



Direct coding of anatomical facial expressions associated with physiological and emotional chills responses

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ABSTRACT

Rooted in thermoregulation, chills experiences have been recognized as an indicator of human response to significant emotional events, yet these experiences have never been studied in conjunction with facial expressions (Panksepp, 1995). This study was developed to examine potential relationships between positive and negative physiological/emotional chills sensations and anatomical facial expressions. Positive chills (“goosetingles”) occur in conjunction with positive emotions, while negative chills (“coldshivers”) occur in conjunction with negative emotions; each of these chills experiences is defined by six data-driven items developed by past studies (Maruskin, Thrash, & Elliot, 2012). Results indicate that positive chills experiences are positively correlated with emotionally positive facial expressions, while negative chills experiences are positively correlated with emotionally negative facial expressions.

INTRODUCTION

In order to understand the anatomical and physiological responses associated with emotional chills, this thesis research project was designed around subjects viewing three distinct videos, empirically validated to elicit either coldshivers (negative chills), goosetingles (positive chills), or neither (control) (Maruskin et al., 2012). This project involved developing a protocol based on the Facial Action Coding System (FACS) and the Emotional Facial Action Coding System (EMFACS) in order to code and taxonomize facial expressions as subjects experienced chills sensations. This protocol streamlined facial coding for manual use, first by distilling FACS’ hundreds of intensity-coded options into 39 pre-selected, emotion-related Action Units (AUs), and then by grouping them into six combinations of AUs pertaining to specific displayed emotions. Based on preliminary emotional psychology and human physiology research, the research hypothesis was that goosetingles would be associated with objective expressions correlated with positive emotions, and that coldshivers would be associated with objective expressions correlated with negative emotions.

METHODS

Participants

The sample consisted of 18 college students (mean age 21.22 ± 1.35) from the University of California, Berkeley who participated in the research project in exchange for pizza.

Procedure

Participants attended one-on-one sessions in the Keltner Laboratory. Three video clips, empirically derived to elicit goosetingles (Susan Boyle’s heartwarming vocal performance of “I Dreamed a Dream”), coldshivers (a magic trick in which performers use knives on their forearms entitled “Suicide in C-Sharp”), and a control (an instructional video on how to play “Hot Cross Buns”), were shown to each subject (Maruskin et al., 2012). The videos were presented to each participant in a randomized order to avoid bias. While the participant engaged with each video (“I Dreamed a Dream” in the goosetingles condition, “Suicide in C-Sharp” in the coldshivers condition, and “Hot Cross Buns” in the control condition), their facial expressions were coded by observing small changes in facial muscle movements and matching them to 39 AUs (*Study 1*). After watching the three videos, participants answered a Qualtrics survey where they were asked to infer their emotions based on the specific bodily sensations experienced while watching the videos. This involved establishing the presence or absence of a chills sensation, then ranking each of their emotions on a scale from 1 to 7 (1 = not at all, 7 = extremely) per condition (*Study 2*). The statistical program R was then used to generate box plots by categorized emotion, create comparative bar graphs, produce descriptive statistics, and test differences using paired t tests at 95% confidence intervals.

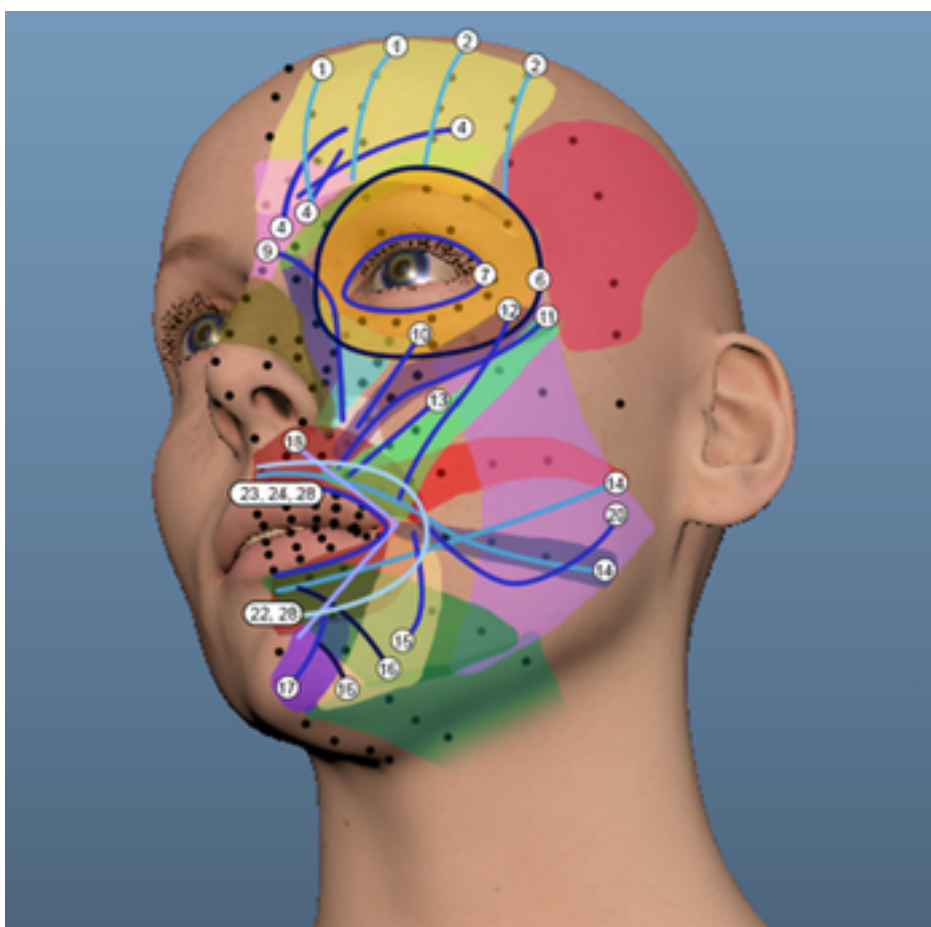


Figure 1: Action Units (denoted by their AU number) correspond to movements of specific muscles (shaded in colors). Using groups of 39 AUs, facial movements were coded as participants engaged with the three videos.

RESULTS

STUDY 1

Table 1: Means, Standard Deviations, and t Tests (Study 1)

Variable	M			SD			t		
	Control	Coldshivers	Goosetingles	Control	Coldshivers	Goosetingles	Coldshivers vs. Control	Goosetingles vs. Control	Coldshivers vs. Goosetingles
Disgust	2.89	20.22	2.89	1.18	1.89	2.02	34.33***	0.0	27.23***
Anger	4.67	21.56	5.56	1.64	3.89	3.22	17.79***	3.25**	9.43***
Happiness	4.00	1.11	15.11	1.75	0.83	4.35	-6.43***	9.03***	-13.52***
Sadness	4.44	16.89	2.89	0.98	2.78	1.37	17.99***	-4.93***	18.57***
Fear	3.78	20.22	4.33	2.48	3.52	1.08	14.48***	8.09***	13.34***
Surprise	1.11	10.67	8.67	0.83	2.68	3.18	15.76***	10.12***	2.28*

*p < .05. **p < .01. ***p < .001.

Figure 2: Mean AU Count by Emotion AU Combination in Control, Coldshivers, and Goosetingles Conditions. Error bars indicate 95% confidence intervals.

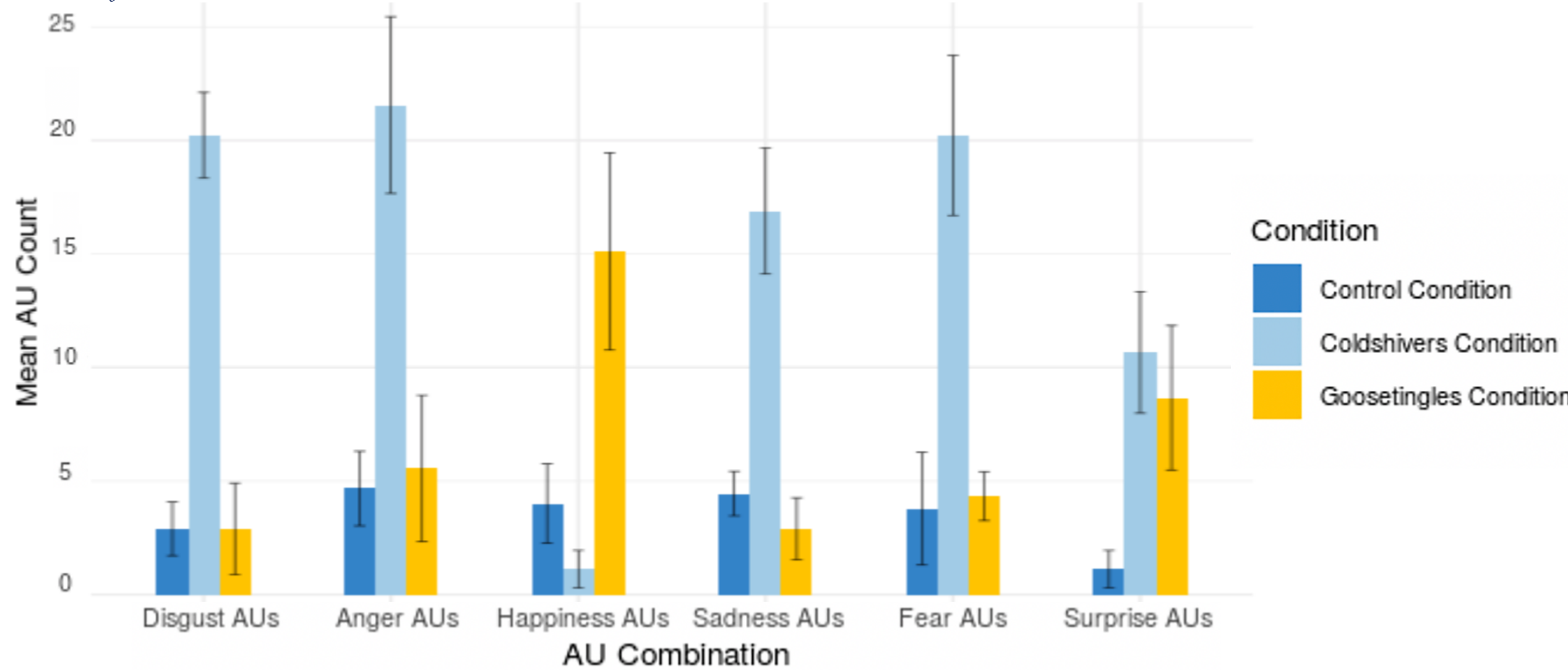


Figure 3: Disgust AU Count in Control, Coldshivers, and Goosetingles Conditions

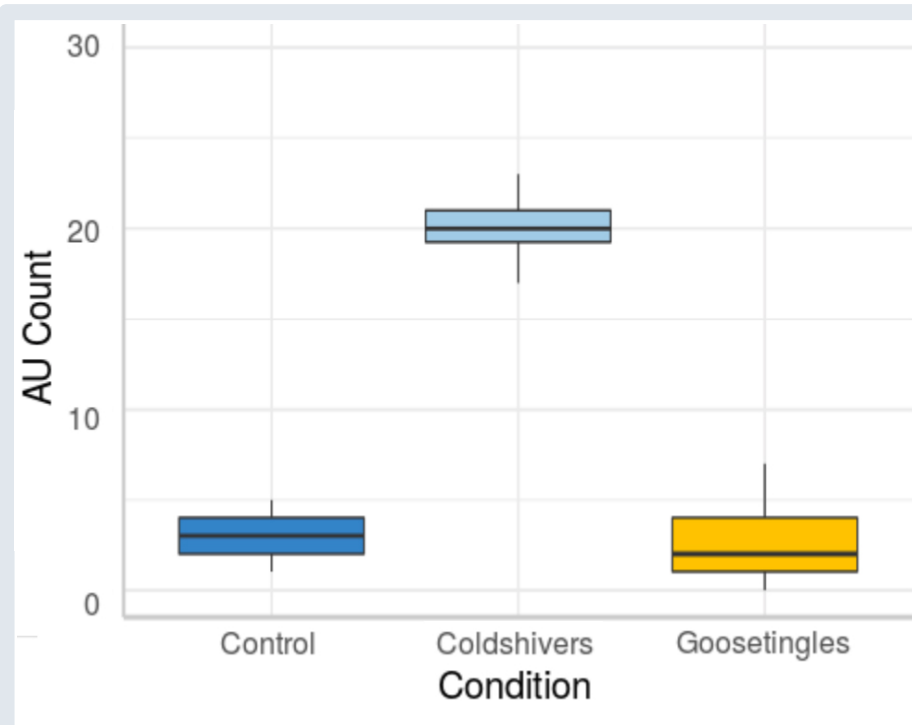


Figure 4: Anger AU Count in Control, Coldshivers, and Goosetingles Conditions

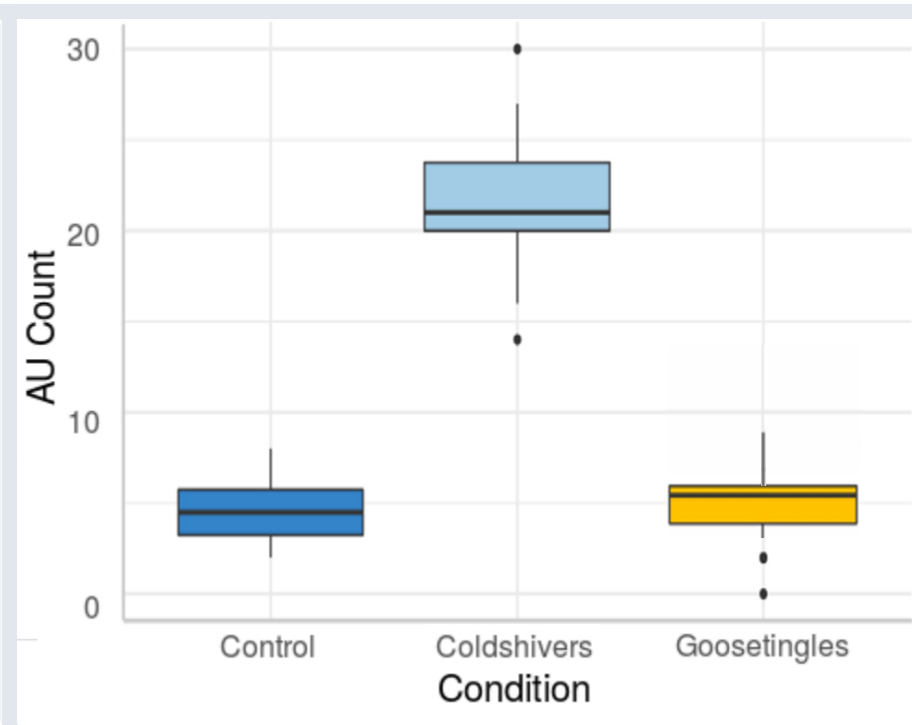


Figure 5: Happiness AU Count in Control, Coldshivers, and Goosetingles Conditions

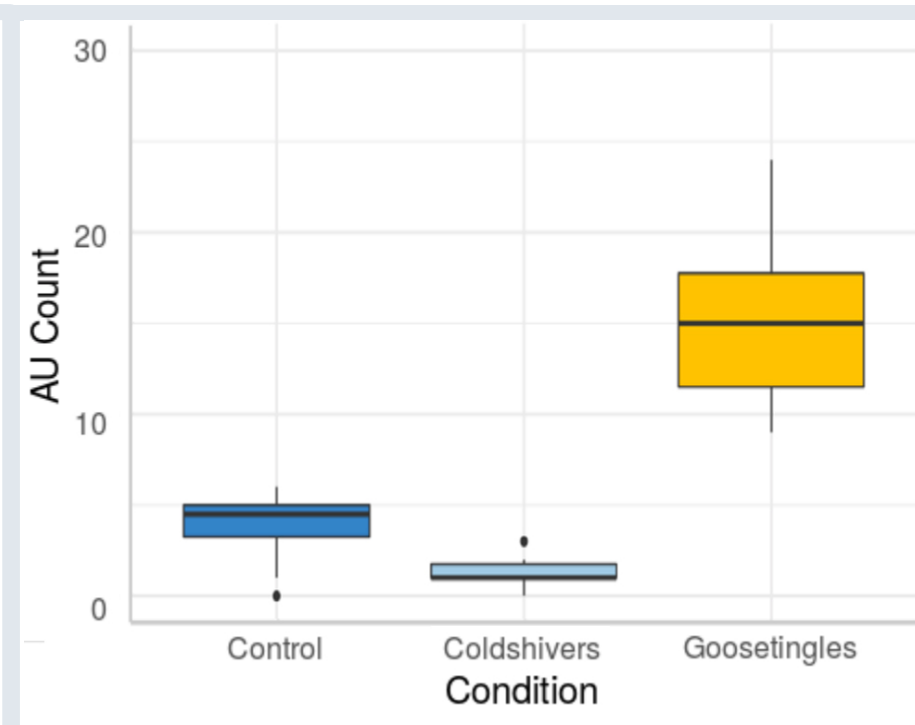


Figure 6: Sadness AU Count in Control, Coldshivers, and Goosetingles Conditions

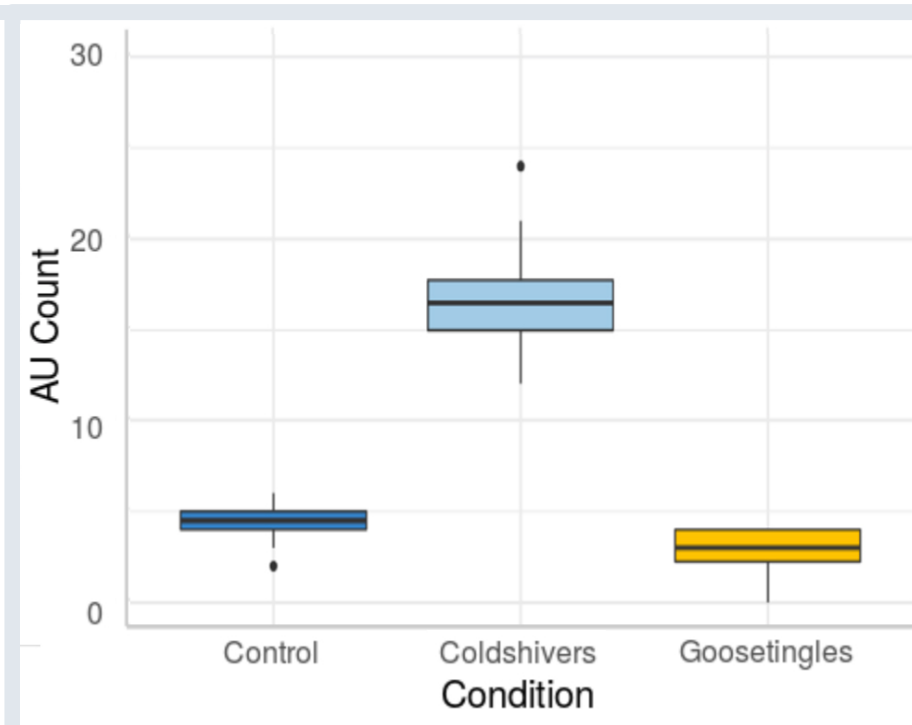


Figure 7: Fear AU Count in Control, Coldshivers, and Goosetingles Conditions

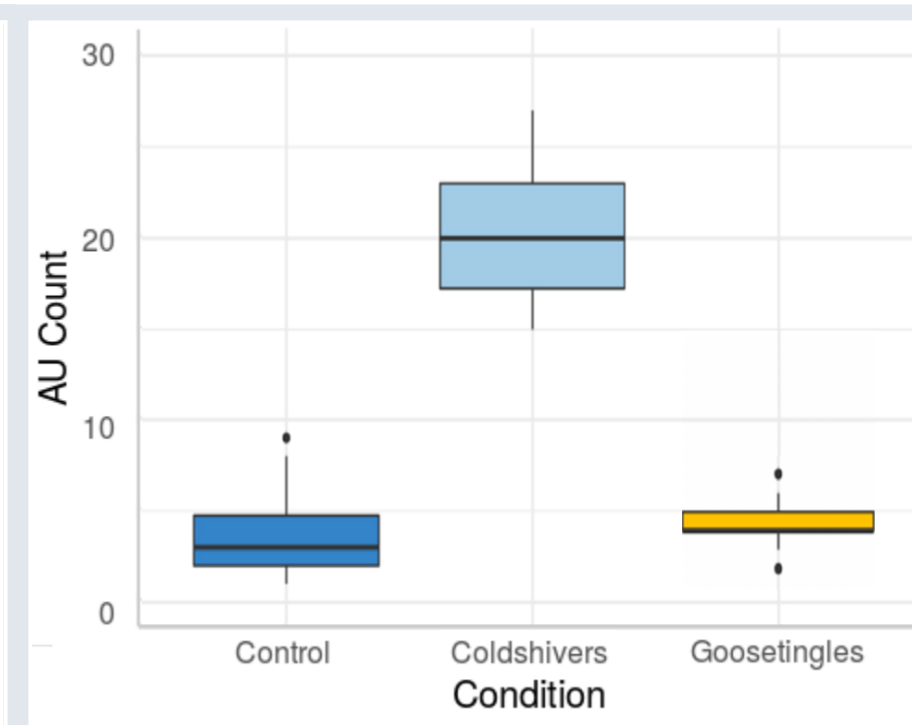
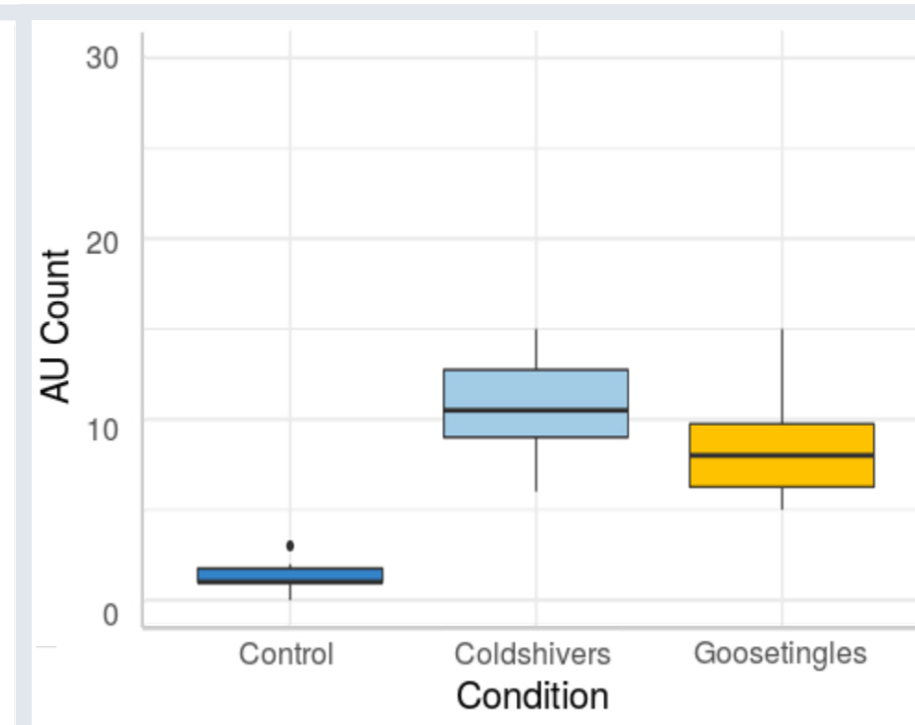


Figure 8: Surprise AU Count in Control, Coldshivers, and Goosetingles Conditions



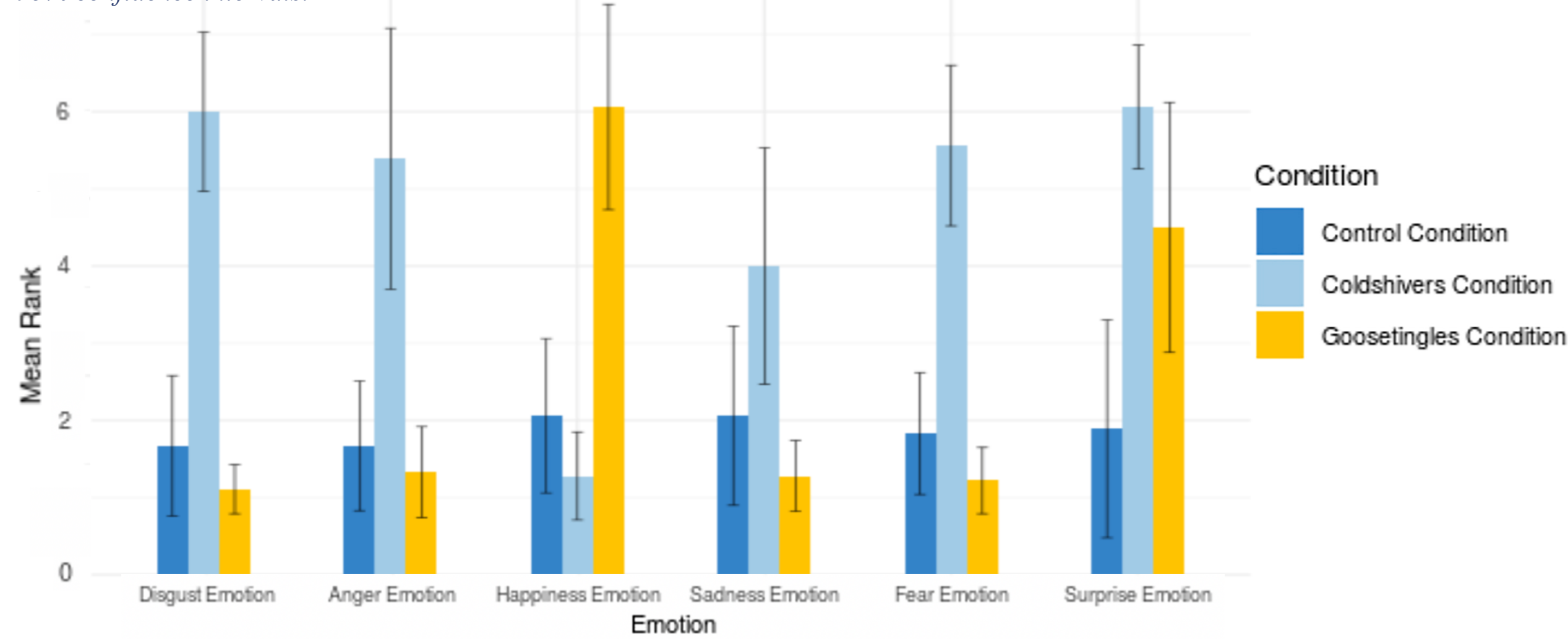
STUDY 2

Table 2: Means, Standard Deviations, and t Tests (Study 2)

Variable	M			SD			t		
	Control	Coldshivers	Goosetingles	Control	Coldshivers	Goosetingles	Coldshivers vs. Control	Goosetingles vs. Control	Coldshivers vs. Goosetingles
Disgust	1.67	6.00	1.11	0.91	1.03	0.32	14.33***	-2.26*	20.28***
Anger	1.67	5.39	1.33	0.84	1.69	0.59	9.86***	-1.31	11.37***
Happiness	2.06	1.28	6.06	1.00	0.57	1.33	-2.61*	9.35***	-18.19***
Sadness	2.06	4.00	1.28	1.16	1.53	0.46	4.59***	-2.36*	7.05***
Fear	1.83	5.56	1.22	0.79	1.04	0.43	10.91***	-3.72***	16.16***
Surprise	1.89	6.06	4.50	1.41	0.80	1.62	12.06***	5.16***	4.28**

*p < .05. **p < .01. ***p < .001.

Figure 9: Mean Numerical Rank by Emotion in Control, Coldshivers, and Goosetingles Conditions. Error bars indicate 95% confidence intervals.



ANALYSIS & DISCUSSION

The hypothesis that goosetingles are associated with objective expressions of positive emotions and coldshivers are associated with objective expressions of negative emotions was supported. According to Table 1, the results from Study 1 indicated that goosetingles involve high levels of happiness and surprise AUs, while coldshivers involve high levels of anger, disgust, fear, sadness, and surprise AUs. In difference testing comparing AUs correlated with coldshivers vs. goosetingles, the p-values confirmed 100% of results were statistically significant (p < .05). Additionally, in difference testing between all groups, 94% of comparisons confirmed statistically significant results (p < .05). Figures 3, 4, 6, and 7 show that the coldshivers box plot is much higher than the corresponding control and goosetingles box plots, suggesting strong differences in emotional facial expressions between conditions. In Figure 5, the happiness box plot is both higher and comparatively taller than the other box plots, suggesting both strong between- and within-group differences. These associations of goosetingles with facial expressions of positive emotions and coldshivers with facial expressions of negative emotions were in accordance with the original hypothesis. The results from Study 2, shown in Table 2, were consistent with the results from Study 1; goosetingles involve higher levels of self-reported happiness and surprise emotions, while coldshivers involve higher levels of self-reported surprise, disgust, fear, anger, and sadness emotions. Difference testing showed statistically significant results (p < .05) for 100% of coldshivers vs. goosetingles comparisons and for 94% of comparisons overall. Studying these changes in AUs and facial expressions (Study 1) alongside the presence of chills sensations and emotions (Study 2) confirmed the existence of a relationship between anatomical facial expressions and physiological chills sensations. These significant results confirmed the hypothesis and indicate strong, positive associations between both goosetingles and objective expressions correlated with positive emotions, as well as coldshivers and objective expressions correlated with negative emotions.

REFERENCES

- Cohn, J. F., Ambadar, Z., & Ekman, P. (2007). Observer-based measurement of facial expression with the Facial Action Coding System. In J. A. Cohn & J. J. B. Allen (Eds.), *Series in affective science: Handbook of emotion elicitation and assessment* (p. 203–221). Oxford University Press.
- Ekman, P., & Friesen, W. V. (1978). Facial Action Coding System. *PsycheTESTS Dataset*. doi:10.1037/t27734-000
- Lucey, P., Cohn, J. F., Kanade, T., Saraghi, J., Ambadar, Z., & Matthews, I. (2010). The Extended Cohn-Kanade Dataset (CK+): A complete dataset for action unit and emotion-specified expression. *2010 IEEE Computer Society Conference on Computer Vision and Pattern Recognition - Workshops*. doi:10.1109/cvprw.2010.5543262
- Maruskin, L. A., Thrash, T. M., & Elliot, A. J. (2012). The chills as a psychological construct: Content universe, factor structure, affective composition, elicitors, trait antecedents, and consequences. *Journal of Personality and Social Psychology*, 102(1), 135–157. doi:10.1037/a0028117
- Panksepp, J. (1995). The Emotional Sources of “Chills” Induced by Music. *Music Perception*, 13(2), 171–207. doi:10.2307/40285693
- Velusamy, S., Kannan, H., Anand, B., Sharma, A., & Navathe, B. (2011). A method to infer emotions from facial Action Units. *2011 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*. doi:10.1109/icassp.2011.5946910

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