A Study of Truthfulness in Male Orthodontic Patients from the Appraisal of Certain Autonomic Responses to Questions Concerning Cooperation

Richard Salvadore Campisi
Loyola University Chicago

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A STUDY OF TRUTHFULNESS IN MALE ORTHODONTIC
PATIENTS FROM THE APPRAISAL OF CERTAIN
AUTONOMIC RESPONSES TO QUESTIONS
CONCERNING CO-OPERATION

by

RICHARD SALVADORE CAMPISI

A Thesis Submitted to the Faculty of the Graduate School
of Loyola University in Partial Fulfillment of
the Requirements for the Degree of
Master of Science

JUNE
1963
LIFE

Richard Salvatore Campisi was born in San Jose, California, on October 7, 1935. He was graduated from Bellarmine College Preparatory in San Jose in June, 1953. He took his pre-dental studies at the University of Santa Clara and was graduated with a Bachelor of Science degree in Biology in June, 1957. In June of 1961 he received his Doctor of Dental Surgery degree from The Creighton University School of Dentistry in Omaha, Nebraska. Upon graduation he enrolled in the Graduate School and the Department of Orthodontics Loyola University School of Dentistry. He is married.
ACKNOWLEDGEMENT

My gratitude and sincere appreciation is extended to all those who have in any way aided in making this investigation possible, particularly to the following:

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To my wife, Barbara, without whose understanding and moral support this work could not have been possible.
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CHAPTER I
INTRODUCTION

A. Introductory Remarks and Statement of the Problem

The purpose of this research is to study the levels of truthfulness in children undergoing orthodontic treatment. This will be accomplished by appraising certain autonomic responses to questions concerning cooperation with a polygraph. The following responses will be studied: respiration, heart rate, blood pressure, and galvanic skin resistance.

Deception testing by the polygraph technique is based upon the theory that the emotion of fear results in stimulation of the sympathetic division of the autonomic nervous system. The sympathetic stimulation in turn results in certain physiological changes, some of which may be easily recorded by the use of suitable instruments.

B. Review of the Autonomic Nervous System

In order to understand the effect of stimulation of the sympathetic division of the autonomic nervous system, a brief description of the autonomic nervous system is in order.

The autonomic nervous system is composed of two divisions, or
systems which differ from each other morphologically and which are for the most part antagonistic to each other physiologically. The morphological differences have to do with the manner in which the two systems are connected with the central nervous system and with the location of their ganglia. The sympathetic division arises from the spinal cord by fibers from all of the thoracic segments and the first two lumbar segments. These fibers run to chains of central ganglia lying on each side of the vertebrae and extending from the base of the skull downward the length of the vertebral column. The parasympathetic division is connected with the central nervous system through certain of the cranial nerves and through the middle three sacral segments of the spinal cord. Its ganglia tend to be placed peripherally near the organs innervated.

Fiber pathways in the autonomic nervous system always consist of two neurons as opposed to one neuron in the spinal cord pathways. A ganglion consists of a group or mass of cell bodies and is a point of synapse between the first and second neurons in the chain. Peripheral autonomic neurons, therefore, are of two types; the pre-ganglionic neuron which is between the spinal cord and the point of synapse and
the post-ganglionic neuron which is between the synapse and the neuro-effector junction.

The autonomic nervous system is concerned with the involuntary activity of the viscera; the digestive organs, the heart, lung, kidneys, glands of all kinds, including sweat glands, and the involuntary muscle of the blood vessels, the pupil of the eye, and the hair follicles. Cannon has described the function of the autonomic nervous system as the maintenance of homeostasis. This involves maintaining a stable internal environment, e.g., regulations of temperature, circulation, respiration, excretion and secretion, and the chemical equilibrium of the body fluids. According to Cannon, the essential and particular function of the autonomic nervous system is to bring about the internal adjustments upon which this constant state depends.

Stimulation of the sympathetic division as a whole results in cardiac acceleration; deeper and more rapid respiration, sweating, piloerection, vaso-constriction in the skin and abdominal viscera with vasodilation in muscles, heart lungs, and brain, dilation of the pupil and secretion of epinephrine from the adenal gland. These reactions put the organism in a condition for maximum activity and has been called
the "fight or flight mechanism". According to Jones this is a maximum generalized response and is not the usual role of the sympathetic system which acts to a much lesser degree ordinarily by accommodating the internal function to the conditions of the external environment.

The parasympathetic division is generally antagonistic to the sympathetic division and is concerned with conservation and protection of the organism.

All autonomic nervous system fibers liberate chemical substances at their terminal endings and the organs they stimulate are reactive to these chemicals, whether from the nerve fiber or from the blood stream. Fibers of the parasympathetic division liberate acetylcholine at their endings. The fibers of the sympathetic system also liberate chemical substances at their terminal endings. Although the preganglionic fibers of this system are reactive to and liberate acetylcholine, the post-ganglionic fibers, for the most part, liberate another chemical which is similar to the epinephrine secreted by the adrenal medulla. This chemical substance is known as norepinephrine. Dale has called parasympathetic nerves cholinergic and sympathetic nerves adrenergic. However, the sympathetic fibers to sweat glands are cholinergic. Recent
reports, indicate that some parasympathetic fibers are adrenergic. Once acetylcholine is liberated into an effector cell, it continues to stimulate or inhibit the cell until the acetylcholine is destroyed by cholinesterase, a substance present in all the different tissues of the body.

When discussing the autonomic nervous system one must not lose sight of the fact that it is not an independent system but is under the influence of the central nervous system.

The psychological basis of detection of deception is the emotion of fear. When a person lies in answer to a question and there is fear that the lie will be detected, certain physiological changes occur. Lyle reports the following changes:

1. Elevation in the blood pressure.
2. Increased heart rate.
3. Increase in frequency and amplitude of respiratory movement.
4. Increase in the secretion of the sweat glands.

C. Review of the Related Literature

1. History of Detection of Deception

Deception is as old as Adam and Eve and began when Adam and
Eve hid among the trees, trying to hide from the Lord their deed of eating the forbidden fruit. After Cain had slain his brother Abel, the Lord said to Cain, "Where is Abel thy brother?" Cain replied, "I know not: Am I my brother's keeper?" Attempts to detect deception are no doubt as old as deception itself. Some of the first attempts at deception were amazingly sound and were based upon the same psychological and physiological principles as the modern day polygraph technique. As early as 300 B.C. the Greek Erasistratus used the pulse rate to detect deception. An example of such a case was when Erasistratus was called to the court of Nicator, to cure his son of an unknown disease. Erasistratus upon arrival at the court acted upon the current suspicion that the son might have developed a passion for the new beautiful wife of his father. While discussing this with Antiochus (Son of Nicator) and feeling his pulse, he denoted its' tremulous rhythm and concluded that Antiochus was truly infatuated with his new mother. This was later born out when Antiochus fathered her daughter.

Another interesting ancient method, was the Chinese method of rice chewing. The subject was given a handful of rice to chew and if he could not swallow it then he was termed guilty. This method has
some scientific foundation in that during the time of fear, such as
telling a lie, there is a decrease in the secretion of saliva. In this
instance the decrease in the saliva secretion would make it impossible
to swallow the rice.

Through the centuries there have been other attempts at detection
which have not been physiologically sound but which have had a valid
psychological effect as they have been mostly religious teachings. Trial
by ordeal, walking on hot coals, placing the tongue on hot iron and many
other such methods have been used and still are in some primitive
societies today.

As early as Boccaccio's time (1313-1373) the quickening of the
pulse and the advance of blood pressure was measured in order to
detect when a person was knowingly lying. However, not until Galileo's
invention of the "pulsilogiom", or watch pulse (1581) was there an
objective way to count the human pulse.

At the time Galileo was experimenting with the "pulsilogiom" a
Roman Court Physician, Lancisi, conceived the idea that emotion may be
produced through the close dependence of mental functions upon the
nerves, ganglia and the coronary vessels of the heart. Emotions are
produced, he thought, by more or less forceful heart action. From this he inferred that the characteristics of the mind were received from the structural and physical changes going on in the body. We know today that Lancisi's theory was exactly backwards and that the physical changes in the body are caused by the thought process of the mind and nervous systems. However, Lancisi's theory formed a basis for much of the later physiological experimentation on the action of the heart during deception, and the function of the body during other emotional experiences. Hales Faini and Riva-Ricci later used Lancisi's theory while experimenting with the measuring of blood pressure. Hales in 1733 began experimenting with the blood pressure of animals by the method of inserting a tube directly into the left auricle of the heart and measuring its height in a glass tube. In 1847 Faivre used direct method to make the first blood pressure test on man. Riva-Ricci in 1896 developed the rubber cuff-manometer method, and in 1897 Hill and Bernard added to this method a means of calibrating pressure. These men worked with their methods to record the blood pressure of man as laboratory experiments only, and it was not until 1908 that Munsterberg began proposing that the courts utilize the blood
pressure method for gauging deception. Marston in 1915 tested two hundred subjects experimentally, measuring the systolic blood pressure at frequent intervals. His results indicated that systolic pressure constituted an accurate means for detecting deception.

In the nineteenth century there was a growing interest in the problems involved in the detection of deception. With the development of suitable apparatus for gauging emotions, many significant studies became possible. One of the pioneers to use such apparatus was the famed Italian criminologist Lombroso. Lombroso developed the hydrosphygmograph, a water filled tank into which the hand was immersed and sealed, and in which pulsations of the blood caused a rising and lowering of the water level which was recorded on a smoked drum. This device was used in many cases to aid the Italian police. Mosso, an Italian physiologist and contemporary of Lombroso's, did work in the field of emotions, especially in his study of fear and its influence on the heart and respiratory system. He concluded through the observation of a subject with a skull impairment which made the brain visible, that the variations which appear in the blood circulation of the brain during fear are far greater than those resulting from the mere noises, sounds
or intellectual changes.

With the development of the various methods for blood pressure and pulse characteristics there appeared many differences of opinion of technique. In the late nineteenth century and early twentieth century there was much disagreement as to what was responsible for the change observed. Some investigations relied on blood vessel dilation and contraction, others on heat measurements and still others on the use of electrocardiographs. These differences continued until early in the twentieth century when Darrow demonstrated a way for determining absolute blood pressure and Benussi developed the "inspiration-expiration" method. Benussi in 1914 and Burt in 1921 recorded respiration of subjects while lying. They concluded that an apparent change in the inspiration-expiration ratio (I/E) was indicative of deception. Darrow's findings have brought about agreement that absolute diastolic and systolic pressure are not needed but that it is the relative changes that signify deception.

Larson in 1921, used an Erlanger sphygmomanograph in combination with a pneumograph, to record blood pressure and respiration of some four hundred police suspects in Berkeley, California.
He reported high accuracy of results in detecting deception.

Two of the researchers to whom are attributed the actual construction of one of the first polygraphs, are Lee and Keeler. Keeler followed closely the work of Larson and others and after a series of experiments he was able to develop improved instrumentation for pneumatic transmission of pulse waves, blood pressure changes, and respiration in 1936. Keeler, like many others before him, did not invent a "lie detector". He modified existing apparatus to be applied to the discovery of emotional complexes and added the gavanograph as a result of Fr. Summers work with skin resistance changes during deception.

2. Present Day Use of the Polygraph

The major users of the polygraph today are law enforcement agencies and business concerns. Federal agencies, such as the Federal Bureau of Investigation, National Security Agency, Military Intelligence Agencies, also use the polygraph even though this is a little publicized procedure with them. The business world has been using the polygraph for over twenty-five years; yet because of the extended controversy which has surrounded it, many firms have been afraid to introduce it. Many business concerns now require pre-employment polygraph examina-
3. Use of the Polygraph in Dentistry

The first known use of the polygraph in the field of dentistry was in 1958 when Lewis and Law conducted a study of certain autonomic responses of children to a specific dental stress. Heart rate, face and hand temperature and galvanic skin response were recorded. Nine boys and nine girls between the ages of five and one half and seven were tested with regard to their psycho-physiologic reactions to the presence or absence of the parent from the operating room during a dental appointment involving oral prophylaxis.

Practically no significant differences were determined in the psycho-physiologic reactions of the child of this age who had previous dental experience, regardless of whether or not the parent was present in the operating room.

In 1961 Roder, Lewis and Law studied the physiological responses of dentists to the presence or absence of a parent in the operatory. The heart rate of six dentists who served as subjects was recorded while administering a local anesthetic to a child patient under two clinical situations, mother present and mother absent from the operatory. No
significant difference was found in the heart rate responses of the
dentist to the two clinical situations.

Ando (1961), studied the psychological responses of patients
undergoing orthodontic treatment. Various clinical procedures were
performed on these patients and galvanic skin reflexes were recorded.
A greater amount of reflex was observed in male patients than in
female patients.
CHAPTER II

METHODS AND MATERIALS

A. Selection of Patients

Fifteen male patients were selected randomly for this study from the orthodontic clinic of the Loyola University School of Dentistry. The patients were between eleven and fifteen years of age. These patients presented with various types of malocclusions and had been under treatment in the clinic for approximately the same length of time.

All patients were required to wear various types of intraoral elastics during treatment, in order to move the teeth in the desired directions. In order to obtain the proper tooth movement the patients were required to wear these elastics from twenty to twenty-two hours a day. It was also necessary that they change the elastics at least three times a day so as to obtain the desired amount of force from them.

In certain cases extraoral force was necessary. This was obtained through use of a headgear to either the maxillary or the mandibular arch or to both archs.

The orthodontist had to rely entirely on the co-operation of the
patients in regards to the wearing of the elastics and headgear. The co-operation levels of the patients as determined by their truthfulness to questions regarding these two forms of orthodontic forces were studied through the appraisal of the following autonomic responses: respiration, heart rate, blood pressure and galvanic skin resistance.

B. Polygraphic Equipment

The Keeler Polygraph, model #302C, was used in this investigation. Its' components are designed to record physiological changes which accompany the psychological effects of interrogation of the individual being questioned. It is equipped with a kymograph mechanism which carries a chart and drives it forward under the pens at a uniform rate during operation. It also contains a cardio-sphygmograph unit for recording amplitude and frequency of heart action of the person being questioned. The model #302C also contains a pneumograph unit for recording amplitude and pattern of respiration. It also has a galvanograph unit to record changes in skin-resistivity of the person being questioned. Accessories necessary to operation of the machine consist of blood pressure cuff assembly and connecting hose for attachment to the cardio-sphygmograph, a blood pressure pump bulb.
FIGURE 1

POLYGRAPH UNIT WITH ATTACHMENTS
FIGURE 2
CARDIO-SPHYGMOMANOMETER ASSEMBLY
FIGURE 3

PNEUMOGRAPH ASSEMBLY
and connecting hose with special spring type pressure clamp, a
pneumograph chest assembly with its connecting hose for attachment to

The patient was provided with a large, naugahyde covered chair.
The arms of the chair were wide enough and long enough to permit the
entire forearm and hand to rest comfortably during questioning.

FIGURE 4
GALVANOGRAPH ASSEMBLY
and connecting hose with special spring type pressure clamp, a pneumograph chest assembly with its connecting hose for attachment to the pneumograph recording unit, a hand electrode with attaching cable for connection with the galvanograph and a line cord for connecting the unit to the 115 volt A.C. power source. The mechanism is completely self-contained in a metal case.

C. Examination Room

A four by nine sound proof room, lined with acoustical tile, was used in the experiment. This was to insure complete privacy and provide an atmosphere free from outside distractions. The room was equipped with a ceiling fan to insure proper ventilation and room temperature. Moderately dim, indirect fluorescent lights were recessed in the ceiling. At one end of the room was a one-way mirror through which the examination could be observed without the knowledge of the patient.

The patient was provided with a large, naugahyde covered chair. The arms of the chair were wide enough and long enough to permit the entire forearm and hand to rest comfortably during questioning.
D. Experimental Procedure

The subject was brought into the sound proof room by the investigator and seated in the chair provided (Figure 5). The subject was then given a pre-test interview to obtain the necessary background data for the examination. This data was recorded on the pre-test interview sheet (Figure 6). During the pre-test interview, the questions to be asked on the test were presented to the subject and thoroughly explained. From his answers, it was determined which of two tests on elastics he would be given.

QUESTIONS REGARDING ELASTICS

TEST A

1. Is your first name ________?
2. Do you drink water?
3. Have you been faithful about wearing your elastics?
4. Other than to change or to eat, have you removed your elastics?
5. Are you ________ years old?
6. Have you always worn your elastics the required time?
7. Have you always worn your elastics ________ hours per day?
8. Are you purposely trying to withhold any information from me about wearing your elastics?
LOYOLA UNIVERSITY - ORTHODONTIC DEPARTMENT

Date __________________________

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Treatment: Begin __________________________

Finish __________________________

Questions: A

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Explanations:

Elastics

FIGURE 6

PRE-TEST INTERVIEW CHART
TEST C

1. Is your first name ________?

2. Do you drink water?

17. Have you been less faithful about wearing your elastics than you told me?

18. Have you kept your elastics off a lot more than you told me about?

5. Are you ________ years old?

19. Have you worn your elastics at least ________ hours a day?

8. Are you purposely trying to withhold any information from me about wearing your elastics?

If during the pre-test interview, the answers to the questions on TEST A showed the subject to be co-operative about wearing his elastics, this then was the test of choice. If the answers to TEST A showed the subject to be unco-operative about wearing his elastics, then TEST C was the choice. When the investigator was sure that the subject understood the meaning of the questions to the test of choice, he proceeded to place the polygraph attachments on the subject.

With the subject comfortably seated in the chair provided, the
The pneumograph tube was attached around the chest by means of the bead chain. The pneumograph tube assembly was centered across the chest and approximately one-half inch of expanded tension applied before fastening the chain into the hook on the other end of the pneumograph tube.

The hand-electrode unit was then prepared for placement. A thin, even film of electrode jelly was applied to the surface of each metal electrode. The hand-electrode was then placed on the palm of the right hand and rubbed against the skin in order to insure that good contact would be made between electrode and skin surface.

Finally, the cardio-sphygmograph unit was attached to the subject's left arm. The bladder portion of the blood pressure cuff was centered over the brachial artery located on the medial surface of the upper arm between the elbow and shoulder. The cloth was wrapped snugly around the subject's arm, about two inches above the elbow and secured.

The subject was then told that the blood pressure cuff may cause his arm to go to sleep, but that he must remain perfectly still. He was instructed to answer all questions by "yes" or "no" and to refrain from giving any other verbal responses. The polygraph was then activated.
and the appropriate test given.

The subject was permitted a fifteen minute rest period following.

FIGURE 7
ATTACHMENTS CONNECTED TO PATIENT
and the appropriate test given.

The subject was permitted a fifteen minute rest period following the first test.

The investigator then proceeded to interview the subject for the second test. The questions to be asked on the test were presented to the subject and thoroughly explained to him. From his answers it was determined which of two tests on headgear he would be given.

QUESTIONS REGARDING HEADGEAR

TEST B

9. Do you go to school?
10. Are you in the ________ grade?
11. Have you been faithful about wearing your headgear?
12. Have you always worn your headgear the required time?
13. Were you born in ________?
14. Have you always worn your headgear ________ hours a day?
15. Is your orthodontist Dr. ________?
16. Do you like Dr. Jarabak?

TEST D

9. Do you go to school?
10. Are you in the _______ grade?

20. Have you been faithful about wearing your headgear as much as you have told me?

21. Have you kept your headgear off more than you have told me about?

13. Were you born in _______?

14. Have you always worn your headgear _______ hours a day?

15. Is your orthodontist Dr. _______?

16. Do you like Dr. Jarabak?

If, during the pre-test interview the answers to the questions on TEST B showed the subject to be co-operative about wearing his headgear, this then was the test of choice. If the answers to TEST B showed the subject to be unco-operative about wearing his headgear, then TEST D was the choice. When the investigator was sure that the subject understood the meaning of the questions to the test of choice, he proceeded to activate the polygraph and run the test.

If, during the first pre-test interview, it was found that the subject wasn’t required to wear a headgear during treatment, questions #15 and #16 were added to the end of TEST A or C depending on which test was
given.

The subject was recalled four weeks later for a repeat examination.

E. Chart Interpretation

Proper question formulation and administration are essential to chart interpretation. If the question is phrased and delivered properly it will influence the subject's fight or flight mechanism in a manner which will facilitate chart interpretation. The polygrams were interpreted for deception through the evaluation of the changes in the following three patterns:

I. Pneumograph Pattern

(1) Any change in the amplitude of the subject's normal respiratory pattern (Figure 8 - #2).

(2) Any change in the rate of the subject's normal respiratory pattern (Figure 8 - #2).

The respiratory pattern may show a marked alteration in amplitude but show no change in frequency. Conversely, the amplitude may remain the same while the frequency may change. Both amplitude and rate may change. There may be an apnea in the respiratory cycle
upon verbal stimulation of a relevant question as seen in the pneumograph tracing (Figure 9 - #2).

II. Cardio-Sphygmograph Pattern

(1) Any change in the position of the dicrotic notch (Figure 9 - #2).

(2) Any change in the amplitude of the subject's normal cardio-sphygmograph pattern, shown as a marked change in the baseline.

(3) Any change in the rate of the subject's normal cardio-sphygmograph pattern, shown as a marked change in the baseline.

The cardio-sphygmograph pattern is capable of different manifestations. On certain subjects the heart rate may remain fairly regular, while the position of the dicrotic notch may change. The heart rate may also change to a marked degree or only slightly. In other cases the dicrotic notch may remain in a steady position and the heart rate remain practically the same but the amplitude will alter. The dicrotic notch represents the closing of the semi-lunar valves of the aorta between systole and diastole.
III. Galvanograph Pattern

Any marked change upward from the subject’s normal baseline is a reaction, indicating a decrease in the subject’s skin resistance (Figure 8 and Figure 9).

This is indicative of deception.

The preceding changes in the three patterns were interpreted as indications of deception.

Figure 10 represents some abnormal recording patterns which might be misinterpreted as indications of deception. It should therefore, be noted here that there exists a definite art of chart interpretation. Careful observation and notation of all abnormal movements (cough, sigh, sneeze, etc.) aid the examiner in chart interpretation.
A. pneumograph tracing.
B. galvanograph tracing.
C. cardio-sphygmograph tracing.
D. dicrotic notch.

1. Black dot (·) -- represents verbal stimulus of irrelevant question.
2. Star (⋆) -- represents verbal stimulus of relevant questions showing deception.

FIGURE 8

TYPICAL POLYGRAPH TRACING SHOWING DECEPTION
1. Irrelevant question asked here.
2. Relevant question asked here showing deception.
3. Relevant question asked here showing deception.

FIGURE 9
TYPICAL POLYGRAPH TRACING SHOWING DECEPTION
ASSOCIATED RESEARCH INCORPORATED.

1. COUGH
2. MOVEMENT

FIGURE 10

POLYGRAPH TRACING
CHAPTER III

FINDINGS

The findings are based on the analysis of the polygraphic recordings obtained from the tests run on each of the fifteen subjects used in this study.

Each test contained a certain number of relevant and irrelevant questions. The relevant questions were listed for each subject and the truthfulness of each answer was noted. The number of truthful responses given by the group of subjects is used as an index of the tendency of the group to co-operate. The results of this study will show the percentage of truthfulness of the group to questions concerning co-operation. This may be interpreted as an indication of co-operation.

A. Elastics

Four relevant questions were listed from the test on elastics given each patient. If TEST A was given, the four relevant questions were numbers 3, 4, 7 and 8. If TEST C was given the four relevant questions were numbers 17, 18, 19 and 8. The number of truthful answers to the four relevant questions were listed (Table I).
**ELASTIC TEST**

**NUMBER OF TRUTHFUL ANSWERS TO THE FOUR RELEVANT QUESTIONS**

<table>
<thead>
<tr>
<th>PATIENT</th>
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<th>TEST 2</th>
</tr>
</thead>
<tbody>
<tr>
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<td>4</td>
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<td>2</td>
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</tr>
<tr>
<td>15</td>
<td>1</td>
<td>4</td>
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**TOTAL**

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<tr>
<td></td>
<td>16</td>
<td>26</td>
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**INDICATION OF TRUTHFULNESS**

<p>| | | |</p>
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<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td><strong>26.6%</strong></td>
<td><strong>43.3%</strong></td>
</tr>
</tbody>
</table>

**IMPROVEMENT**

<p>| | |</p>
<table>
<thead>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>16.7%</strong></td>
</tr>
</tbody>
</table>

**TABLE 1**
The number of truthful answers to the four relevant questions regarding elastics, totaled sixteen out of a possible sixty truthful answers. It was then calculated that the truthfulness of the group was 26.6%.

The second test on elastics resulted in a total of twenty-six truthful answers. Thus, the truthfulness of the group was 43.3%, a 16.7% improvement over the first test.

The improvement between the first test and the second test was found to be significant at the 5% level.

B. Headgear

Three relevant questions were listed from the test on headgear given each patient. If TEST B was given, the three relevant questions were numbers 11, 12 and 14. If TEST D was given, the three relevant questions were 20, 21 and 14. The number of truthful answers to the three relevant questions were listed (Table II).

The number of truthful answers to the three relevant questions regarding headgear, totaled eight out of a possible fifteen truthful answers. The truthfulness of the group was 53.3%.
HEADGEAR TEST

NUMBER OF TRUTHFUL ANSWERS TO THE THREE RELEVANT QUESTIONS

<table>
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</thead>
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<td>*</td>
</tr>
<tr>
<td>TOTAL</td>
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<td>9</td>
</tr>
</tbody>
</table>

INDICATION OF TRUTHFULNESS

<table>
<thead>
<tr>
<th>IMPROVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>53.3%</td>
</tr>
<tr>
<td>60.0%</td>
</tr>
<tr>
<td>6.7%</td>
</tr>
</tbody>
</table>

* NO HEADGEAR WORN DURING TREATMENT

TABLE II
The second test on headgear resulted in a total of nine truthful answers. Thus, the truthfulness of the group was 60%, a 6.7% improvement over the first test.

The improvement between the first test and the second test was not significant.
CHAPTER IV
DISCUSSION

A major problem in orthodontics is patient co-operation. Due to the fact that it is necessary for the patient to wear various types of intraoral elastics and extraoral headgear, the orthodontist must rely a great deal on the co-operation of the patient. Unless a certain amount of co-operation is obtained from the patient, the movement of teeth in the proper direction is futile.

Basically then, the purpose of this study was to determine the percentage of truthfulness obtainable from a group of patients undergoing orthodontic treatment; to questions concerning co-operation. This was done by recording certain autonomic responses of the patient to various questions regarding elastics and headgear on a polygraph.

The experimental procedure of this study was identical to a collateral study on female patients conducted by Dr. Thomas Cavanaugh. This enabled the two groups of patients to be compared to each other without introducing any variables. The following conclusions were derived from comparing the two groups:
1. The females showed a 20% higher indication of truthfulness on the first test concerning elastics than did the males. This was significant at the 5% level.

2. On the second test concerning elastics, the females showed a 16.7% higher indication of truthfulness than did the males. This was not significant at the 5% level.

3. The males showed a 24.3% higher indication of truthfulness on the first test concerning headgear than did the females. This was not significant at the 5% level.

4. On the second test concerning headgear, the males showed a 2.9% higher indication of truthfulness than did the females. This was not significant at the 5% level.

During the pre-test interview the subjects were told that the polygraph would be able to tell if they were wearing their elastics and headgear. Consequently, out of fear, a great number of the patients
admitted being unfaithful about wearing their elastics and headgear. Most of these patients had told their orthodontist that they always wore their elastics and headgear the required time. It was also noted that when tested by the polygraph they were even less faithful than they had admitted.

The subjects as a group showed a very poor percentage of truthfulness or indication of co-operation on the first test given on elastics (26.6%). We can only speculate as to the reasons for this lack of co-operation; Was it the immaturity of the child? Was there no motivation from the very beginning? Was the child compelled by the parent's insistence to have this work done?

The boys appeared to lack motivation. They had very little interest in personal appearance as compared to the girls. It is easy to see from comparing the records of the boys with those of the girls, that the girls scored higher in their willingness to wear elastics. This may be due to the fact that boys advance in to the outside world and away from parental influence younger; girls, for a longer period, remain close to the hearth, thereby being more influenced by their parents. One realizes when studying boys and girls in this age group
that the girls mature earlier than the boys. They are motivated by a desire for a more attractive personal appearance earlier in life than the boys; therefore, they are naturally more strongly motivated upon realization that orthodontics will improve their appearance.

During the pre-test interview many of the patients said that the elastics caused them pain when they first put them on and that rather than adapt themselves to it they would remove their elastics. It is well known that girls can withstand more pain for longer periods of time than boys. This may be another explanation for the difference between the two groups.

It was also noted that those patients who seemed to have a low threshold of pain and complained about the blood pressure cuff attachment were generally considered poor co-operators.

The second test on elastics showed a significant improvement of 16.7%. This improvement may have been due to the fact that the subjects feared the consequences that would follow if their parents found out that they were not wearing their elastics. After the first test the subjects knew that they could no longer deceive us, and that they had to take a repeat test in one month. This may have motivated
them to wear their elastics more.

It is interesting to note that this improvement was based totally on the increase of co-operation of the grammar school boys. One would assume that youngsters in grammar school are still more under parental supervision than high school boys. They are still childlike enough to respect authority; therefore, if they are told to wear their elastics, they are more likely to do so.

It is also to be realized that even though these conclusions can be drawn, all rules have exceptions. It is my personal belief that any child properly raised and taught respect for his parents, will not only listen to and follow the instructions of his parents, but, also any responsible adult, in this case the orthodontist, who, for the child's own good directs him to wear elastics.

It is sad to realize that young men of today have so little regard for their parent's concern and obvious financial sacrifice that they will not co-operate in order to insure prompt and satisfactory treatment.

The male subjects showed much better co-operation in wearing their headgear than they did their elastics. This was probably due to the fact that the headgear was obviously visible; thereby making it
easier for the parents to observe when the child was wearing it. They showed a slight improvement of 6.7\% between the first test and the second test, which was not significant.

The question (Do you like Dr. Jarabak?), was used to see if there was any feeling of resentment between the patients and the chairman of the department which might effect co-operation. Eight of the fifteen patients showed definite physiological responses to this question. This might not actually indicate dislike, but, rather, it might indicate fear. Fear may motivate co-operation where as unco-operativeness may come from dislike.

Much has been learned about co-operation through the use of the polygraph in this study. It has proved it's worth as an instrument of research, and it's future is bright as an aid to the orthodontist in this very important area of patient co-operation.
CHAPTER V
SUMMARY AND CONCLUSIONS

A. Summary

This study was conducted in order to determine the amount of truthfulness obtainable from a group of patients undergoing orthodontic treatment. This was done by appraising certain autonomic responses of patients to various questions concerning their co-operation in wearing elastics and headgear. The following responses were recorded by a polygraph: respiration, heart rate, blood pressure, and galvanic skin resistance.

Fifteen male patients were selected randomly for this study from the orthodontic clinic of the Loyola University School of Dentistry. The patients were between eleven and fifteen years of age. These patients presented with various types of malocclusions and had been under treatment in the clinic for approximately the same length of time. All of the patients were required to wear various types of intraoral elastics during treatment. Five out of the fifteen patients were required to wear a headgear during treatment.
The subjects were given a test composed of a series of relevant and irrelevant questions concerning elastics. Those subjects that wore a headgear during treatment were given a similar test concerning headgear.

The subjects were recalled four weeks later for a repeat examination.

The number of indicators of co-operation or truthful answers to the relevant questions were listed and the percentage of truthfulness of the group was calculated.

B. Conclusions

1. The first test on elastics showed a 26.6\% indication of truthfulness for the group.

2. The second test on elastics showed a 43.3\% indication of truthfulness for the group.

3. The improvement between the first and second test on elastics was 16.7\%. This was significant at the 5\% level.

4. The first test on headgear showed a 53.3\% indication of truthfulness for the group.
5. The second test on headgear showed a 60% indication of truthfulness for the group.

6. The improvement between the first and second test on headgear was 6.7%. This was not significant at the 5% level.
BIBLIOGRAPHY


Fallmer, W.F. Personal communication.


Harrelson, L.H. Policy of the Keeler Polygraph Institute. (Mimeographed)

Harrelson, L.H. The Keeler Polygraph Institute Training Program. (Mimeographed)

Harrelson, L.H. The Polygraph. (Mimeographed)

Harrelson, L.H. The Polygraph, A Scientific Aid to Investigation. (Mimeographed)
Harrelson, L. H. Specialized Interrogation Techniques Using Mechanical Devices.


Jones, D. S. Concepts of Neuroanatomy. Lectures notes, Loyola University's Stritch School of Medicine, Revised edition, 1962.


The thesis submitted by Dr. Richard S. Campisi has been read and approved by members of the Departments of Anatomy and Oral Biology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Science.

5-15-63
DATE

Joseph R. [Signature]
Signature of Adviser