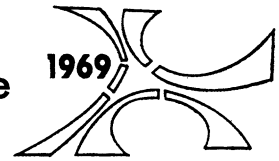
The Application of Operant Conditioning Procedures to the Facial Grimace Problem



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Facial grimaces that accompany the speech of some persons with inadequate velopharyngeal closure have been described in various ways: "... wrinkling or wiggling the nose ... or pulling downward on the nose" (Harkins, *3*, p. 18); "nasal grimaces" (Van Riper and Irwin, *10*, p. 206–207; Morley, *7*, p. 175); "alar constrictions" (Powers, *8*, p. 63). These behaviors are viewed as relatively unsuccessful attempts to block nasal air escapage (Van Riper and Irwin, *10*), and to have negative effects on interpersonal communication (Westlake and Rutherford, *11*). Although facial grimaces generally are considered undesirable, no studies have been reported in which an attempt was made to manipulate these grimaces in any systematic way, or in which an attempt was made to investigate the relationship between these grimace behaviors and speech.

Recently, several studies have been reported in which operant conditioning procedures were employed to manipulate various aspects of disordered speech (Flanagan, Goldiamond, and Azrin, *2;* Brookshire and Martin, *1;* Martin and Siegel, *5, 6;* Quist and Martin, *9;* Haroldson, Martin, and Starr, *4*). Of particular relevance in terms of an observable response is the experiment by Martin and Siegel (*5*) in which "nose-wrinklings" that occurred during a moment of stuttering were virtually eliminated by delivering an electric shock contingent on each response.

The purposes of this study were: a) to determine whether facial grimaces of an adult male with velopharyngeal inadequacy could be reduced by presenting the word *wrong* contingent on the occurrence of a grimace, and b) to assess the effects of grimace reduction on perceived nasality.

Method

SUBJECT. The subject (S), a 39-year-old male, experienced bulbar polio at age 26. X-ray data, oral manometer ratios, speech evaluations, and observations of palatal functioning during sustained vowel production

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Portions of this paper were presented at the 1969 International Congress on Cleft Palate, Houston.

and gagging indicated palatal paresis and inability to accomplish velopharyngeal closure for speech and nonspeech activities. At the time of the study, S had used a speech bulb for four years. Because the facial grimaces were more frequent and more observable when the speech bulb was removed, it was not worn during the study.

RESPONSE CLASS. Prior to the study, the senior author (E) prepared a four-minute silent film of S reading aloud. Four speech pathology graduate students viewed the film and independently recorded the occurrences of facial grimaces. From the data provided by the film and the independent observers' frequency counts, E constructed the following description of S's facial grimace response:

> Facial grimaces are defined by a pulling upward of the cheek muscles superiorly toward the eyes. This can be observed by viewing the phenomenon bilaterally or unilaterally. The nose shows minimal movement by itself, but consists of a downward pull such that the cheeks appear to rise superiorly relative to it. There is also a minimal compression of the wings of the nose. One response occurrence is defined, operationally, as the superior movement of the cheeks, and, as long as the cheeks remain in the superior position it is the same response, regardless of small twitches. Once the cheeks appear to resume the normal position (i.e. down) the response is concluded. Another upward pulling of the cheeks constitutes another response.

APPARATUS. The study was conducted in a two-room suite connected by a one-way mirror. The experimental room contained a chair, table, monaural earphone, and microphone. The control room contained the necessary equipment to record observations of facial grimaces, to present and control the verbal stimulus word *wrong* and to record the sessions.

During the experiment, E depressed an electronic handswitch each time S emitted a facial grimace. Each depression of the handswitch was recorded on a printout counter which printed and cleared at two-minute intervals.

The word *wrong* was prerecorded 600 times on a stimulus tape. A 354 Ampex tape recorder was modified in such a way that, when E depressed his handswitch, the word *wrong* was delivered within .20 second to the monaural earphone on S's right ear. The recorder stopped automatically, primed to deliver the same *wrong* on the next depression. A Gerbrands ratio programmer was incorporated into the 354 Ampex circuitry in such a way that *wrong* was delivered with every fourth depression of E's handswitch.[1]

An 860 Ampex was used to record S's speech and stimulus presentations of *wrong* during all sessions. A closed circuit television camera, located in the control room, and a monitor, located in a second control room, were used during one session to allow an independent observer to observe the monitor and count facial grimaces.

[1] For a more complete description of the 354 Ampex circuitry the reader is referred to Robert H. Brookshire, The differential effects of three verbal punishers on the disfluences of normal speakers, Unpublished Ph.D. dissertation, University of Minnesota, 1965.

PROCEDURE. S was asked to participate in a study concerned with velopharyngeal closure. He was told he would receive $5.00 per session and that no further information would be provided until the study was completed. During all sessions, S was seated in the experimental room and read prepared material. In the control room, E activated the recording and programming equipment and signaled S to begin reading. Thereafter, E observed S reading and depressed the handswitch after each facial grimace. At no time could E hear S; thus, all judgments were made on the basis of visual stimuli.

Since S's behavior during the sessions could not be predicted, the following guidelines were established before the study was initiated.

a) S will be run for a maximum of 12 sessions. No session will be longer than 60 minutes or shorter than 30 minutes.

b) No experimental treatment will be introduced during session one, nor will treatment be introduced until responding has stabilized. Baserate will be established on the basis of a stability criterion after 20 minutes of session one. Response rate will be considered stable when variations in the number of facial grimaces in three consecutive two-minute periods remain within predetermined limits. In establishing the limits, the number of grimaces in the first of three consecutive two-minute periods will be used as a base. In order for the behavior to be considered stable, the following two periods must vary within certain limits. If the number of grimaces in the base period is between 1 and 9, a variability of 1 will be allowed. If the base is between 10 and 19, a variability of 2 will be allowed; and so forth. Baserate will be defined as the mean response rate in the three consecutive periods used in the stability criterion.

c) Beginning with session two, experimental treatment will be introduced when the stability criterion is achieved. Thereafter, the verbal stimulus *wrong* will be delivered after every fourth depression. Reliability of E's observations of facial grimaces will be determined during the second session using an independent observer and the closed circuit television system.

d) If stability criterion is not achieved by the end of the fifth session, the study will be terminated.

e) If the experimental treatment is introduced, it will be continued until the following two conditions are met: (1) the mean number of facial grimaces for 10 consecutive two-minute periods is 40% or less of baserate; and (2) the stability criterion is achieved during the last three of the 10 consecutive periods, or any three thereafter. These two conditions will be referred to hereafter as the 40% reduction criteria.

f) If S does not achieve the 40% reduction criteria by the end of the ninth session, the study will be terminated.

g) If S achieves the 40% reduction criteria, the experimental treatment will be withdrawn. This will continue until the following two conditions are met: (1) the mean number of facial grimaces for 10 con-

secutive two-minute periods is at least 90% of baserate; and (2) the stability criterion is achieved during the last three of the 10 consecutive periods or any three thereafter. These two conditions will be referred to hereafter as the 90% return-to-baserate criteria.

h) If S achieves the 90% return-to-baserate criteria, the experimental treatment will be reintroduced and continued through session 12.

Results

In session one, no experimental treatment was introduced. S achieved the predetermined stability criterion during the first three two-minute periods after the 20-minute adjustment period. The mean response rate for these three periods was 51.7 and became the baserate. Contingent on this baserate, 40% reduction and 90% return-to-baserate criteria required response rates of 31.0 and 46.5, respectively.

During the first two-minute period of session two, S's response rate was 65, or about 14 more than baserate. The stability criterion was achieved during the first three periods of session two. Consequently, the experimental treatment was introduced and continued throughout the session. After 30 minutes of experimental treatment the response rate decreased to a low of 44 (Figure 1). The mean response rate for the entire session was 52.4. During those periods when the experimental treatment was present the mean was 50.4.

The mean response rates for sessions three, four, five, and six, were

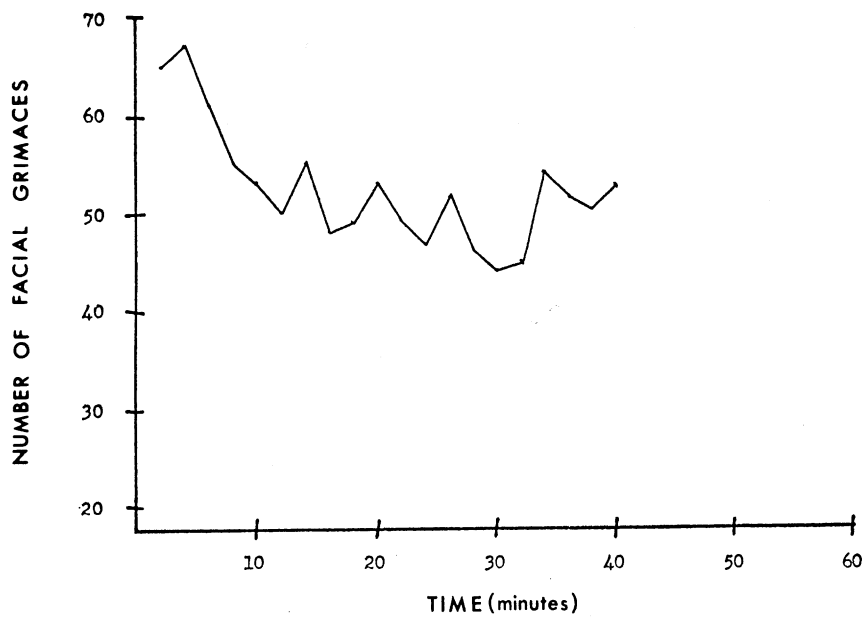

FIGURE 1. Session two. Verbal stimulus *wrong* was introduced after six minutes of the session.

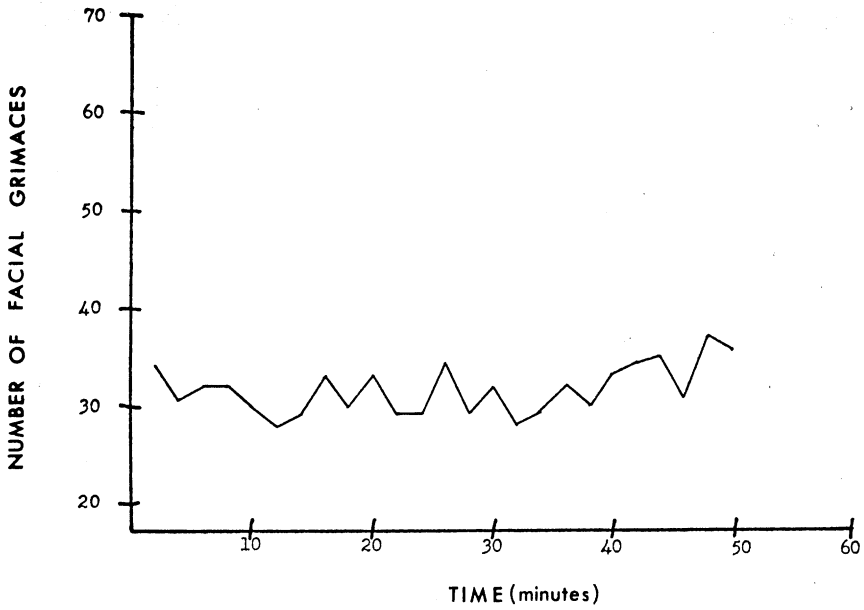

FIGURE 2. Session seven. Verbal stimulus *wrong* was withdrawn after 36 minutes of the session.

39.2, 37.5, 33.8, and 30.7, respectively. The 40% reduction criteria were achieved in session six. At this point E decided to continue the experimental treatment in an attempt to decrease response rate further. In session seven response rates remained at the 40% level. After 34 minutes of session seven the 40% criteria were again achieved and the experimental treatment was discontinued (Figure 2). During that part of session seven when the experimental treatment was present, the mean response rate was 30.7; during the time when the experimental treatment was not present, the mean was 33.4.

The mean response rate was 40.4 for session eight and 44.6 for session nine. No experimental treatment was present during these two sessions. After 26 minutes of session 10, the 90% return-to-baserate criteria were achieved, and the experimental treatment was reintroduced. Response rates decreased markedly during the next four minutes and more gradually during the remaining 20 minutes (Figure 3). When no experimental treatment was present the mean response rate was 48.4; when the treatment was present the mean was 37.5.

Experimental treatment was present during sessions 11 and 12. Response rates decreased to about 50% of baserate. After session 12, the study was concluded.

The effect of the experimental treatment can be seen from an analysis of the mean response rates for each session (Figure 4). Experimental treatment was introduced in session two, withdrawn in session seven,

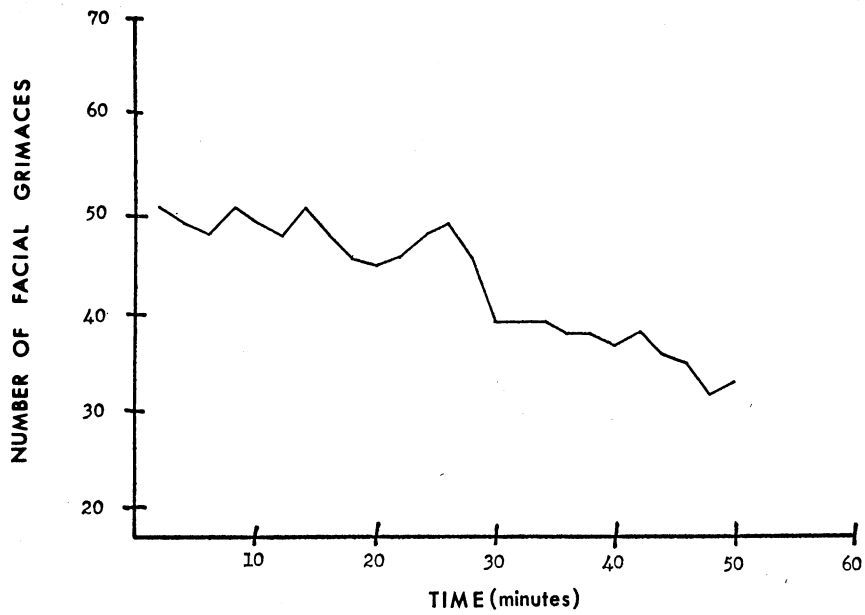

FIGURE 3. Session 10. Verbal stimulus *wrong* was introduced after 26 minutes of the session.

and reintroduced in session 10. Mean response rates were about equal for sessions one and two. They decreased in sessions three, four, five, and six, increased in sessions seven, eight, and nine, and decreased in sessions 10, 11, and 12.

In order to analyze verbal output, the number of words spoken in each session was divided by the number of two-minute periods in that session. These means ranged from 234.7 to 259.3, indicating that verbal output did not change significantly when experimental treatment was present.

During the second session, an independent observer was used to determine the reliability of E's observations. The number of responses per two-minute period was recorded by both E and the observer. A Pearson Product-Moment Coefficient of .84 was obtained.

In order to determine the effect of facial grimace reduction on the speech product, two 20-second segments were taken from the tape recordings of five conditions in the experimental sessions. The five conditions were: I. Baserate (session one); II. Early conditioning (session two); III. 40% reduction criteria (session seven); IV. 90% return-to-baserate (session 10); and V. 50% reduction (session 11). A total of ten 20-second samples was randomly placed on a master tape and presented to nine speech pathology graduate students. Subjects were instructed to rate degree of nasality on a nine-point equal-appearing interval scale with *one* representing "mild nasality" and *nine* representing "the most severe nasality you can imagine". Analysis of orthogonal contrasts on

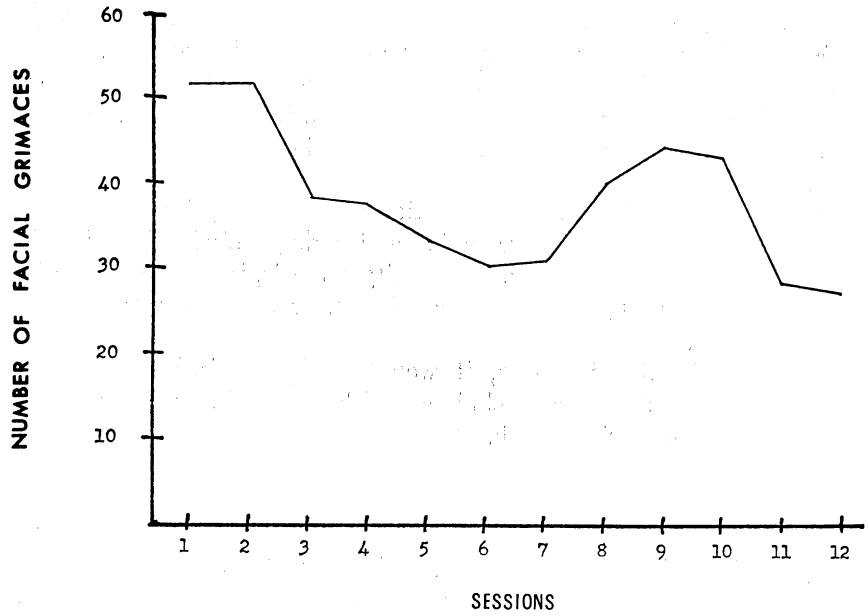

FIGURE 4. Graph representing the mean number of facial grimaces for each session. Verbal stimulus *wrong* was introduced in session two, withdrawn in session seven, and reintroduced in session 10.

the mean ratings for the five conditions tended to indicate that perception of nasality decreased in proportion to facial grimace reduction, however, only a statistically significant difference ($P < .01$) between conditions I and III was obtained.

At the conclusion of the study S reported that he believed the stimulus was presented when he "wrinkled his face" during the production of specific sounds.

Discussion

Within the limits of this study, it appears that the presentation of the verbal stimulus *wrong* contingent on the emission of facial grimaces, leads to a decrement of that response, but not to its elimination.

Failure to obtain a greater response decrement may be attributable to difficulties encountered in applying the experimental technique. The high frequency of facial grimaces prevented stimulus presentation after each response. Different schedules of presentation may have increased response decrement. A different stimulus word may have been more effective in increasing the decrement. Length and variability of the time interval between response occurrence and stimulus presentation could have reduced stimulus effectiveness.

During the study, E observed that when experimental treatment was introduced, a reduction in magnitude of the facial grimace preceded a

reduction in rate, and, after the experimental treatment was withdrawn, an increase in the magnitude preceded an increase in the rate. In E's opinion, reduction in response rate does not adequately describe all the changes in facial grimaces which occurred during the study. From a clinical standpoint, magnitude changes may be as important as rate changes.

The effects of facial grimace reduction on the perception of nasality, although small, indicate that reduction and perhaps elimination of facial grimaces have no adverse effect on nasality (that is, increased perception of nasality) and may, under some conditions, even decrease the perception of nasality.

On the basis of this study, it would appear desirable to explore further the use of operant techniques with observable behaviors that occur in conjunction with speech.

Summary

Operant conditioning procedures were employed in an attempt to reduce facial grimaces in a subject with velopharyngeal inadequacy and to assess the effect of this reduction on the perception of nasality. Experimental design employed the following procedures: establishing a baserate of responding; introducing the verbal stimulus *wrong,* contingent on every fourth facial grimace; discontinuing the stimulus when 40% reduction criteria were achieved; reintroducing the stimulus when 90% return-to-baserate criteria were achieved; concluding the study after 12 sessions. Results indicated that the rate of facial grimaces could be reduced to the 40% criteria, returned to the 90% criteria, and again reduced to 50% of baserate. Reliability of observations assessed during one conditioning session was considered sufficient for the purposes of the study. The verbal output remained consistent during the study. Analysis of the tape recordings indicated that a reduction in facial grimaces does not adversely affect perception of nasality. The limited reduction of facial grimaces was attributed to difficulties in the application of the technique.

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