Relationship between compliance by adolescent orthodontic patients and performance on psychological tests

By Antonio Cucalon III, DDS, MS; and Richard J. Smith, DMD, PhD

The pattern of facial growth and the degree of compliance exhibited by a patient are two factors over which the orthodontist has limited control. From the amount of research on each of these topics in the orthodontic literature, it would seem that facial growth is far more important than patient compliance to the orthodontist. Yet this often is not the case. A patient who is either a "poor grower" or a "poor cooperator" will substantially limit the quality of orthodontic treatment, while the "good grower" or the "good cooperator" generally indicates a patient for whom much can be achieved.

It is evident that we have much to learn about predicting and controlling compliance during orthodontic treatment. Several studies have documented that compliance with medical regimens by adolescents is related to socioeconomic, social and psychological variables.[1-4] In this study, we use three previously published and validated psychological inventories which identify socioeconomic and psychological variation in adolescents, and test their value in predicting compliance by adolescent orthodontic patients.

Materials and methods

A total of 252 orthodontic patients between 11 and 17 years of age were included in this study. Patients were selected from the graduate orthodontic clinic at Washington University School of Dental Medicine and from two private practices in Northern California. The distribution of patients by sex, practice location and race are listed in Tables 1 and 2.

All patients were categorized as exhibiting either good, fair, or poor compliance. The criteria used in defining compliance included: 1) oral hygiene, 2) appliance maintenance and care, 3) rubberband and/or headgear wear, and 4) missing and/or being late for scheduled orthodontic

Abstract

Two hundred and fifty-two adolescent orthodontic patients were categorized according to their general level of compliance during orthodontic treatment. Each patient completed three standardized psychological tests, (1) The Comprehensive Personal Assessment System: Self-Report Inventory, by Oliver H. Bown, (2) The Adolescent Alienation Index, by F.K. Heussenstamm, and (3) The Home Index, by Harrison Gough. The most important variable in predicting compliance was the sex of the patient. Females were more compliant than males. The psychological tests indicated that more compliant patients scored higher on self-esteem, derived self-satisfaction from personal achievement, were optimistic regarding the future, had higher socioeconomic status and had a low degree of general alienation from society. These easy-to-administer, brief psychological inventories could be helpful to clinicians in anticipating compliance problems during orthodontic treatment.

This manuscript was submitted March 1989.

Key Words

Orthodontic treatment • Adolescence • Compliance • Psychological testing

Table 1
Distribution of Patients by Location of Study

Source	Sample Size	% of Sample Size	Males	%	Females	%
Washington University Clinic	208	82.6%	98	38.9%	110	43.7%
California Private Practices	44	17.4%	18	7.1%	26	10.3%
Total	252	100%	116	46.0%	136	54.0%

Table 2
Racial Distribution of Patients

Race	Sample Size	% of Sample Size
Caucasian	108	71.1%
Black	24	9.5%
Asian	5	2.0%
No Data	43	17.4%
Total	252	100%

appointments. Good oral hygiene was defined as consistently clean appliances with minimal presence of gingivitis. Good appliance maintenance and care referred to the absence of broken or distorted appliances and few loose bands and/or brackets during the treatment period. Good rubberband and headgear compliance referred to continuous wear of each item as directed by the orthodontist. Good compliance with regard to missing and/or being late for appointments was judged by the number of absences and latenesses over the period of active treatment. Patients categorized as exhibiting good compliance performed well in all of the above areas, fair compliance indicates that while there were some problems in one or more categories, there was no category in which the patient could be considered negligent. Poor compliance meant that the patient was negligent in most areas or in one area to an extent that treatment was significantly compromised. Thus, good compliers facilitated treatment, poor compliers substantially hindered treatment, and average compliers allowed routine orthodontic treatment to proceed in a conventional fashion. All patients were in active treatment at the time of the study, and had been seeing the orthodontist who evaluated their compliance level for at least one year.

After categorization of patients, three questionnaires were administered:

1) Comprehensive Personal Assessment System: Self-Report Investory, by Oliver H. Bown.[5,6]
2) The Adolescent Alienation Index, by F.K. Heussenstamm.[7]
3) The Home Index, by Harrison Gough.[8,9,10]

These questionnaires measure different aspects of the adolescent's personality and environment, such as self-concept, socioeconomic status of the family and the extent of alienation of the adolescent from society.

These particular tests were selected from among many hundreds that are available [11] for practical reasons relevant to orthodontists in private practice. They are all simple to obtain, administer, and interpret. They are short in length, possess a relatively simple scoring procedure, and unlike many other commercially available psychological tests, do not require membership in the American Psychological Association or other documentation of psychological training to obtain them from the publisher. Thus, if useful, they could be incorporated into orthodontic practices without difficulty.

Most patients completed all three surveys in approximately thirty minutes.

Description of each questionnaire

1. **Comprehensive Personal Assessment System: Self-Report Inventory (SRI)**

The SRI was developed by Oliver H. Bown in 1958, and is presently in its third revision. Subjects are asked to evaluate their perceptions and feelings toward themselves and the significant relationships in their lives. This forty-eight item, paper-pencil, multiple choice questionnaire consists of eight sections:

a) *Self:* Items which express acceptance, the liking or valuing of oneself.
b) *Others:* Items which express acceptance, the liking or valuing of peers, or the importance of satisfying relationships with peers to one's own sense of well-being.
c) *Children:* Items expressing the acceptance, liking or valuing of children, or the satisfaction derived by the subject in a relationship with children.
d) *Authority:* Items which express acceptance, the liking or valuing of older persons outside the family who are in positions of authority with respect to the subject.
e) *Work:* Items expressing a value of work or accomplishment for intrinsic or self-enhancing satisfaction to the subject.
f) *Reality:* Items expressing the acceptance or valuing of life as a process (including death).
g) *Parents:* Items expressing acceptance, liking or valuing of one's own parents or the importance of one's relationship with parents to one's own sense of well-being.
h) *Hope:* Items expressing an optimistic anticipation of the future or a sense of confidence that one will play a significant and satisfying role in future relationships and undertakings.

Responses on the SRI are indicated by a five-point scale that expresses the extent to which the item reflects an individual's own feelings and attitudes. The scale runs from "very much like me" to "very much unlike me." The inventory yields eight subscores in the above-listed categories, with a total score computed from the eight subscores.

2. **The Adolescent Alienation Index (AAI)**

The Adolescent Alienation Index (AAI) was devised by F.K. Heussenstamm[7] in an attempt to determine the extent of "alienation" a child has developed, defined in five categories:

a) *Powerlessness:* The extent to which an individual holds the attitude that his own behavior cannot control the occurrence of events.
b) *Meaninglessness:* The condition that prevails when an individual is unclear as to what he ought to believe.
c) *Normlessness:* The situation in which there is a high expectancy that socially unapproved behaviors are required to achieve given goals.
d) *Social Isolation:* The individual who in thought and behavior is one who has become estranged from society and the culture it carries.
e) *Self-Estrangement:* The feeling that there is some ideal human condition from which the individual has fallen away or has become estranged.

The test consists of forty-one items. Responses involve choosing between two self-descriptive statements for each test item and selecting the one which best approximates the individual's own feelings. A single overall degree of alienation is determined with no subscores. Norms for the AAI are based upon suburban White, urban Black, and rural Mexican-American high school students.

3. **Home Index**

The Home Index, developed by Harrison Gough,[8] is a twenty-two item, true-false inventory. The Index assesses information from junior high and high school students concerning their home backgrounds and socioeconomic status. Socioeconomic status refers to the standing that an individual or family has attained in a community, with specific regard to material well-being, and the educational, residential, and other advantages that are linked to visible attainment.

The Home Index measures four areas of the adolescent's family background: a) social status, b) ownership, c) socio-civic involvement, and d) esthetic involvement.

Scoring on the Home Index is accomplished by tallying the number of "yes" responses. Students scoring higher on the Index tend to be more comfortable in meeting social demands and interpersonal situations. Also, these adolescents are argued to be better able to focus and direct their ability and to be more optimistic about what their future holds.

Norms for each of the four subsections and for the combined overall score are based on 4,381 junior and senior high school students in a nationwide sample.

Statistical analysis

Data were analyzed with the Statistical Analysis System.[12,13] Chi-Square analysis was used to evaluate differences in compliance by age, sex, race and testing site.

Differences between compliance categories on each of the twelve sub-sections and three overall scores available from the three tests were evaluated by a two-way Analysis of Variance. Stepwise Logistic Regression[13,14] was used to determine if a multivariate combination of test sections could be significant in predicting levels of compliance.

Results

The distribution of patients in the three levels of compliance is shown in Table 3.

The results of a Chi-Square analysis (Table 4) for differences in compliance related to age, sex, race and practice type (University clinic versus private practice) indicate that the only variable

Table 3
Distribution of Patients by Level of Compliance

Compliance	Sample Size	% of Sample Size	Males	%	Females	%
Poor	63	25.3%	40	15.9%	23	9.2%
Fair	87	34.4%	40	15.9%	47	18.7%
Good	102	40.3%	36	14.2%	66	26.2%
Total	252	100%	116	46%	136	54%

Table 4
Chi-Square Analysis for Differences in Compliance for Descriptive Variables

Variable	Chi-Square	Significance
Source:		
Wash. Univ. Clinic vs. Private Practices	0.121	0.94 (n.s.)
Race:		
Caucasian, Black, Asian	0.936	0.919 (n.s.)
Sex:		
Male, Female	1.461	0.002**
Age:		
14 years and under vs. 15 years and over	0.889	0.641 (n.s.)

with a significant relationship to compliance was sex ($p<.002$), with females much more likely to exhibit good compliance and males poor compliance.

The effect of age on compliance was also evaluated with a one-way Analysis of Variance. The F ratio between age groups was 0.04, with a probability of 0.957, indicating no significant difference in age among the three compliance groups. The mean ages of patients in the good, fair and poor categories were 14.59, 14.64 and 14.51 years, respectively.

The distribution of scores on the psychological tests were first examined for deviations from normality. Most results are close to being normally distributed. However, parametric statistical evaluation of the Home Index Ownership subscale should be interpreted with caution because of excessive negative skewness and positive kurtosis. The Home Index Esthetic subscale should also be interpreted with caution because scores on this test only range in value from 0-2. The Ownership subscale was later found to be non-significant for compliance, while the Esthetic subscale was significantly different between groups.

Data were pooled for age, race and source of patients, as the Chi-Square tests showed no significant differences in cooperation for these variables. Because sex was significant, scores on each psychological subtest were evaluated by a two-way Analysis of Variance, using compliance and sex as the main effects. The results are shown in Table 5. The Home Index Esthetic subscale was included after a non-parametric Kruskal-Wallis One-Way Analysis of Variance[14] showed it to be significant for both compliance (Chi-Square 12.90, $p<.002$) and sex (Chi-Square 9.87, $p<.002$).

Of the 15 psychological test scores generated for each patient, Table 5 indicates that six are significantly different for compliance ($p<.05$). Four of these six also are significant for sex differences. However, there are no significant interactions between compliance and sex. The six significant tests for predicting compliance are:

1) Home Index: Esthetic Subscale
2) Home Index: total score
3) Adolescent Alienation Index
4) Self-Report Inventory: Self Subscale
5) Self-Report Inventory: Work Subscale
6) Self-Report Inventory: Hope Subscale

When the scores for patients with good and poor compliance on these six tests were placed on histograms, it was evident that in spite of statistical significance there was sufficient overlap between groups to make it inappropriate to attempt to predict compliance with any reason-

Table 5
Two-Way Analysis of Variance Comparing Test Scores with Compliance Levels and the Sex of the Patient

	Main Effects				Interactions	
	Comp.		Sex		Comp. X Sex	
	F	Sig.	F	Sig.	F	Sig.
Home Index: Social Status	2.47	0.09	0.03	0.86	0.20	0.82
Home Index: Ownership	1.01	0.37	0.00	0.97	0.46	0.63
Home Index: Civic Involvement	1.16	0.32	1.88	0.17	0.57	0.57
Home Index: Esthetics	5.12	0.01*	4.91	0.03*	0.86	0.42
Home Index: Total Score	4.75	0.01*	0.95	0.33	0.03	0.97
Adolescent Alienation Index	4.95	0.01*	7.56	0.01*	1.40	0.25
SRI: Self	4.78	0.01*	1.33	0.25	0.24	0.78
SRI: Others	1.05	0.35	15.10	0.00*	0.09	0.91
SRI: Children	1.32	0.27	14.70	0.00*	0.34	0.71
SRI: Authority	2.38	0.09	8.16	0.00*	0.77	0.47
SRI: Work	3.09	0.05*	4.36	0.04*	0.33	0.72
SRI: Reality	2.19	0.11	2.48	0.12	0.04	0.97
SRI: Parents	2.17	0.12	4.34	0.04*	0.93	0.40
SRI: Hope	3.47	0.03*	4.12	0.04*	0.47	0.63
SRI: Total	2.25	0.11	5.13	0.02*	0.33	0.72

able degree of clinical accuracy from a single test score. The next step in the analysis, therefore, was to use Stepwise Logistic Regression to determine whether or not a multivariate combination of scores could be used for clinical prediction.

For this analysis, all psychological tests and subtests, as well as sex, were used as predictors, except that only the total score on Gough's Home Index was used. The four Home Index subtests were excluded because of the non-normal distribution of two of these four items. The four variables entering the equation, in order of importance, are as follows, with Chi-square values and probabilities as indicated: 1) sex (9.21, $p = .002$), 2) Home Index: total score (6.32, $p = .012$), 3) Self-Report Inventory: Children subscale (7.13, $p = .008$), and 4) Adolescent Alienation Index (8.26, $p = .004$). The ability of these test scores to predict compliance was limited. When predictability was increased by excluding fair complying patients, the equation correctly predicted 73 percent of the good and poor compliers, with a false positive rate of 16 percent and false negative rate of 11 percent.

Discussion

Although orthodontists often refer to the *cooperation* of orthodontic patients, the term *compliance* is generally preferred in the literature on patient behavior. As discussed by Romano,[15] the description of a patient as uncooperative indicates a judgment concerning the character of the patient, while non-compliance indicates only the observable fact that the patient did not do as told.

For all three tests, the mean scores for the orthodontic patients were within one standard deviation of the published normative values. The division of subjects in this study into age groups, 11- to 14-years-old and 15- to 17-years-old, was not found to be significant in predicting compliance. Studies that have found age to be a significant variable generally report that the younger age categories are more compliant.[16,17,18]

More significant than any psychological test score in predicting compliance was the sex of the patient. While the sample included 136 females and 116 males, the good complier group was 65 percent female and the poor complier group was 63 percent male. Starnbach and Kaplan[19] also found sex to be an important factor in compliance. They attributed this to the fact that orthodontics is concerned with improving appearance, which is of greater concern to adolescent girls. Females also generally mature more quickly than males and are more capable of complying with treatment in an adult fashion. Kreit, Burstone and Delman[20] also concluded that most females comply better than most males, and that sex was an accurate predictor of compliance. Russell[21] conducted tests on oral hygiene and found female patients exhibited better oral hygiene. In the present study, females frequently scored higher than males within each level of compliance. For example, on the Self-Report Inventory: Self Subscale, the female participants in each compliance category scored higher than males. It should be noted, however, that a sex difference in compliance is not always observed. Jacobson et al.[2] found no sex difference in compliance with therapeutic regimens in 9- to 15-year-old adolescents with insulin-dependent diabetes mellitus.

Six text scores are statistically significant ($p<.05$) in differentiating between levels of compliance. These are the subscales of the Self-Report Inventory dealing with Self, Work, and Hope, the Esthetic subscale of the Home Index, the overall Home Index, and the overall Adolescent Alienation Index. Although these test scores could not accurately predict patient compliance, they are useful as indications of the psychological parameters in patients related to differences in compliance.

The questions in the Self-Report Inventory: Self subsection dealt with attitudes regarding an individual's basic self-concept. The higher the score on the test, the greater the self-esteem. The test score averages indicate that patients with poor compliance lack self-esteem, while good compliance is associated with a positive self-concept. These results confirm the suggestion of Miller and Larson,[22] that one reason patients did not comply with their orthodontist was because they have a negative self-concept. Since a primary aim of most orthodontic treatment is esthetic, they suggest that individuals with a low level of self-esteem would not want to look better because they do not feel better. This also corresponds with Albino's [23] observation that better compliers sought orthodontic treatment to improve the negative psychological impact of their malocclusion. The positive relationship between high self-esteem and good compliance has been observed often.[1,2,3]

The Self-Report Inventory: Work subsection dealt with the attitudes of patients toward work, accomplishment and self-satisfaction from performing a job. Higher scores indicate greater value placed by the patient on their own accomplishments. Thus, one motivation for good compliance during orthodontic treatment would be the self-satisfaction derived by the patient in accomplishing their part of treatment. Field[24] and Gross et al.[25] reported that in addition to self-satisfaction, the offer of rewards to a child during orthodontic treatment would also enhance compliance.

Patients exhibiting good compliance scored significantly higher on the Self-Report Inventory: Hope subsection. Bown and Richek[5] describe hope as an optimistic anticipation of the future and a sense of confidence that one will play a significant role in future relationships and undertakings. Together, the differences between patients with good and poor compliance in the subscales of the Self-Report Inventory supports the conclusion that a patient with good compliance thinks highly of himself, takes pride in his accomplishments and thinks optimistically about future prospects.

The Home Index was used to measure the patient's socioeconomic background and status. Higher scores indicated greater material possessions and community status. A high score has also been found to correlate with academic performance and involvement in social activities. As expected, better compliance was observed in patients with higher scores on this test. The improvement in compliance with socioeconomic status was also shown by Jenkins et al.[26] for orthodontic patients. Blum[4] emphasizes that the socioeconomic relationship to compliance may be related to a variety of familial factors, such as supportiveness, communication, and family involvement.

As discussed previously, the Adolescent Alienation Index measures the level of alienation a patient feels from society. Alienation occurs when an individual feels isolated and pressured by others. Individuals lacking in self-esteem and with negative views of their ability to be productive members of society are more likely to be alienated than those with positive thoughts about themselves. Alienation may stem from parental conflict when a child feels he cannot turn to his parents for support. Kreit, Burstone and Delman[20] conclude that the most salient

characteristic of an uncompliant patient was a poor relationship with his parents. If the child feels alienated from his parents, he may turn to peers, who may produce additional pressure and uncertainty. Miller and Larson[22] suggest that a patient may not be compliant because the child feels the parent is trying to control his body. Field's[24] study suggested that poor compliers have problems with their parents and home life.

As is often the case, and unfortunately for the purposes of predicting clinical compliance, group differences have many exceptions when used to evaluate individuals. The results of this study suggest that females from higher socioeconomic groups will tend to exhibit good compliance, while males with low socioeconomic status can be expected to comply poorly. Yet every clinician is well aware of exceptions to these generalizations. The challenge remains to understand the motivations of orthodontic patients and the methods by which clinicians can increase motivation and improve compliance.

Author Address

Dr. Richard J. Smith
Department of Orthodontics
Washington University School of
Dental Medicine
4559 Scott Avenue
St. Louis, Missouri 63110

A. Cucalon is in the private practice of orthodontics in San Francisco, California.

R.J. Smith is Dean and Professor and Chairman of the Department of Orthodontics, Washington University School of Dental Medicine, St. Louis, Missouri.

References

1. Litt, I.F., Cuskey, W.R., Rosenberg, A.: Role of self-esteem and autonomy in determining medication compliance among adolescents with juvenile rheumatoid arthritis. Pediatr., 69:15-17, 1982.
2. Jacobson, A.M., Hauser, S.T., Wolfsdorf, J.I., Houlihan, J., Milley, J.E., Herskowitz, R.D., Wertlieb, D., Watt, E.: Psychologic predictors of compliance in children with recent onset of diabetes mellitus. J. Pediatr., 110:805-11, 1987.
3. Friedman, I.M., Litt, I.F.: Adolescent's compliance with therapeutic regimens. J. Adolescent Health Care, 8:52-67, 1987.
4. Blum, R.W.: Compliance in the adolescent with chronic illness. Semin. Adolescent Med., 3:157-62, 1987.
5. Bown, O.H., Richek, H.G.: The Bown Self-Report Inventory (SRI): A quick screening instrument for mental health professionals. Comp. Psych., 8:45-52, 1967.
6. Bown, O.H., Veldman, D.J.: Scoring procedure and college freshman norms for the Self-Report Inventory. University of Texas, Manual, 1967.
7. Heussenstamm, F.K.: Adolescent Alienation Index. Monitor, Hollywood, 1971.
8. Gough, H.G.: A cluster analysis of Home Index status items. Psych. Reports, 28:923-29, 1971.
9. Gough, H.G.: Socioeconomic status as related to high school graduation and college attendance. Psychology in the Schools, 3:226-31, 1971.
10. Gough, H.G.: Manual for the Home Index, Institute of Personality and Assessment and Research. University of California, Berkeley, 1974.
11. Sweetland, R.C., Keyser, D.J. (Eds.): Tests: A comprehensive reference for assessments in psychology, education, and business, 2nd ed. Test Corporation of America, Kansas City, 1986.
12. Helwig, J.T.: SAS Introductory Guide. SAS Institute Inc., Cary, North Carolina, 1982.
13. Helwig, J.T.: SAS User's Guide. SAS Institute Inc., Cary, North Carolina, 1982.
14. Huck, S.W., Cormier, W.H., Bounds, W.G. Jr.: Reading Statistics and Research. Harper and Row Publishers, New York, 1974.
15. Romano, P.E.: Semantics: *Compliance* is a better term than *cooperation*. Arch. Ophthalmol., 105: 314-15, 1987.
16. Allan, T.K., Hodgson, E.W.: The use of personality measurements as a determinant of patient cooperation in an orthodontic practice. Am. J. Orthod., 54:433-40, 1968.
17. Colenary, C., Gabriel, H.F.: Predicting patient cooperation. J. Clin. Orthod., 11:814-19, 1977.
18. Weiss, J., Eiser, H.: Psychological timing of orthodontic treatment. Am. J. Orthod., 72:198-204, 1977.
19. Starnback, H.K., Kaplan, A.: Profile of an excellent orthodontic patient. Angle Orthod., 45:141-45, 1975.
20. Kreit, L.H., Burstone, C.J., Delman, L.: Patient cooperation in orthodontic treatment. J. Am. Coll. Dent., 35:327-32, 1968.
21. Russell, A.L.: A social factor associated with the severity of periodontal disease. J. Dent. Res., 36:922-26, 1957.
22. Miller, E.S., Larson, L.L.: A theory of psycho-orthodontics with practical applications to office techniques. Angle Orthod., 49:85-91, 1979.
23. Albino, J.E.: Psychological factors in orthodontic treatment. N.Y. State Dent. J., 50(8):486-89, 1984.
24. Field, R.S.: Influencing patient cooperation. J. Clin. Orthod., 11:814-19, 1980.
25. Gross, A.M., Samson, G., Dierkes, M.: Patient cooperation in treatment with removable appliances: a model of patient non-compliance with treatment implications. Am. J. Orthod., 87:392-97, 1985.
26. Jenkins, P.M., Feldman, B.S., Stirrups, D.R.: The effects of social class and dental features on referrals for orthodontic advice and treatment. Brit. J. Orthod., 11:185-88, 1984.