores between treated and untreated parents were found. Moreover, no differences in subscale sum scores were found between parents/caretakers of a male or a female patient.

Comparison of results of both samples

The two-tailed paired samples *t*-test used to compare the (determinants of the) intention of patients to comply with the (determinants of the) intention of parents to stimulate their child to comply revealed three differences. In Table 4, mean values and standard deviations of the subscale sum scores in the patient and parent sample, as well as Student's *t*-values, are presented.

Parents score slightly higher than patients on every subscale except 'subjective norm', but the difference is only significant on the subscales 'intention', 'attitude' and 'perceived control'. With regard to the maximum sum score of each sale, both patients and parents score relatively high on the subscales 'intention' and 'anticipated regret' and relatively low on the subscales 'behavioral beliefs' and 'perceived control'.

The results of the correlation analyses of the intentions, attitudes, behavioral beliefs, outcome evaluations, subjective norms, perceived control and anticipated regret of patients and parents are presented in Table 5.

As can be seen in Table 5, the behavioral beliefs of patients and parents are highly intercorrelated (r = 0.53, P < 0.01). However, the patients' intention to comply was correlated only to the attitude of the parent towards compliance. This result was confirmed by a stepwise regression analysis, in which the subscale sum scores of the parents were examined as predictors for the patients' intention to comply. Only the parents' attitude was a significant predictor for the patients' intention to comply [F(1,137) = 8.74, P < 0.01]. The parents' attitude explained 6% of the variance on intention.

A stepwise regression analysis in which the subscale sum scores of the patients were exploratively tested as possible predictors for the parents' intention to stimulate their child to comply showed no significant results.

Table 4. Mean values, standard deviations (SD) and Student's *t*-values for differences between sum scores of patients and parents (*n* varies from 144 to 156)

	Patients, mean (SD)	Parents, mean (SD)	<i>t</i> -value	<i>P</i> -value
(1) Intention $(n = 156)$	4.61 (0.56)	4.93 (0.26)	-6.55	< 0.01
(2) Attitude ($n = 152$)	17.30 (1.83)	18.20 (1.36)	-5.49	< 0.01
(3) Behavioral beliefs ($n = 144$)	42.63 (5.17)	42.82 (4.84)	-0.48	n.s.
(4) Outcome evaluations ($n = 146$)	47.18 (4.76)	47.72 (4.30)	-1.19	n.s.
(5) Subjective norm $(n = 154)$	3.90 (0.97)	3.77 (1.09)	1.12	n.s.
(6) Perceived control ($n = 148$)	18.30 (2.55)	19.11 (2.17)	-3.09	< 0.01
(7) Anticipated regret ($n = 151$)	22.50 (2.83)	22.99 (2.62)	-1.67	n.s.

Table 5. Correlations between variables of both samples (n varies from 143 to 157)

	Variables in patient sample:										
Variables in parent sample:	(1)	(2)	(3)	(4)	(5)	(6)	(7)				
(1) Intention	0.03	0.06	0.02	-0.07	-0.00	0.00	-0.04				
(2) Attitude	0.23*	0.22*	0.23*	0.10	0.01	0.21*	0.25*				
(3) Behavioral beliefs	0.11	0.20*	0.53*	0.07	0.17	0.28*	0.18				
(4) Outcome evaluations	0.02	0.14	0.27*	0.27*	0.05	0.12	0.17				
(5) Subjective norm	0.09	0.13	0.16	-0.03	0.11	0.10	0.10				
(6) Perceived control	0.14	0.10	0.20*	0.03	0.06	0.11	0.02				
(7) Anticipated regret	0.12	0.24*	0.26*	0.08	0.13	0.07	0.13				

*Correlation is significant at the 0.01 level (one-tailed).

Discussion

The results of this study suggest that the TRA can be used successfully in the study of patient compliance in orthodontics. The TRA accounted for 20% of the variance in the patients' intention to comply. Although this result is relatively low compared with other studies in which the explained variance in intentions is 40-50% when attitudes, subjective norms and perceived behavioral control are considered together (10, 13, 14), it is relatively high when one takes into account that the model was tested among a population of children. Most models for the measurement of cognitive phenomena were originally developed for adults, and the reliability and validity of these models for children is not firmly established (15). The TRA is no exception to this rule. However, it has been stated before that the TRA is appropriate as a model of pre-adolescent children's decision processes (16), and this finding was confirmed by our results.

Although it has been suggested that childrens' intentions may be primarily a function of norm, rather than attitude (16), it is interesting to note that the childrens' attitude toward compliance was a significant predictor for their intention to comply.

Ajzen (17) has stated that perceived control can account for considerable variance in intentions, but this variable did not seem to increase the explanatory power of the model in our study. However, the variable anticipated regret did have predictive value. This suggests that the variable anticipated regret is a useful extension of the TRA. As regret is only one of a variety of anticipated emotions that might influence intentions, in a future study the efficacy of anticipated regret could be compared with for example the anticipation of guilt or embarrassment (10).

Interestingly, the intention of patients to comply was also predicted by the parents' attitude toward compliance. In order to increase the patients' intention to comply, it may therefore be useful in daily practice to focus not only on patients' attitudes, anticipated regret or motivation to comply, but also to pay extra attention to the parents' attitude as a determinant of their child's compliance.

The intention of patients to comply in the absolute sense was lower than the intention of parents to stimulate their child to comply. Moreover, the attitude of patients toward compliance and their perceived control was less positive. This may suggest that parents, at the start of treatment, believe more profoundly that compliance is necessary to get a successful treatment result, that parents are more motivated to make sure this result is reached, and that parents are more confident about the abilities of patients to cooperate than the patients themselves.

On the subscale 'normative beliefs', girls scored higher than boys. As we found no differences in subjective norms of parents of boys or girls, this difference may reflect that girls are more susceptible than boys for the opinions of others about their compliant behavior. The differences found between male and female parents were relatively small and therefore are considered to have little clinical relevance.

To conclude, it has been stated before that the TRA is an accurate description of some behaviors, for some people, in some situations, whereas for other behaviors - and for other people, in other situations - more or less major changes to the TRA should be incorporated (18). Of course, on the basis of the present study, only any definite conclusion about the use of the TRA in the field of orthodontics is preliminary. We may add, for instance, that, as indicated in Table 4, several variables show a restricted variability, and it is well known that such a restriction of range and the size of the correlation coefficients found are related. Indeed, this is a major problem in research, because restricted variability of key variables may affect the outcome of analyses, and influence the size of correlation coefficients, as well as which variables are included as significant parameters in the regression analyses, and the proportion of explained variance of the final models.

However, our findings do suggest that patients' intentions to comply during orthodontic treatment are influenced by factors outside of the TRA. Therefore, it is recommended to develop a new theoretical model, in which factors of the TRA are included, which can be used specifically for the study of compliance in orthodontics. In this model, factors like the complexity of the regimen; the situational aspects of the treatment; and the patients' views on disease and treatment should be included. Indeed, it seems evident that for a better understanding of patient compliance in orthodontics, more theory-based research is needed.

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