6+9+12: EVERYONE CAN BE TAUGHT TO DELIBERATELY FAKE A SMILE WITH THE "GENUINE ENJOYMENT DUCHENNE MARKER"

A Senior Scholars Thesis

by

BENJAMIN SHLOMO

Submitted to the Office of Undergraduate Research
Texas A&M University
in partial fulfillment of the requirements for the designation as

UNDERGRADUATE RESEARCH SCHOLAR

April 2011

Major Subject: Chemistry

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Approved by:

Research Advisor: Stephen Balfour
Director for Honors and Undergraduate Research: Sumana Datta

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ABSTRACT

6+9+12: Everyone Can be Taught to Deliberately Fake a Smile with the "Genuine Enjoyment Duchene Marker". (April 2011)

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It is generally believed that people cannot deliberately contract the *orbicularis oculi pars orbitalis* ("Action Unit 6," "Duchenne Marker" or "Cheek Raiser") muscle together with the *zygomaticus major* ("AU12" or "smile" muscle) unless they experience genuine happiness. This experiment tested the theory that both muscles can be activated together voluntarily if one first contracts the *levator labii superioris alaeque nasi* ("AU9" or "nose wrinkler") muscle. Subjects in isolation followed a set of instructions written and picture instructions to capture themselves posing different facial expressions. The images were then coded for muscular contraction intensity by two people trained in the Facial Action Coding System but unfamiliar with the goals of this study. The results question the use of observing simultaneous *orbicularis oculi pars orbitalis* and *zygomaticus major* activation as a sufficient measure of positive affect in future psychological studies of emotion.

ACKNOWLEDGMENTS

I would like to thank my research advisor Dr. Stephen Balfour of Texas A&M University for his advice and assistance in analyzing the project’s theoretical background, securing the computer facilities needed to perform the experiment and guiding me through the administrative requirements.

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CHAPTER I

INTRODUCTION

Facial expressions have been held to be a critical system for the signaling of emotion between people (Thoresen & Powell, 1992). The earliest successful system developed to explore the relationship between facial expressions and emotions was the Facial Action Coding system ("FACS") developed by Paul Ekman and Wallace Friesen (1978). FACS uses objective standards for measuring facial expressions by visually identifying and distinguishing the muscle groups ("Action Units" or AUs) and that contract or relax to alter a subject's expression (Ekman & Friesen, 1978). FACS coding makes no inherent assumptions about the affective meaning of observed expressions. The reliability of FACS measurement has been demonstrated by consistent intercoder agreements in a growing body of research examining FACS scores as the primary independent variables resulting from the tested stimuli (Ekman & Friesen, 1976; Ekman, Friesen & Simons, 1985; Fox & Davidson, 1988; Krause, Steimer, Sanger-Alt & Wagner, 1989; Steiner, 1986).

In 1982, Ekman and Friesen used FACS to empirically confirm Guillaume-Benjamin-Amand Duchenne (de Boulogne)'s theory that smiles conveying genuine joy or happiness incorporate a contraction of the muscle surrounding the eye (Duchenne, 1862/1990). In FACS terms, both the *zygomaticus major* "smile" muscles (AU12) and

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This thesis follows the style of the *Journal of Personality and Social Psychology*.

the *orbicularis oculi (pars orbitalis)* “cheek raiser” muscles (AU6) must contract together during felt joy. “The most replicated and best documented of [genuine enjoyment] markers, which has shown the most convergent validity across subject groups and social conditions, is Duchenne's marker” (Frank, Ekman & Friesen, 1993). AU12 by itself merely marks deliberate expressions where the individual is not truly happy but might smile for social reasons (Ekman, Davidson & Friesen, 1990). See Figures 1 as an example:

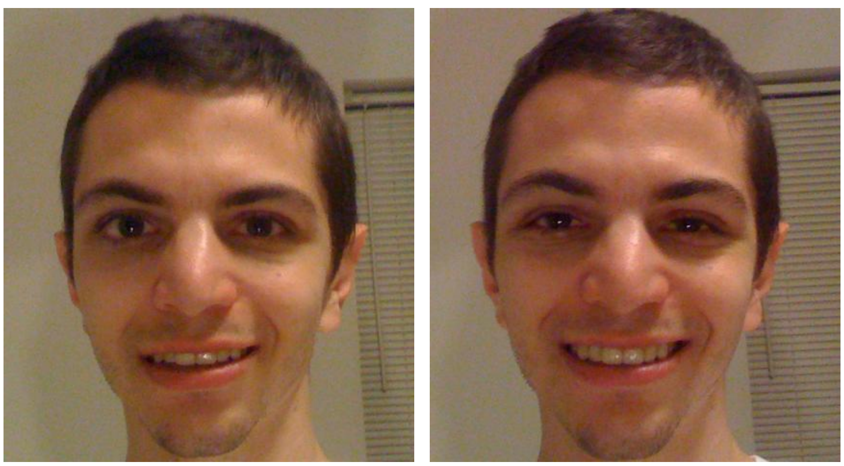

Figure 1. An AU12 “Empty Smile” (left) and a 6+12 Genuine Duchenne Smile (right)

Trained actors using the Stanislavski Method Acting system--wherein the actor produces emotional displays by intentionally recalling and reliving past emotional events--can also generate Duchenne Smiles (Gosselin, Kirouac & Dora, 1997). A 6+12 expression, unlike the mere AU12 expression, has been shown to generate electrical activity in the left anterior part of the brain (Ekman & Davidson, 1994; Fox & Davidson, 1988), which indicates positive affect (Davidson, 1992).

Using the body of literature surrounding the contraction of both AU 6 and 12 as a marker of joy, researchers could examine individuals' affective feelings towards related phenomena such as correlating: increased frequencies of 6+12 smiles with honesty (Ekman, Friesen & O'Sullivan, 1988); the rated funniness of humor stimuli (Ruch, 1995); infant reactions to mothers but not strangers (Fox & Davidson, 1988); extraverted personalities (John, 1990); or, lifetime marital and health benefits (Harker & Keltner, 2001).

The presence of AU6 is the key differentiation between a "True Smile" and a "Fake Smile" made in Paul Ekman's commercial literature (Ekman, 1985, p.151), because "[o]ur research confirmed Duchenne's assertion that no one can voluntarily contract the orbicularis oculi muscle (it 'does not obey the will.')" (Ekman, 2003, p.208; Ekman, Roper & Hager, 1980; Harker & Keltner, 2001). In other words, the presence of AU6 together with AU12 is both a necessary and a sufficient indication that the individual is experiencing genuine joy.

It is notable that AU6 also appears in a Pain reflex expression (Figure 2), which is 4+6+7+9/10+43/45 in FACS terms (Prkachin, 1992). In fact, AU6 is displayed more frequently in faked pain than in genuine pain: "The presence during pain of a pattern of facial activity often associated with pleasure attests to the complex interpersonal qualities of the experience of pain." (Craig, Hyde & Patrick, 1991, p170).

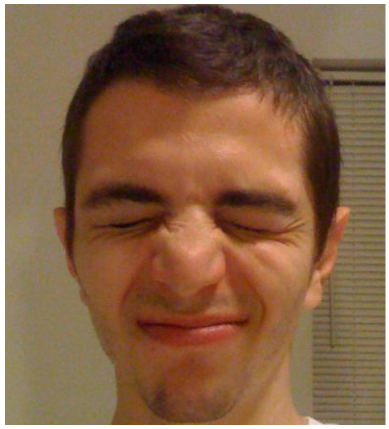

Figure 2. 4+6+7+9+12+43 Pain

Combined with an AU12 smiling action, which is easy to perform deliberately, a blend of the Pain and Smile expressions (Figure 3) would contain both FACS Action Units 6+12 and yet seemingly be a deliberate facial gesture, not indicative of genuine joy.

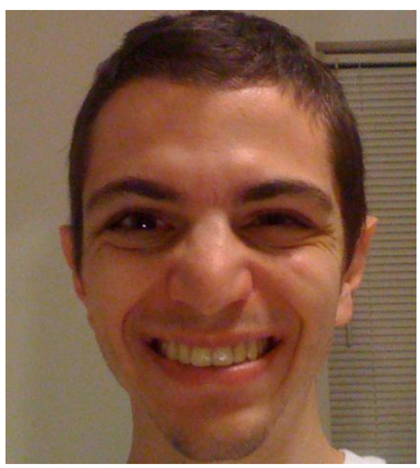

Figure 3. 6+7+9+12 Pain-Smile Blend

Ambadar, Cohn & Reed (2009, pp29-30, internal citations omitted) reported "[t]he idea that genuine smiles include AU 6 is so well-ingrained in the literature that there is a tendency to use this single characteristic as a marker of genuine amused smiles...[o]ur findings question this practice." Subjects were asked to perform directed facial action tasks (DFAT) to create desired facial expressions that were analyzed with FACS. Because Ambadar et al. (2009) had only subjects' self-reports of their feelings and the results of FACS which they were testing, they had no independent differentiation of "genuine" from "polite" smiles, leaving the possibility that DFAT tests designed to trigger non-genuine smiles may have triggered genuine enjoyment smiles. In fact, that perceived amused smiles more often included AU6 than perceived embarrassed/nervous smiles in the findings is more support for the Duchenne Smile Hypothesis than a challenge to it.

Harris & Alvarado (2005) tickled subjects until both pain and genuine smile facial actions blended, finding that both subject's self-report and FACS indicated both pleasure and displeasure. This study likewise does not establish that an expression may combine AU6 and AU12 without the subject experiencing genuine enjoyment, because subjects did show the AU 6 contraction and also reported both pleasure and pain.

Kunz (2009) demonstrated that subjects given painful stimuli (i.e., thermal or electric shocks) would often smile afterwards. However, the smile muscle movement was a secondary response that began distinctively 3-4 seconds after the pain expression had already been completed, so that the two expressions overlapped (partially blended) rather than simultaneously co-occurred. This might still mean that AU6 and AU12 appear at some particular instances due to a blending of pain and smiling, although not necessarily deliberately. Other studies have suggested that expressing joy increases subsequent tolerance to pain (Zweyer, 2004).

This project challenges the proposition that AU6 is a *sufficient* requirement for true joy; a smile including both 6+12 but not expressing genuine joy can be performed deliberately, not just by the minority of people, but by almost anyone. Subjects were asked to pose smiles by: a) recalling a pleasant experience (Stanislavski's Method Acting); b) directly attempting to contract AU6 and AU12; and, c) simulating a pain expression and smiling. The hypothesis is that the latter smile (c) will feature more contractions--and with stronger intensities--of AU6 than the other two conditions, demonstrating that the AU 6 contraction is not a sufficient marker for genuine joy.

It is quite likely that many if not most subjects will be unable to produce the 6+12 genuine joy expression even with instructions to imagine past happy experiences, because the conscious awareness of being taped or photographed makes the subject self-aware and less likely to produce natural, spontaneous expressions (Hager, 1982). Previous research by Ekman and colleagues has demonstrated that in deliberate expressions, AU12 (and AU4 if present) will be stronger on the left while AU9 will be stronger on the right (Hager & Ekman, 1985). Thus, condition c/the "Pain Smile" should be more asymmetrical than condition a/the "Joy Smile".

Other studies suggest there would also be a difference in the timing (onset, latency period, and offset) of the Pain Smile compared to a genuine Duchenne Smile (Hess & Kleck, 1997; Frank, Ekman & Friesen, 1993), however due to the use of still photographs this study lacks the complexity necessary to measure such timing variations. The "Pain Smiles" should have more intense components of AU4 and AU9, which are part of the Pain expression but not the Joy expression.

CHAPTER II

EXPERIMENT

Twenty-five undergraduate students at Texas A&M volunteered to participate as unpaid subjects after announcements were made in three undergraduate courses and the school's gymnastics club. Each subject scheduled a time to come, alone, to an unoccupied computer lab room. After signing a consent form, the subject filled a demographics questionnaire (Appendix A).

When the questionnaire had been completed, the principal investigator started the default image capturing software of a Logitech Quickcam Communicate MP connected to a Dell Optiplex 780 computer running the Windows XP operating system. The imaging software's default settings were used at maximum (1280 by 960 pixels) resolution. The principal investigator read instructions aloud (Appendix B) while subjects followed along on their laminated copy of the instructions with demonstrative images of the principal instructor. The principle investigator also assisted each subject in taking their first picture, which was a blank baseline image. Two of the subjects asked how they would receive their future instructions, but there were no other questions.

Then the principal investigator handed the subject page 2 of the instructions which detailed how to take an image after a) recalling a pleasant experience, b) directly attempting to contract AU6 and AU12, or c) simulating a pain expression and then doing that and smiling. Subjects were left alone in the lab room but the principle investigator was standing outside the door during the procedure. After each subject had finished the each page of instructions, they would open the door and request the next page in sequence. The first three pictures (the first three pages of instructions) were taken in the order presented Appendix B, however the order of the last four varied, except that the "Pain" picture (Appendix B, p.35) always immediately preceded the "Pained" smile picture on page (Appendix B, p.36). The a) "Joy" picture (Appendix B, p.34); b) “Pain” (Appendix B, p.35) then “Pained” images (Appendix B, p.36)and c) "Posed" smile picture on (Appendix B, p.37) were counterbalanced, such that there were six different possible orders, with each ordering occurring in at least four different subjects. The purpose of counterbalancing the pictures was to test for order effects.

Although three subjects expressed difficulty with the “Pained Smile” instruction page after the experiment, all subjects successfully produced seven pictures each. Before leaving, each subject was reminded not to discuss the purpose or format of the experiment to avoid influencing subsequent participants.

Five images per subject were e-mailed as jpeg attachments to two paid University of California at Davis psychology graduate students who were licensed in FACS coding: the “Neutral” image derived from page 2 of the instructions (Appendix B, p.32); the “Joy” image (Appendix B, p.34); the “Pain” image (Appendix B, p.35); the “Pained” smile image (Appendix B, p.36); and, the “Posed” smile image (Appendix B, p. 37).

Only the latter four of these images per subject were coded: the “Neutral” image was not coded but merely provided to the coders to assist in their determination of which muscles were active in the other images. Moreover, all four images of the principal investigator appearing in the laminated instructions were sent to the graduate students for coding in order to test the efficacy of these images on the subjects. Thus, 104 images for 26 people were sent for analysis. The other images were not coded due to lack of funds.

Of the 25 experimental subjects, images for two of the subjects were not coded by the graduate students. Additionally, images for two other subjects (both in the “Group 1” ordering) were analyzed only by a third coder who did not code any images in common with the other two graduate students and thus the data was discarded. Originally data was analyzed using the third coder’s work, but because this coder could not be rated for intercoder reliability with the other students. This left 21 subjects. Where different results may have been obtained using all 23 subjects, notes will be made below.

Due to the counterbalanced order in which the images were requested, “Group 1” (three subjects, not including the discarded set) was asked to take images in the Joy/Posed/Pain/Pained order; “Group 2” (four subjects) followed the Posed/Joy/Pain/Pained order; “Group 3” (four subjects) followed the Joy/Pain/Pained/Posed order; “Group 4” (three subjects) followed the Pain/Pained/Joy/Posed order; “Group 5” (three subjects) followed the

Posed/Pain/Pained/Joy order; and, "Group 6" (four subjects) followed the Pain/Pained/Posed/Joy order.

The coding used standard but detailed FACS analysis, with each AU muscle group rated on a six-point scale: not at all; "A" for minimal contraction up to "E" for maximal contraction. Each half of each face was rated separately, such that different scores were obtained for the left and right sides of each subject. One of the coders analyzed nine images alone, the second analyzed ten images by himself, and the remaining three images were coded by both.

Results

The intercoder reliability, conducted over 14% of the final sample pool, was calculated by taking, for the images both had worked on, the number of action units coded in common divided by the total number of action units coded by both. An action unit was only considered "coded in common" for this purpose if both raters had assigned it the same degree of intensity ("A" through "E") on both sides of the face. The intercoder reliability for this experiment was 0.717, which is comparable to other FACS studies, where the intercoder reliability tends to vary from 0.65 to 0.85 (Rosenstein & Oster, 1988). For the three subjects coded by both analysts, the ratings from the coder who had analyzed the slight majority (ten subjects' images by himself) were incorporated for the final dataset. Additionally, the computer the webcam had been connected to automatically time-stamped the date of creation for each new file to the nearest second.

Thus, the principal investigator could estimate the time a subject spent on each of the four coded images by subtracting the timestamp of the image from that of the previous image. Comparisons were then made using a two-tailed T-test of statistical significance (Boneau, 1960).

The images of the principal investigator that had been present in the instructions were coded as follows: "Neutral" for the image (Appendix B, p.32) that had been intended to demonstrate Neutral; 6B+12C+25C for the "Joy" and "Posed" images (Appendix B, p.34 & p.37) that had been intended as a 6+12 genuine smile (AU25 is merely the code for "open mouth"); 4B+6B+7D+9E+L14C+43E for the image (Appendix B, p.35) intended as 4+6+7+9+43 Pain; and, 6C+12D+20A+25D for the image (Appendix B, p. 36) intended as a "Pained" smile. With the exception of the left-side AU14C (which pulls the corner of the mouth horizontally) and the trace AU20 (*Risorius* muscle), these images generally conveyed the sought-for images to the subjects, and possibly served as better explanations than the written instructions.

In a binary, present-or-absent sense, AU6 was fairly common. Of the 84 images, only 21 lacked some contraction of the *orbicularis oculi pars orbitalis* (see Table 1 below).

Five subjects (one each from “Group 1,” “Group 2” and “Group 3” and two from “Group 6”) failed to produce a smile with AU6 in either the “Joy” or “Posed” conditions, but managed to contract the *orbicularis oris pars palpebralis* for “Pain” and the “Pained” smile. Conversely, of the two subjects who failed to produce a “Pained” smile with AU6, one (in “Group 3”) also failed to produce AU6 in any condition other than the (non-smiling) “Pain” expression.

Table 1: *Presence of AU6*

	Joy	Posed	Pain	Pained	Group Total
Group 1 (Joy/Posed/Pain/Pained)	2/3	1/3	3/3	3/3	9/12
Group 2 (Posed/Joy/Pain/Pained)	1/4	3/4	4/4	4/4	12/16
Group 3 (Joy/Pain/Pained/Posed)	3/4	2/4	3/4	3/4	11/16
Group 4 (Pain/Pained/Joy/Posed)	3/3	3/3	3/3	3/3	12/12
Group 5 (Posed/Pain/Pained/Joy)	0/3	2/3	3/3	2/3	7/12
Group 6 (Pain/Pained/Posed/Joy)	2/4	2/4	4/4	4/4	12/16
Condition Totals	11/21	13/21	20/21	19/21	63/84

While Table 1 suggested that about as many subjects produced AU6 expressions in “Joy” and “Posed” conditions, and that this number is lower than those subjects who produced an AU6 contraction in Pain and Pained expressions, the differences between the four conditions did not rise to the level of statistical significance using a two-tailed T test ($T(2,40) = 0.77$, $p>0.1$ for “Pain” vs. “Joy”).

The action units were then assigned to a six-point numerical intensity scale, with 0 for “not present,” 1 for “A” or minimal, 2 for “B” or subtle, etc., up to 5 for “E” or maximal. Of the 379 total AUs coded from the subjects, only thirteen showed asymmetry: nine AU12’s, two AU10’s, one AU14 and one AU20. Four of the AU12’s were stronger on the right side of the subject's face, five were stronger on the left. Nine of the thirteen asymmetries were a difference of merely one degree of intensity on the six-point scale and no individual subject showed more than two asymetrical AUs in all four coded images. Interestingly, five of the nine AU12 asymmetries occurred in the "Joy" compared to two in the "Pained" smile condition, whereas the opposite had been predicted (more asymmetry in the complex, deliberate "Pained" smile compared to felt emotional joy). Because asymmetry was so rare, where it occurred, the intensities on each side of the face were averaged for the final dataset. Despite the great volume of information available, the analysis focused exclusively on those action units most relevant to the traditional expressions of either pain or joy.

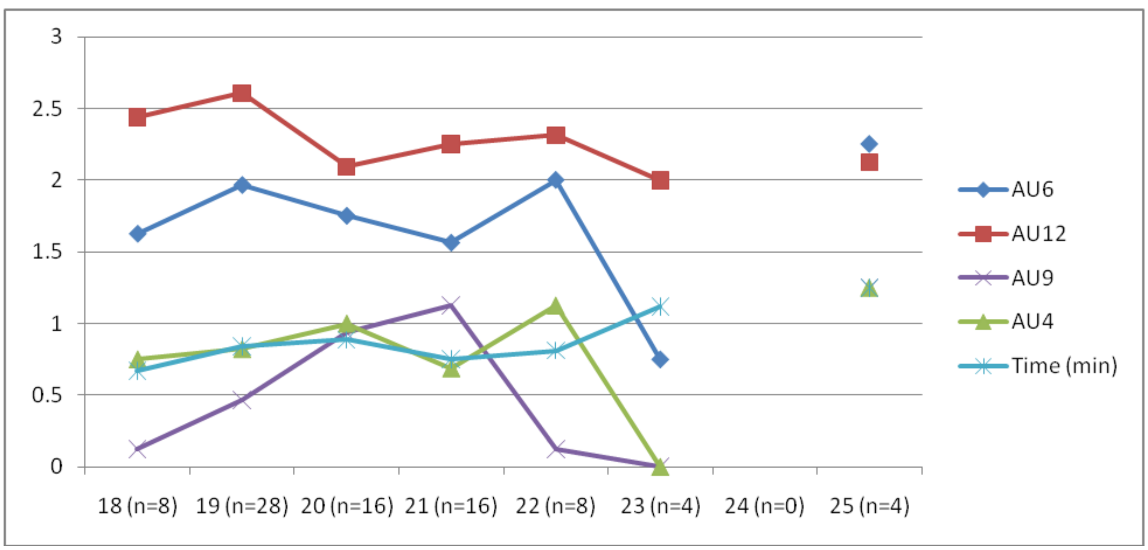

Figure 4. Average AU Intensity by Age

Figure 4 suggests a (very) slight trend of decreasing contraction intensity and increasing time spent per image as the subject age increases, however the number of subjects per age group (i.e., only one 25-year-old participated) is too small to draw meaningful conclusions.

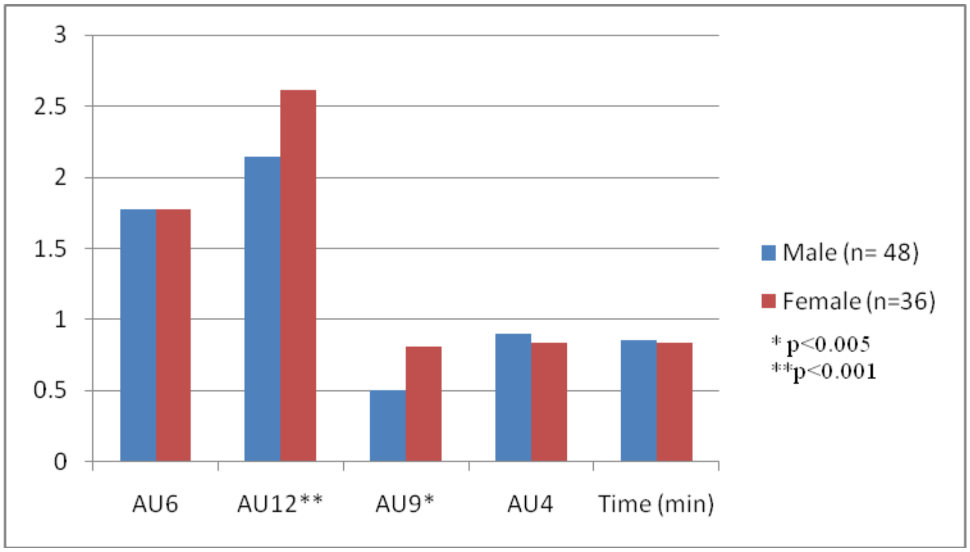

Figure 5. Average AU Intensity by Gender

When comparing AU intensity by gender (*Fig. 5*), the nine women had statistically significantly stronger average AU12 ($T(2, 82) = 4.15$, $p<0.001$) and AU9 ($T(2, 82) = 2.94$, $p<0.005$) contraction than the twelve men, although average eye contraction (AU6) was almost identical. This is partially unsurprising, as women are traditionally discovered to be more emotionally expressive when measured by FACS intensity scores (Ekman, 1972). However, it is interesting that the key action unit for distinguishing genuine from faked joy, the *orbicularis oris pars palpebralis,* is seemingly unaffected by gender.

The demographics questionnaire revealed, for 21 subjects, 12 different undergraduate study majors. The Ethnicity category led to the opposite problem: uniformity. 17 of the 21 subjects self-identified as “White,” 2 as “Hispanic or Latino,” 1 each as “Black or African American” and “Other,” and one subject marked two options (“Asian ” and “Native Hawaiian or Pacific Islander”). Further analysis accounting for study major or race would have fragmented the limited data beyond its capacity to reveal useful conclusions.

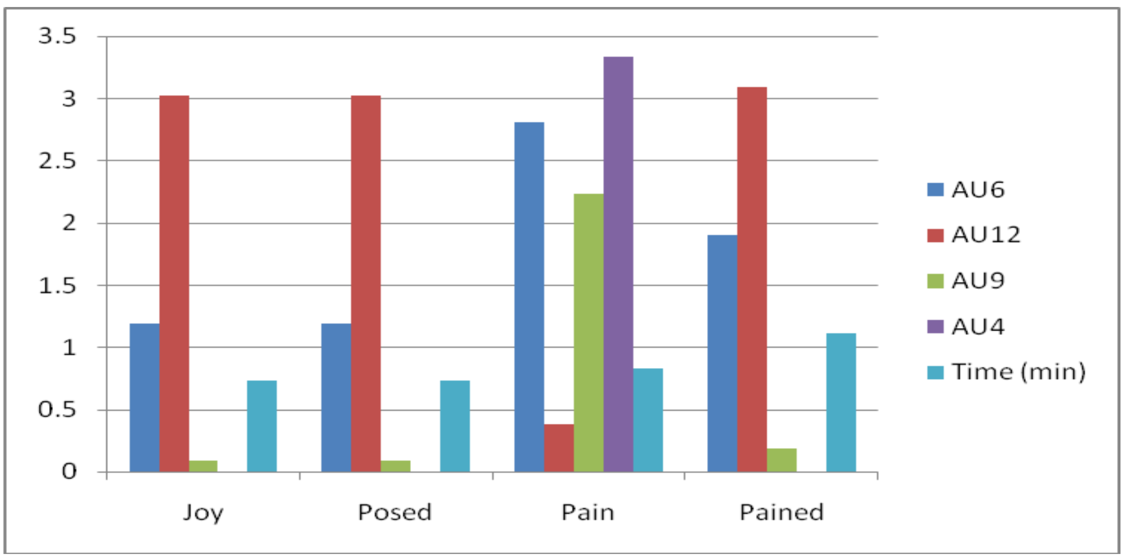

Figure 6. Average AU Intensity by Condition (n=21 for each condition)

Figure 6 aggregates the subjects but separates the images by condition; that is, by the type of expression the instructions requested. Although the average Action Unit 6 contraction in the “Pained” smile expression appears stronger than in the near-equal “Joy” and “Posed” condition (but less than in the “Pain” condition), the difference between the “Pained” and the “Joy” AU6 ($T(2, 40) = 1.84$, $p<0.1$) and is only statistically significant to $p<0.1$, whereas most psychology research requires at least $p<0.05$ statistical significance for trustworthy conclusions (Stigler, 2008). The difference between the "Pained" and "Posed" AU6 ($T(2, 40) = 2.05$, $p<0.05$) is, however, statistically significant. The "Pain" condition was statistically different from the three in terms of the four analyzed AUs. smiles ($T(2, 40) = 3.65$, $p<0.05$,) Thus, the "Pain" expression is qualitatively different from the other three, and that the "Pained" smile is much closer to the other two smiles than to a "Pain" expression. In fact, although AU4 leakage was expected in the "Pained" smile, AU4 does not appear in the dataset outside of the "Pain" expressions (note that AU4 does appear in both "Pained" images from the two subjects discarded because they were analyzed solely by the third coder; however, when those eight images were added to the total dataset, none of the statistical significances in the by-condition analysis were altered).

A different result occurs in the by-condition analysis when we examine the time spent per image. More specifically, the average time spent on the "Pained" images was statistically significantly longer than spent on the other three conditions (($T(2, 40) = 3.65$, $p<0.001$ vs. "Joy"); ($T(2, 40) = 3.49$, $p<0.001$) vs. "Posed"; ($T(2, 40) = 2.82$, $p<0.01$), whereas none of the other comparisons (e.g., "Pain" vs. "Joy", "Pain" vs. "Posed," etc.) had different time averages. This result reflects the comments of the three subjects who spontaneously spoke about the difficulty of interpreting the "Pained" instructions (Appendix B, p.36). These instructions appear qualitatively more time-consuming than the others, including the "Pain" instructions.

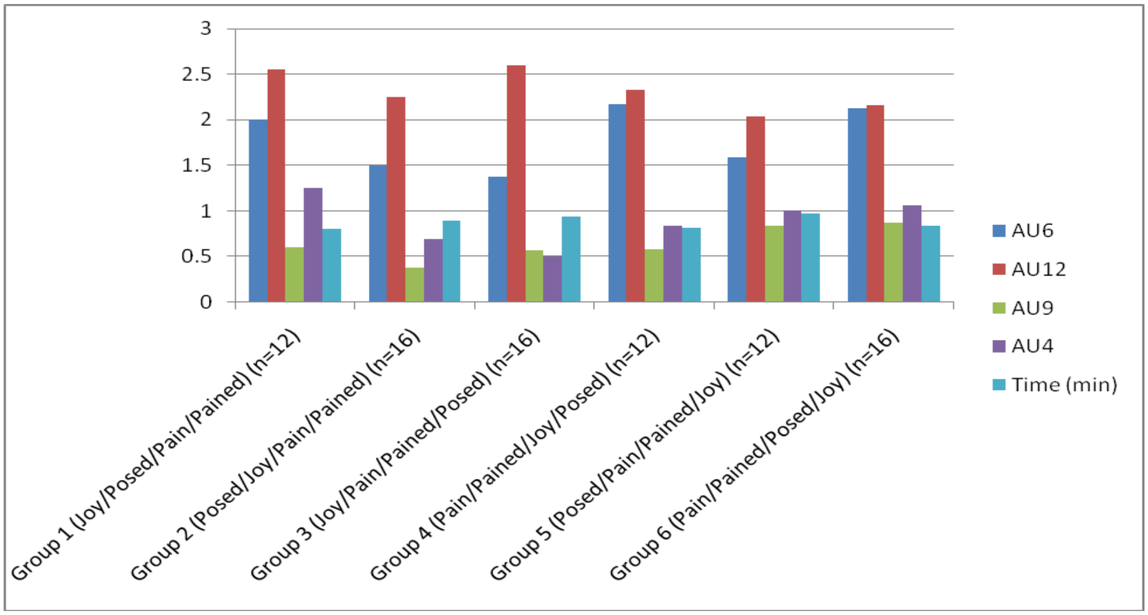

Figure 7. Average AU Intensity by Order

Separating the dataset by group (based on the order in which the subjects were presented the laminated instruction pages) failed to reveal any statistically significant differences in either average AU intensity or the time spent per image.

Ordinarily, where data can be grouped by multiple variables (i.e., Group order or Condition), an Analysis of Variance (ANOVA) test would be employed to check for interaction effects (Cohen & Cohen, 1983). However, because of the variances and small numbers of subjects per condition, the ANOVA would not have detected any differences in the conditions.

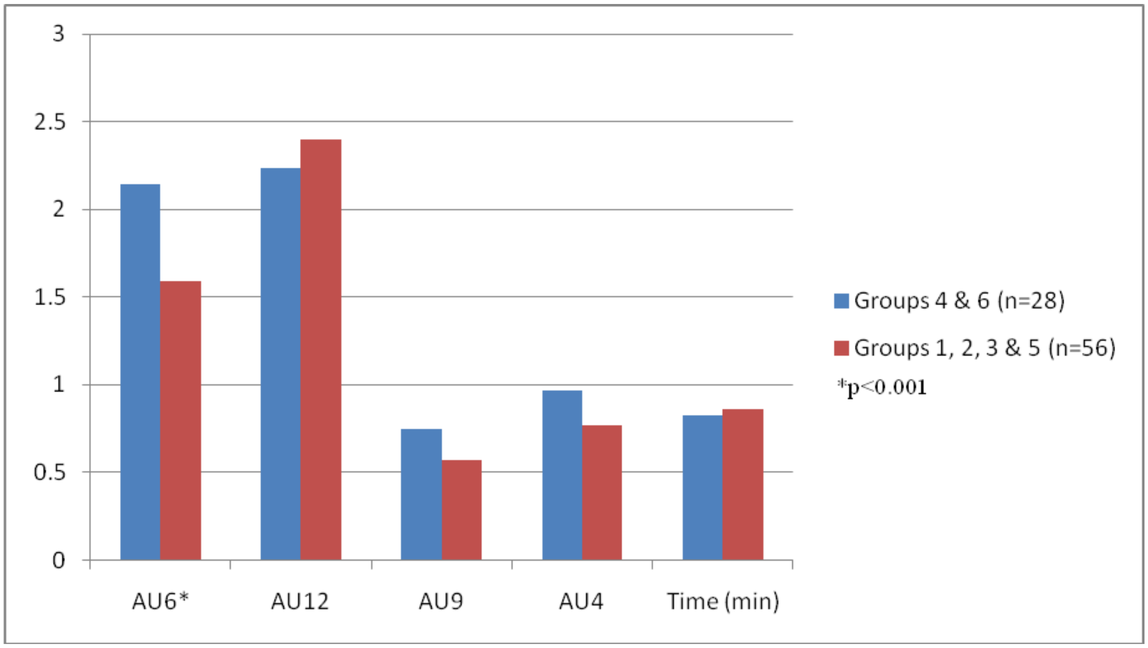

Figure 8. Exposure to "Pain"/"Pained" First Compared to Other Groups

Grouping did matter when the instructions for "Pain" and "Pained" occurred before "Joy" or "Posed." Figure 8 above reveals that those subjects in the two Groups asked to portray the "Pain" and "Pained" expressions before the "Joy" or "Posed" expressions had significantly stronger average AU6 contractions ($T(2, 82) = 5.34$, $p<0.001$). This suggests that exposure to the "Pain" technique of first contracting AU4 and AU9 to activate AU6 enabled stronger AU6 contractions in the later expressions, while the reverse (exposure to either "Joy" or "Posed" first) did not have as much of an effect. Interestingly, neither average AU4 brow lowering contractions ($T(2, 82) = 1.28$, $p>0.1$) nor AU9 nose wrinkling ($T(2, 82) = 1.46$, $p>0.1$) were also statistically significantly different (although they were stronger) for the combined "Group 4" and "Group 6", which suggests that these subjects were able to learn to access AU6 using the "Pained

Smile" method for subsequent "Joy" and "Posed" expressions without allowing the major action units of "Pain" other than AU6 to pollute such smiles.

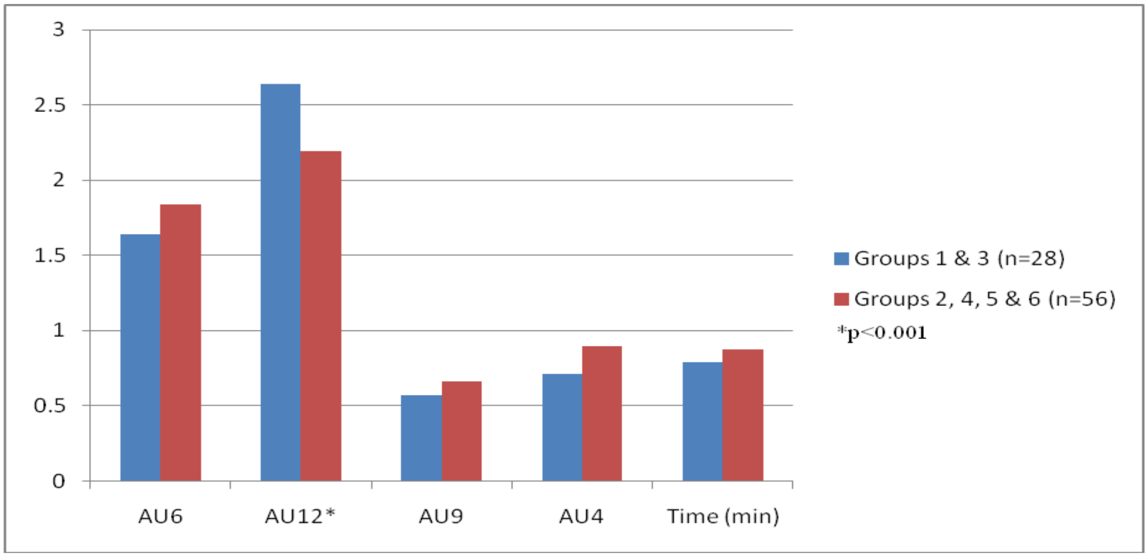

Figure 9. Exposure to "Joy" First Compared to Other Groups

However, asking subjects to present the expression upon attempting to experience Joy did statistically significantly increased the average strength of the *zygomaticus major* smile ($T(2, 82) = 3.53$, $p<0.001$) but did not appear to affect the other action units (Figure 9). Conversely, if first asked to pose a fake smile (*Fig. 10*), subjects displayed statistically significantly weaker expressions in terms of both action units ($T(2, 82) = 3.58$, $p<0.001$ for AU6); ($T(2, 82) = 2.17$, $p<0.05$ for AU12) involved in the Duchenne smile.

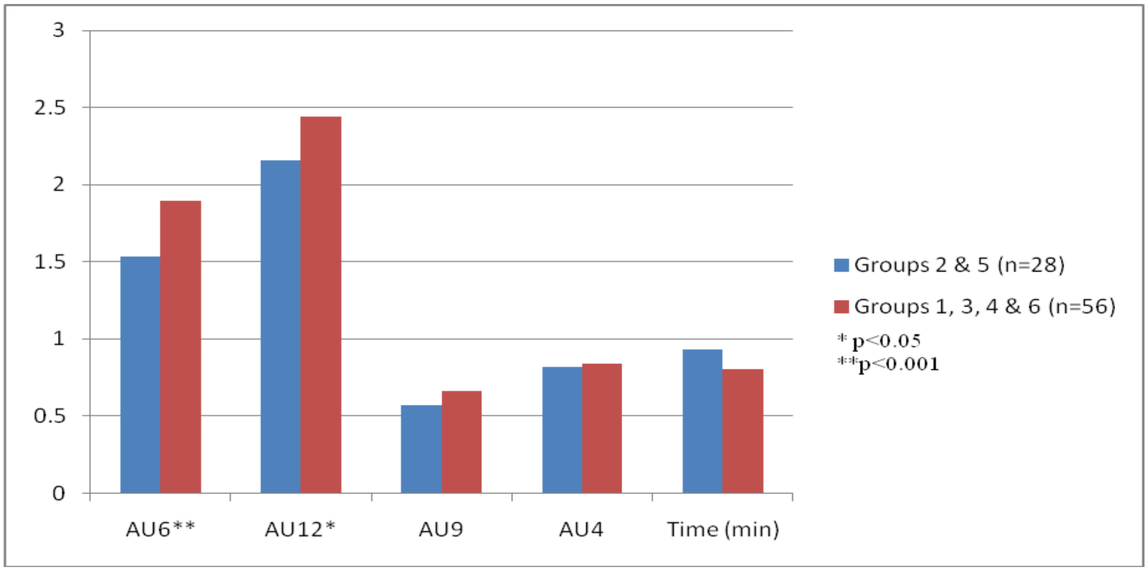

Figure 10. Exposure to "Posed" First Compared to Other Groups

Discussion

The most significant finding was that almost all subjects made nearly statistically indistinguishable smiles in response to the instructions for "Joy," "Posed," and "Pained" smiles. AU 6 was contracted in almost each case (and significantly more so with "Pained" than "Posed" smiles), a clear demonstration that relying on AU 6 alone as a marker for genuine joy is untenable.

The increase in AU6's appearance (Table 1) and intensity (Figure 6) in the "Pained" condition compared to either "Joy" or "Posed", although only statistically significant only when comparing the average "Pained" to "Posed" AU6 intensity, supports the paper's thesis that the Pained Smile technique of shifting from Pain to a smiling expression enables untrained subjects to better access their *orbicularis oris pars palpebralis* and deliberately fake what most FACS research would misclassify as "genuine joy." This is further supported by the fact that those subjects who were taught this technique first appear to have applied the Pained Smile technique towards the "Joy" and "Posed" smiles to achieve stronger AU6 contractions (Figure 8) than in the inverse case (Figure 10). Because some subjects reported that the "Pain" and "Pained" instructions were difficult to interpret, clarifying these instructions could have shown greater differences in AU 6 by condition.

A post-hoc test of the mean AU6 intensity for the "Pained" set revealed that, for the n=21 images available, the statistical power to reveal the medium effect size (d=0.40) was merely 0.086. To obtain the traditionally accepted statistical power of 0.20, assuming the same variance in the data, would require 48 subjects for an 82% chance to detect a medium effect (Cohen & Cohen, 1983). Thus, increasing the number of subjects in this procedure could reveal effects undetected by the current study.

The primary concern of this experiment was the presence and intensity of the Duchenne marker in the faked "Pained" smile compared to a genuine joy smile. However, the comparisons used in this experiment assume that the smiles produced in the "Joy" condition are actually expressions of genuine joy. This seems unlikely, as the subjects were aware of and participated in photography, which makes producing natural, spontaneous expressions challenging (Hager, 1982). The difficulty of posing expressions can be illustrated by the fact that even the principal investigator could not produce the exact action units desired. Indeed--aside from the fact that subjects exposed to the “Posed” instructions first produced weaker AU6 and AU12 contractions (Figure 10) while no similar finding was found for those subjects exposed to the “Joy” instructions first (Figure 9)--there were no statistically significant differences found in the data between the “Joy” and “Posed” conditions. Studies that have analyzed the intensity of AU6 typically correlate the strength of the muscle with the degree of happiness (Harker & Keltner, 2001). It is possible that the “Pained” expression might be distinguishable from genuine joy because its AU6 is stronger, but such determination would require identifying a baseline expression for true joy. One possibility would be to take hidden footage of subjects watching comedic films (Ruch, 1995), but this would be more time-consuming and still requires the principal investigator to apply his own definition of what would qualify as a “genuine smile.” “Unlike with self-report and physiological measures, there is no true baseline period for coding facial expression,” (Sayette, et al., 2003, p.221).

The failure of the instructions to convey the Pained Smile technique is revealed by the significantly longer average time the subjects spent on this set of instructions (Figure 6), a difference seemingly unaffected by subject gender (Figure 5) or the order in which these instructions were presented (Figures 7-10). Additionally, the spontaneous comments of three subjects indicated that the language used in the instructions was awkward and difficult to understand. An alternative that had been considered in the planning stages involved having the principal investigator observe the subjects in real-time to direct the subjects both verbally in posing--a setup that has been used in prior

FACS research (Ekman & Davidson, 1994)--but the concern was that the Principal Investigator's bias towards the hypothesis would result in more detailed instructions for the "Pained" condition. The experiment conducted used text and static images that could be FACS-coded, but future experiments may benefit from a video of the Principal Investigator demonstrating the expression rather than a photograph.

The lack of many asymmetrical expressions is unsurprising due to the fact that each subject had as much time as he or she desired to examine themselves through the computer screen before taking each photograph (52 seconds per image was spent on average). Although symmetry was not discussed in the instructions, subjects probably adjusted their expressions until they achieved muscular symmetry. Far more subjects would be needed for the data to reveal statistically significant differences in asymmetrical expressions by condition or by group order.

The high number of AU6-containing smiles is seemingly incongruent with Ekman's claims that this is a difficult muscle to activate deliberately, but other studies have found it to be fairly common (Ekman, Roper & Hager, 1980, for instance, found that 32/45 subjects could perform Duchenne smiles on command). Additionally, the fact that subjects had time to set up poses for static images likely contributed to their ability to achieve 6+12 smiles. Regardless, the results indicate that 6+12 smiles were more likely using the "Pained" smile technique than by posing or by attempting the "Method Acting" technique.

A better measurement of the smiles would have been video rather than static images, as such data would have revealed temporary, fleeting differences in asymmetry, muscle contraction duration, and "leakage" from other AU's a subject might contract in the course of attaining the posed, static image. However, coding video is obviously far more time-consuming than individual photographs; one study estimated it takes up to 10 hours to code each minute of footage with full detail (Ekman, 1982).

The substantial costs of video data and increased subjects may become necessary for subsequent psychological affect research. If the *orbicularis oris pars palpebralis* Duchenne Marker is the only feature used to distinguish genuine from faked joy, such research is vulnerable to the posed "Pained" smile technique investigated here, which enable deliberate control of AU6. More comprehensive analysis of the "Pained" smile technique might reveal differences in smile duration, muscle asymmetry, or the presence of additional AU "leakage" that could identify "Pained" expressions and prevent researchers from misclassifying them as Joyful.

CHAPTER III

SUMMARY

The experimental data partially supported the conclusion that subjects were more likely to activate AU6 in smiling expressions and with greater contraction intensity if they first performed an expression of Pain, however the differences fell short of statistical significance in most measures. Future FACS research of positive affect should account for the fact that the use of the "Duchenne Marker" alone to identify expressions of happiness is vulnerable to this form of deliberate posing.

Conclusions

Future studies should use many more subjects, which should validate the experimental thesis that the "Pained" smile produces more and stronger AU6 contractions than simply posing or acting happy. Alternatively, video of the subjects could be taken and coded for temporal, more detailed analysis.

Prior studies have shown that untrained judges can indeed distinguish between genuine joy smile to a nonspontaneous deliberate expression of the same subject (Frank, Ekman & Friesen, 1993). A second experiment using the data from this study could be conducted, testing whether a new set naïve subjects could distinguish which in which condition (i.e., "Pained" vs. "Posed") a smile was performed. The extent to which observers will distinguish the effect of AU9 or AU10 on the upper lip in a 6+9+12 smile compared to a 6+12 smile should be investigated.

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APPENDIX A

DEMOGRAPHICS QUESTIONAIRE

Questionaire

Please circle the answers below that best describe you, or write where appropriate.

1. **Gender**
    a. Male
    b. Female
2. **Age** (please write): ______________
3. **Ethnicity**: Which ethnic group do you self-identify with?
    a. American Indian or Alaskan Native
    b. Asian
    c. Hispanic or Latino
    d. Black or African American
    e. Native Hawaiian or Other Pacific Islander
    f. White
    g. Other
4. What is your **Major** at A&M? (please write): ________________

APPENDIX B

LAMINATED INSTRUCTIONS

Sit comfortably in front of the computer and pull the chair close enough that your face appears as large as possible on the webcam's screen, but make sure that your whole face is in camera--i.e. the webcam captures just above the top of your head *and* just below the bottom of your chin. Try to center yourself so that your face appears in the middle of the webcam screen.

We will now take the initial test photo. Make sure the mouse pointer is hovering over the "Take Photo", then look at the webcamera eye sitting on top of the monitor and press the left mouse button. There is at least one full second of lagtime delay between when you click "Take Photo" and when the computer captures an image, so for each picture make sure you keep looking at the webcam for a few seconds after you click or it may capture you looking down at the screen. For each subsequent picture, try to face the camera squarely and look directly into the lens.

Do not delete any pictures you take. For the subsequent six photos, you may only take one picture per page of instructions. If there are not seven pictures after you are finished, your sample set will be discarded from the study.

I will be waiting outside the room during the subsequent photos. When you have finished with each page of the instructions, please step outside and prompt me for the next page.

Relax all of your facial muscles and make your face look "neutral" or "blank," expressing nothing. It may look somewhat like the picture below.

Take a picture of your blank face.

After you have taken this picture, please return this page to the Investigator.

Take a picture of yourself smiling.

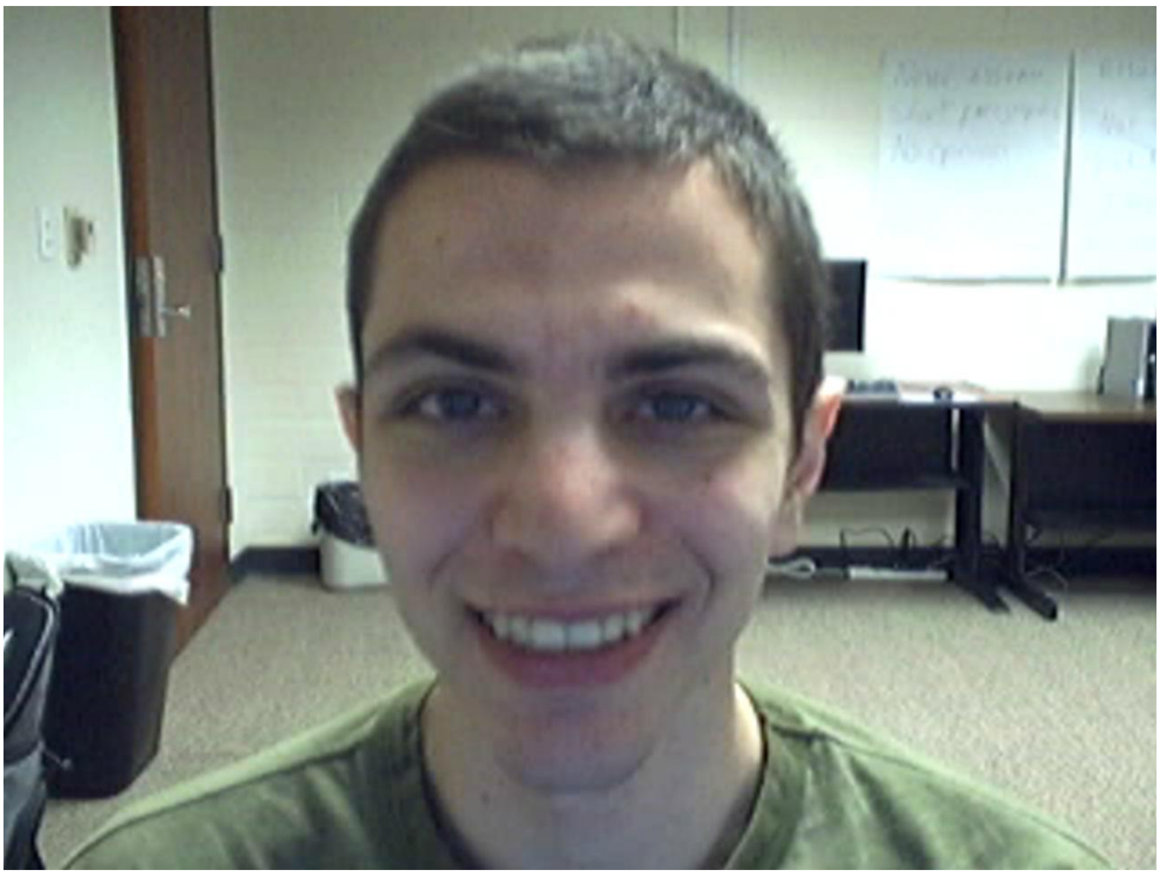
After you have taken this picture, please return this page to the Investigator.

Try to let yourself experience true happiness. Imagine your most joyful moment or a funny joke you heard recently. You should feel yourself:

a) smiling and
b) your cheeks moving up and outward and causing crows' feet wrinkles around your eyes,

but do not force your facial muscles; simply allow them to express what you feel when you are truly happy. It may look somewhat like the picture below.

Take a picture of your happy face.

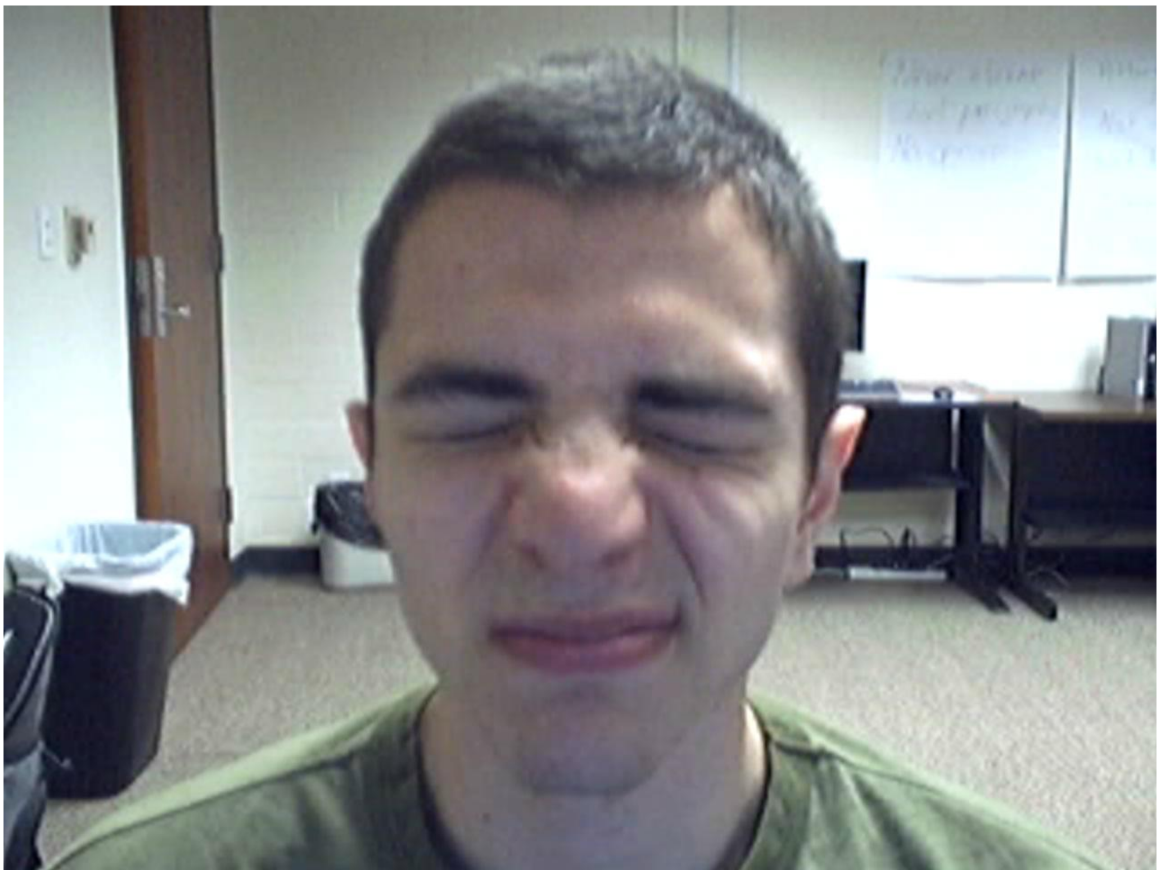


After you have taken this picture, please return this page to the Investigator.

Try to make an expression of Pain. You should notice:
a) your eyebrows move down and closer together, causing vertical wrinkling between them;
b) your eyes squeeze shut;
c) your cheeks move up and outward and cause crows' feet wrinkles around your eyes; and
d) your nose wrinkles, pulling your skin towards the center of your face.

It may look somewhat like the picture below.

Take a picture of your pain face.



When you are finished, return this page to the Investigator.

Again try to make an expression of pain. Now smile while you are holding the pain expression. Slowly open your eyes and try to relax the muscles that were

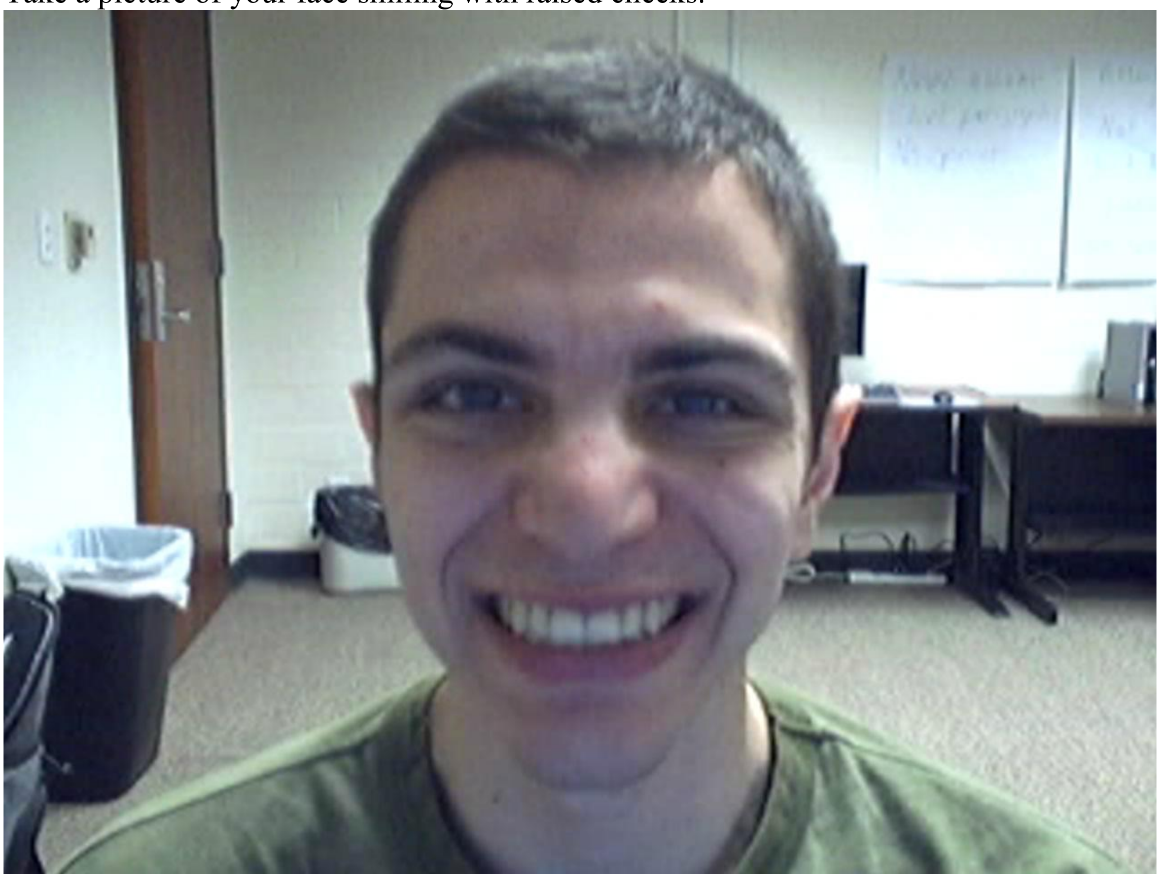
a) moving your eyebrows down and closer together,
b) squeezing your eyes shut, and
d) wrinkling your nose.

In other words, relax as many other muscles on your face as possible, as long as you keep:

a) smiling and
b) keep holding your cheeks up and outward with crows' feet wrinkles around your eyes.

You may need to keep your nose wrinkled or contract other muscles to do this. Do not attempt to actually feel any emotion, but try to convince an unknowing observer that you are genuinely happy. It may look somewhat like the picture below.

Take a picture of your face smiling with raised cheeks.



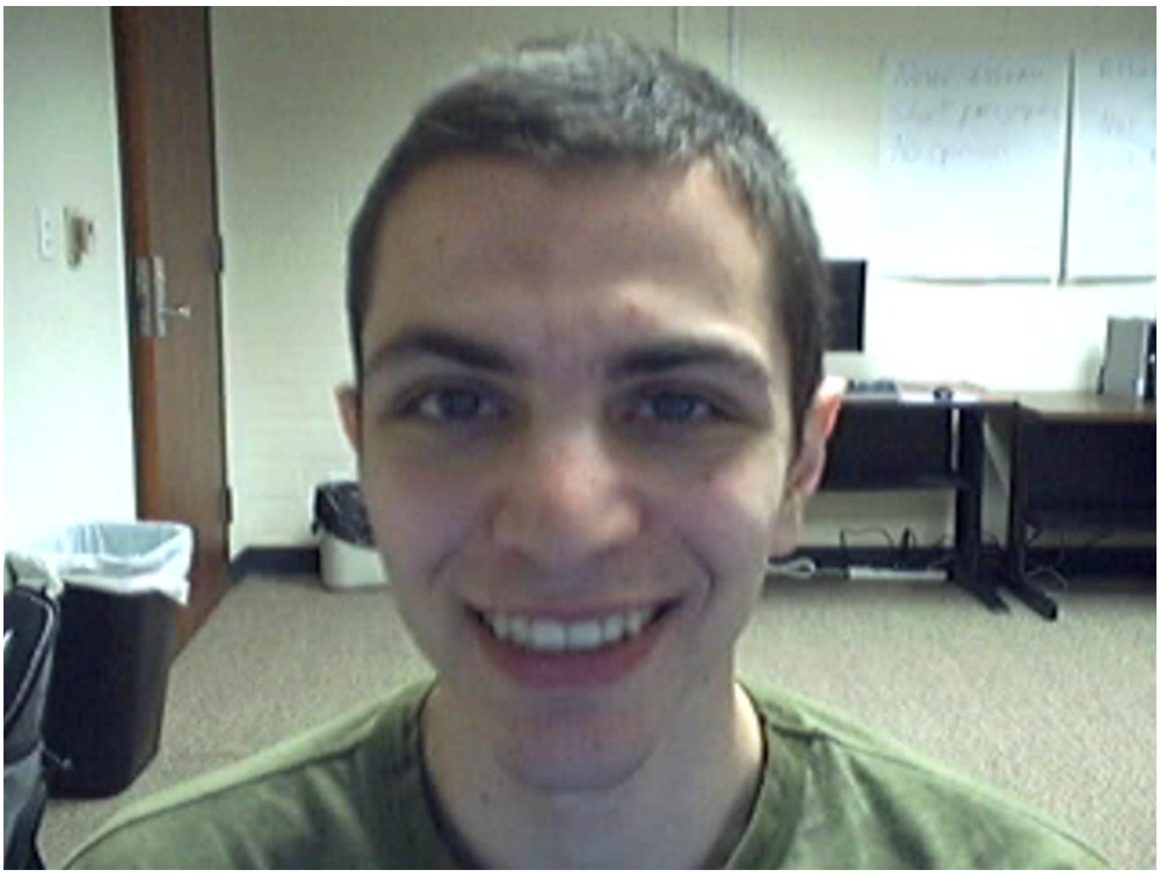
When you are finished, return this page to the Investigator.

Try to make an expression of:

a) smiling and
b) raising your cheeks up and outward and causing crows' feet wrinkles around your eyes.

Do not attempt to actually feel any emotion, but try to convince an unknowing observer that you are genuinely happy. It may look somewhat like the picture below.

Take a picture of your face smiling with raised cheeks.



When you are finished, return this page to the Investigator.

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