Abstract

This study is a close replication of 'Study 2' by Coles el al. (2020) from the report titled 'Demand characteristics moderate, but do not fully account for, facial feedback effects'. Specifically, we aimed to find more evidence for the moderating effects of demand characteristics on facial feedback effects - the influence of an individual's facial expressions on their emotional experience. 55 'Psychology and Technology' students of Eindhoven University of Technology were divided over two demand conditions in which we either told them the researchers hypothesized their facial poses would (a) affect their emotion, or (b) not affect their emotion. Participants posed happy and neutral facial expressions for multiple trials and self-reported their emotion after each trial in short questionnaires containing happiness, anger and filler items. Consistently with the study by Coles et al., results show that happy poses positively influenced reported happiness, in both demand conditions. This is in line with the facial feedback hypothesis. However, we failed to replicate that demand characteristics moderate facial feedback effects. In other words, unlike the original study, our study did not show a significant pose by demand interaction. Furthermore, participants reported more feelings of anger after posing happy expressions compared to neutral expressions. This indicates a failed manipulation check, since participants should not experience any feelings of anger throughout the study. We suspect that our slight modifications in the original study design might be the cause of this, but we have yet to find an explanation for the increased anger after happy poses compared to neutral poses.

1. Introduction

The theory of the facial feedback, having resemblances to the James-Lange Theory, has multiple branches. In the history of the theory of facial feedback hypothesis, there exist two founding fathers. The first is Charles Darwin, who was the first to publish the notion that physiological change was an influence on emotion and not just an effect rising from emotion. The second founding father was William James, who implied that physiological change was not just an influence on emotion, but that the physiological change *was* the emotion (I-Researchnet, 2016).

A study was conducted by Strack, Martin and Stepper (1988) to test Darwins' hypothesis, in which participants had to hold a pencil in their mouth to achieve the desired facial muscle activation for the sensation of things like smiling or frowning. This study yielded positive results past the expectations of the scientific world. Despite the lack of direct replication studies at that time, the facial feedback hypothesis is commonly discussed in introductory psychology courses. Wagenmakers et al. (2016) set up a multilab study in which 17 laboratories conducted a direct replication of the original facial feedback study from 1988. This study failed to replicate the original result in a 'statistically compelling fashion'. This raised many questions and concerns regarding the facial feedback hypothesis. For instance, a recurring concern was that demand characteristics entirely or mostly influenced the facial feedback effects (Coles et al., 2020).

The aspect of demand characteristics, doing something in a way you believe the experimenter would want you to behave (Cherry, 2020) was something that was tested several times for the facial feedback hypothesis. Some studies, for example the study by Strack, Martin and Stepper (1988), focused on trying to eliminate the demand characteristics by inducing participants' facial expressions by letting them hold a pencil in their mouths instead of directly asking for a smile or a frown. Despite multiple attempts of controlling for demand characteristics, mixed results in unobtrusive studies

remain. The study by Coles et al. (2020) had a different approach to demand characteristics by including demand characteristics as manipulation rather than trying to eliminate them. This allows the researchers to assess causality and to conduct severe tests. Before the start of the experiment, participants were either told the researchers hypothesized their facial poses would (a) affect their emotion (positive expectation condition), (b) not affect their emotion (null expectation condition), or (c) the participants were not told anything about the hypothesis (control condition). The experiment itself included multiple tasks of posing happy, angry, and neutral facial expressions followed by short survey items to self-report emotional experience. Results indicated that demand characteristics moderate facial feedback effects, but they do not fully account for the effects. Moreover, facial expressions still influenced self-reported emotion in the null expectation condition.

By means of replication, the current study aims to find more evidence for the results of the study by Coles et al. (2020). Specifically, we want to test whether demand characteristics moderate the effects of the facial feedback hypothesis. Consistently with the results of Coles et al. (2020), our hypothesis is that demand characteristics do play a role in facial feedback effects, but that they do not explain away the effects. Thus, we predict that facial feedback effects still exist, even when we experimentally control for demand characteristics.

2. Method

2.1 Design

The experiment has a 2 (Pose: happy, neutral) × 3 (Block: first, second, third) × 2 (Demand: positive expectation, null expectation) mixed design, with demand characteristics manipulated between subjects and facial expressions manipulated within subjects. Participants were randomly assigned to one of the demand conditions. Participants in the positive expectation condition were told that the researcher expects that their facial expressions influence their emotions whereas participants in the null expectation condition were told that their facial expressions do not influence their emotions. Unlike the study by Coles et al. (2020), we removed the angry facial expression condition as well as the control demand condition to increase the number of trials to raise the statistical power. Consequently, to keep six trials of poses, we have three blocks of two trials instead of two blocks of three trials as in the original study. The blocks enable us to ensure equal distribution and randomization of happy and neutral facial expression tasks. With this design, we aim to test whether the dependent variable; experienced affect (happy or angry feelings), is influenced by the independent variables; facial expression task, and demand condition. Specifically, we focus on the interaction effect between task and demand condition for happy emotions to observe the significance of the influence of demand characteristics on facial feedback effects.

2.2 Participants

55 ‘Psychology and Technology’ students of the Eindhoven University of Technology (26 male, 29 female) were recruited to participate in this study. The age of the participants ranged from 19 to 28 (M = 21.5, SD = 1.9). Participation in this study was voluntary and participants could stop the experiment at any point without any consequences. No reward or compensation was given to the participants.

2.3 Measurements

To measure the participant's experienced affect, a modified Discrete Emotions Questionnaire (C. Harmon-Jones, Bastian, & Harmon-Jones, 2016) was used including three items regarding happy feelings (happiness, enjoyment, and satisfaction, overall $\alpha = .88$), three items regarding angry feelings (aggravation, annoyance and irritation, overall $\alpha = .76$), and three filler items (alarmed, fear, and scared). Participants were able to choose from a 7-point Likert scale (0 = "not at all" to 6 = "an extreme amount") to complete the questionnaire. After each pose, participants completed a short questionnaire with three items to evaluate their concentration, and experienced task difficulty on a 7-point Likert scale (0 = "not at all" to 6 = "an extreme amount"). In one item, participants are asked to choose 'slightly' as response to the question as a test to see if participants' responses were genuine. However, this is exploratory data, and it was not used in the analysis. After completing the posing tasks, some qualitative data was gathered by asking participants to describe in 1-2 sentences what they thought the purpose of the study was. Participants were asked to honestly assess to what degree (0 = "not at all", 6 = "an extreme amount") they followed the instructions given for the facial expressions, to evaluate whether participants performed the task correctly. Furthermore, more qualitative data was gathered by asking participants for honest feedback regarding distractions, concentration, and other factors. This data can be used to get more insight into participants' responses and potential confounding variables. Lastly, to measure the participants awareness of our interest in testing the facial feedback hypothesis and demand characteristics for the manipulation check, two separate items (0 = "not at all aware", 4 = "completely aware") were filled in by the experimenter after the debriefing session.

2.4 Procedure

The experiment took place online. Participants were individually invited into a call in the platform Microsoft Teams. Here, the experimenter provided the participant with a brief introduction to the procedure of the experiment. It was important that the participant could perform the experiment in private. Every participant took part in the experiment from their own home. Under normal circumstances, if the experiment were to take place offline as in the original experiment by Coles et al. (2020), the participant would be placed in a private room. To replicate this as closely as possible, participants were asked to perform the experiment alone in a quiet room. Furthermore, it was important that the participants did not feel like they were being watched by the experimenter. To ensure that this would be the case at all times, both the experimenter and the participant temporarily left the Teams call while the participant was filling out the survey. The experimenter explained that the participant could rejoin the call when they were done with the survey or whenever they had any questions whilst filling out the survey. A copy of the consent form is attached in the appendix. The survey has been created on the platform Qualtrics, so the participant then filled out the survey on their website. In the meantime, the experimenter paid close attention to whether the participant rejoined the call, so they could act proactively if this were the case. As in the original study, participants completed six trials of poses. For each of these trials, the participant was instructed to pose either neutral or happy expressions. A neutral expression meant that they had to maintain a blank facial posture for five seconds. The happy expression asked the participant to move the corner of their lips towards their ears, thus elevating their cheeks, for five seconds. After the posing, the participant completed a modified Discrete Emotions Questionnaire (Harmon-Jones et al., 2016) as previously described in the measurements section. Following the posing tasks, the participant filled out the questions corresponding to the qualitative data. The experiment took

about fifteen minutes to complete. The participant took on average eight minutes to complete the questionnaire itself.

Once the participant had completed the experiment, they would rejoin the Teams call again. Then, the experimenter would ask whether they successfully completed the experiment. If this was the case, the experimenter would continue to the next part of the experiment. This next part consisted of asking two questions. The first question was 'What did you think the hypothesis of this study was?'. The goal of this question was to probe the participant's awareness of the facial feedback hypothesis and the demand characteristic manipulation. The participants should be fully aware that we are interested in testing the effect of facial movements on emotional experience. However, they shouldn't be aware of the manipulation that was performed since each participant only receives a single condition. The second question was 'Did you hear about the concept of facial feedback before?'. The goal of this second question was to check whether the participant had heard of the facial feedback theory prior to participating in the study. The experimenter stored the answers to these questions via a separate Qualtrics link. To conclude the experiment, the participant was provided with the debriefing. This debriefing is also attached to the appendix. After the debriefing, the participant had the opportunity to ask any questions and/or leave any comments.

2.6 Statistical analysis

Potential outliers were handled in the same way as in the original study by Coles et al. (2020). First of all, some demographics regarding the proportion of women and men and age descriptives were calculated. These demographics can be used to gain insight into the participants. The survey measures the experienced emotional responses on happiness and anger items. Both happiness and anger was measured through several individual items. The distribution of these individual items were first visualized by means of histograms. The awareness of the facial feedback hypothesis was also visualized in a density plot. By performing a one-way ANOVA, it could be either confirmed or discarded that awareness ratings between participants varied per each sort of trial. In addition, by computing pairwise comparisons the effect estimate and confidence intervals regarding the awareness ratings were found. The linear mixed effect model was ran with the same parameters as the original report. For this, the alpha level is set to 0.001. The table of the ANOVA analysis shows the significance of the tests. The direction of these effects were transformed to means and standard deviations, displayed in the decompose effects section. A summary of all of the results is displayed in one figure. The major difference with the original study is that this replication study only contains two conditions (happy versus neutral) instead of three (happy, neutral and angry). As a result, the figure will only contain two columns and two bars for each plot cell.

3. Results

3.1 Descriptive analysis

Figure 1 displays three histograms showing the range in reported positive emotions (happiness, satisfaction and enjoyment) after each trial. The data is skewed to the right for both happy and neutral trials, meaning that the lower points on the happiness item scales are most popular. However, the results are less steep for the happy trials, so on average people report feeling happier after the happy trials (M = 1.490, SD = 1.34) compared to the neutral trials (M = 0.659, SD = 0.940).

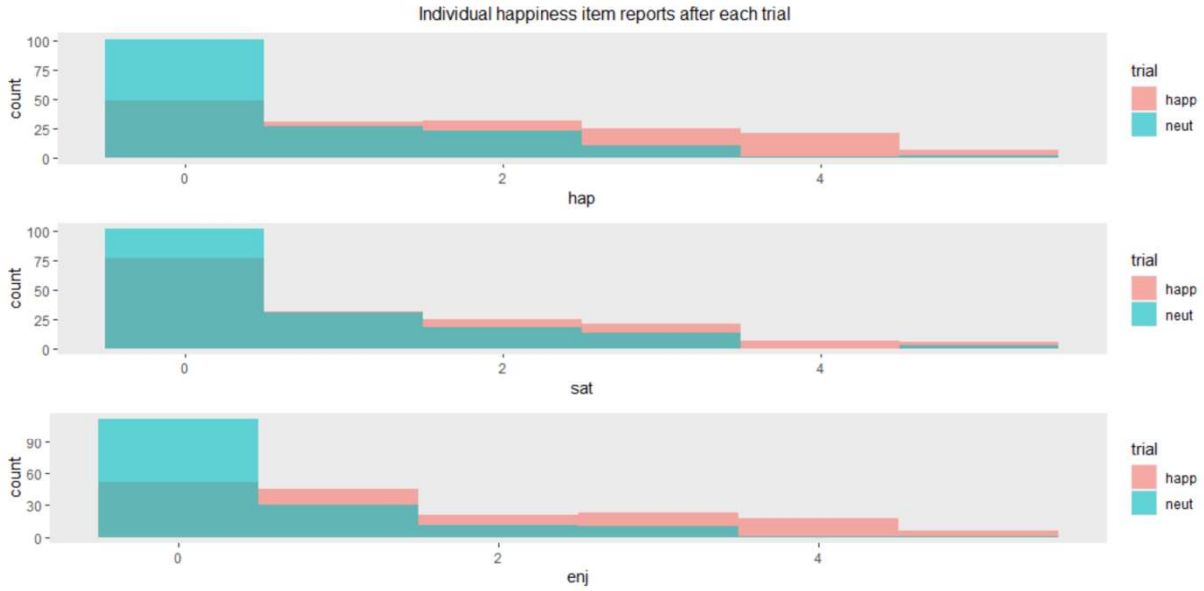

Figure 1: histograms showing individual happiness item reports after each trial with 'hap' meaning happiness, 'sat' meaning satisfaction, and 'enj' meaning enjoyment.

Figure 2 shows similar histograms regarding reported negative emotions with the anger items aggressiveness, annoyance and irritation. Similar to figure 1, results in figure 2 are rightly skewed for both happy and neutral trials. Compared to the happiness item reports (M = 1.078, SD = 1.229), the anger item reports are on average lower (M = 0.424, SD = 0.646). Furthermore, it is noticeable that on average there are more reports on feelings of anger after the happy trials (M = 0.535, SD = 0.713) compared to the neutral trials (M = 0.313, SD = 0.552).

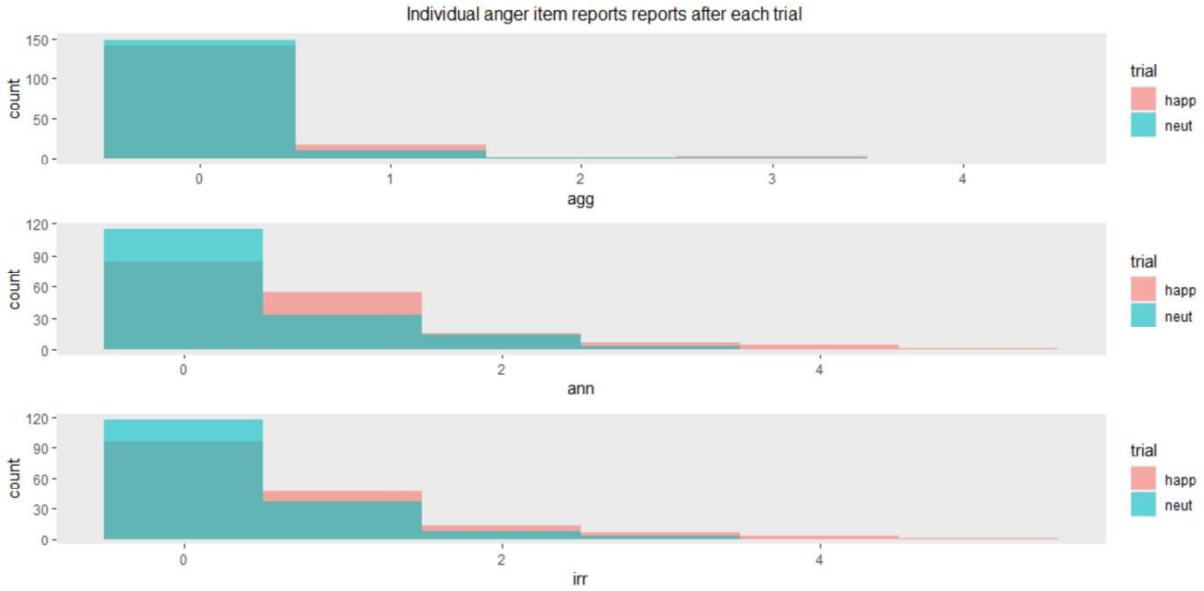

Figure 2: histograms showing individual anger item reports after each trial with 'agg' meaning aggravation, 'annt' meaning annoyance, and 'irr' meaning irritation.

3.1.1 Awareness of interest in testing facial feedback effects

Figure 3 shows participants' awareness of our interest in the facial feedback hypothesis in each demand characteristic condition. The awareness of interest in the facial feedback hypothesis was measured to test the efficacy of the demand characteristics manipulation. If there is no difference in awareness ratings between demand conditions, and the ratings are relatively high in both groups, the manipulation of the demand characteristics is effective. The results of the one-way ANOVA show that there is no significant evidence of variation in awareness per expectation condition, $F(1, 53) = 0.502$, $p = .482$. The pairwise comparison shows the same evidence in positive expectation condition ($M = 3.08$, $SD = 1.11$) vs. null expectation condition, ($M = 2.83$, $SD = 1.42$), $t(53) = -0.709$, $p = 0.48$, M_{diff} 95% CI [-0.96, 0.46]. This means that the manipulation is successful, because there should not be any differences between the demand conditions and the means of the ratings are relatively high considering the scale (0 = "not at all aware", 4 = "completely aware").

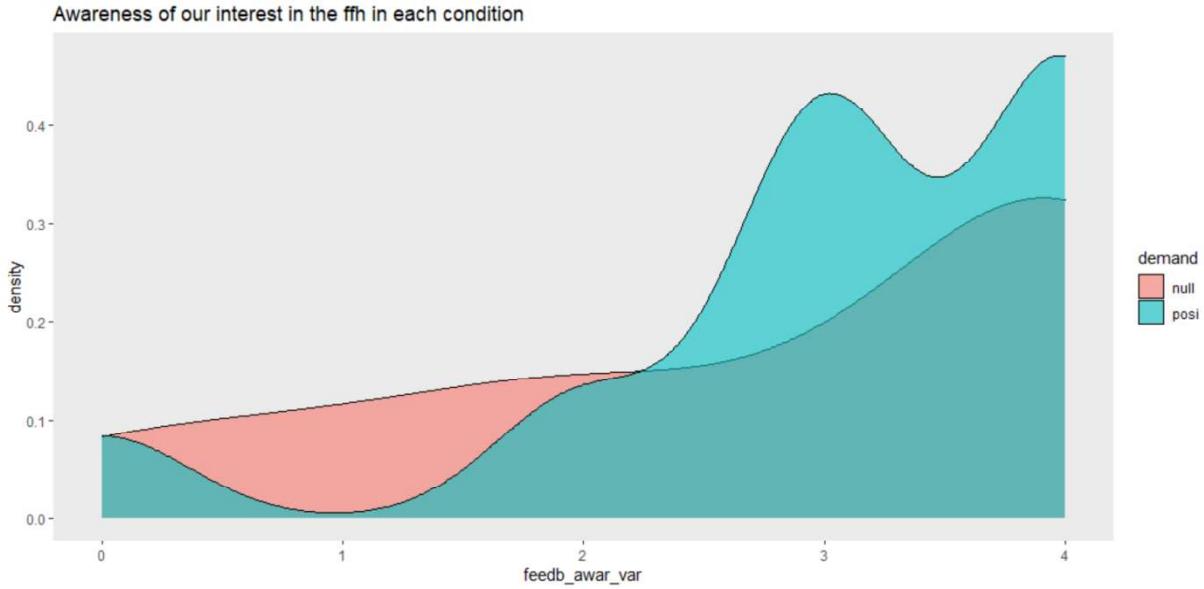

Figure 3: density plot showing awareness of the participants' interest in the demand characteristics in the null and positive demand condition on a scale from 0 (not at all aware) to 4 (completely aware).

3.1.2 Awareness of research hypothesis

Figure 4 shows participants' awareness of our research hypothesis in each demand condition. This measure is an additional manipulation check for the efficacy of the demand characteristic manipulation and is used to examine whether participants are blind to our overall research hypothesis. Results from a one-way ANOVA and pairwise comparisons show that there is no significant evidence that awareness differed between positive ($M = 0.500$, $SD = 0.974$) vs. null expectation condition ($M = 0.690$, $SD = 1.150$), $t(53) = 0.646$, $p = .521$, M_{diff} 95% CI [-0.40, 0.78]. This confirms a successful manipulation, since we want a low average awareness and there should be no differences between demand conditions.

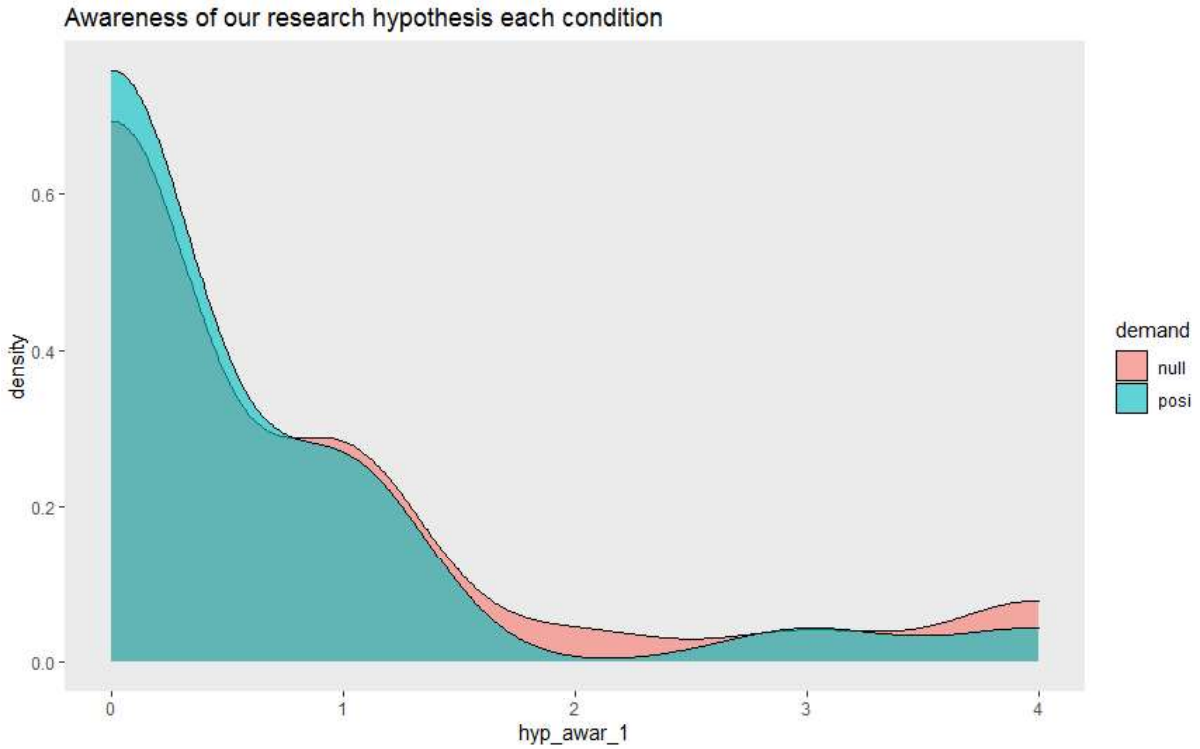

Figure 4: density plot showing awareness of the participants' interest in the facial feedback hypothesis in the null and positive demand condition on a scale from 0 (not at all aware) to 4 (completely aware).

3.1.3 Self-reported anger

To examine the effectiveness of the pose manipulation, we checked whether participants report no feelings of anger in either pose conditions. To do this, we used linear mixed effects modeling identical to the one Coles et al. (2020) use. Results show that the difference in reported anger between the two pose conditions (happy, neutral) is statistically significant $F(1, 265) = 14.890$, $p < .001$. Accordingly, participants reported more feelings of anger after posing happy expressions ($M = 0.535$, $SD = 0.713$) compared to neutral expressions ($M = 0.313$, $SD = 0.552$). This indicates that this experimental manipulation was not successful since participants should not feel angry in any condition. Furthermore, the Pose by Demand interaction, that is, the difference in reported emotions by pose between null and positive demand conditions, is not statistically significant, $F(1, 265) = 0.0049$, $p = 0.944$.

3.2 Hypothesis testing

3.2.1 Self-reported happiness

Figure 5 shows the self-reported happiness and anger emotions with respect to the facial expression pose and the expectation condition. There is a noticeable difference between happy and neutral trials regarding self-reported happiness in both the positive and null demand condition. Self-reported anger is somewhat higher after happiness trials for both the positive and null demand condition. See table 1 for the means and standard deviations of self-reported happiness regarding the combination of these conditions.

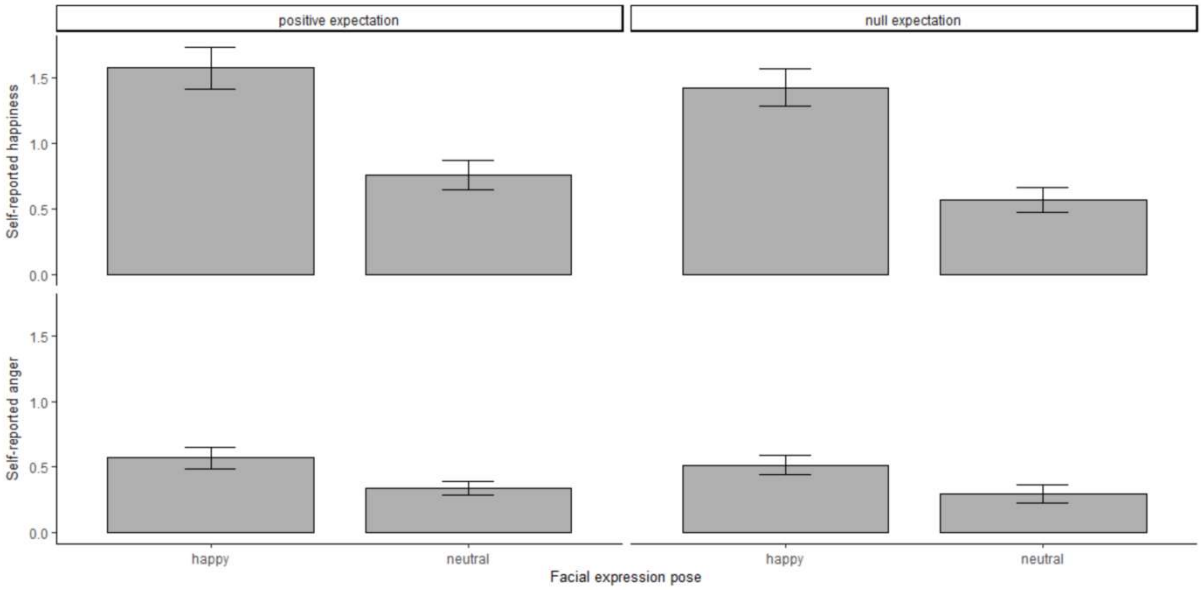

Figure 5: boxplots showing self-reported anger and happiness emotions regarding the facial expression and expectation condition

Table 1. Means and standard deviations of self-reported happiness for different combinations of conditions.

Demand	Pose	Mean	SD
Null	Happy	1.43	1.30
Null	Neutral	0.571	0.880
Positive	Happy	1.57	1.39
Positive	Neutral	0.756	0.999

To check whether the pose manipulation has an effect on self-reported feelings of happiness, linear mixed effects models were used again. According to the ANOVA test the difference in reported level of happiness between the happy pose condition (M = 1.49, SD = 1.34) and the neutral pose condition is statistically significant, (M = 0.659, SD = 0.940), $F(1, 265) = 106.691$, $p < 0.001$. This could indicate that pose manipulation is successful in changing self-reported happiness without taking demand characteristics into account. However, the Pose by Demand interaction is not statistically significant, $F(1, 265) = 0.056$, $p = 0.814$.

Taking a person's belief in the working of the facial feedback analysis instead of demand characteristics in the ANOVA gives Pose by Belief interaction. The difference in self-reported happiness between different poses and with or without the belief in the facial feedback hypothesis is statistically significant, $F(2, 250) = 9.216$, $p < 0.001$.

4. Discussion

As stated in the results, participants reported feeling happier in the happy trials compared to the neutral trials. Results suggest that whenever a participant was required to smile, this resulted in significantly higher self-reports feeling of happiness compared to the participants that were asked to keep a neutral face. These self-reports seem to be in line with the facial feedback hypothesis.

However, when one takes a closer look at the individual item anger reports after each trial, it can be seen that participants in the happy trials report to feel more irritated and annoyed compared to the participants in the neutral trials. This is not in line with the original tested theory, since it is only expected that people report to feel happier. One could say that these both happy and angry feelings are mutually exclusive and thus this phenomenon represented in our data is worth observing. In order to check what causes this, we took a closer look into the qualitative data.. Several participants reported that they felt annoyed and/or irritated since the trials were quite repetitive, because of the large number of tasks they had to perform and mostly the large number of item batteries they had to fill in. Secondly, a point can be made for the case that participants reported feeling they were making a fool of themselves by repeatedly smiling at their screens. The participants in the neutral trials on the other hand did not have to make such faces and could therefore feel less anger. A third possible cause for this could be that the choice for self-reports on emotions or feelings are not an indicator that is suitable for this study, or even studies in general. Self-reports can be argued as a second-hand data type. You not only do you have to trust the participant to be honest, but you also have to trust the participant in being able to pinpoint their own emotions and feelings, which sometimes can be very tricky. This question on the actual representativeness of self-reports in psychological studies would definitely be an interesting subject for a future study.

The results show that participants were overall not aware of the true hypothesis on demand characteristics. This shows us that the data is more representative than we initially thought. As all of our participants were Psychology & Technology students, we suspected a higher grade of awareness of demand characteristics. Demand Characteristics are a part of one of the courses in the study curriculum, so one would assume people are aware of testing such an effect unannounced. As to whether it was not clear enough or people just forgot about the course, the qualitative data tells us that it is mostly a combination of both.

Our predictions about the facial feedback hypothesis are mainly substantiated, so that is in line with the study we are trying to replicate (Coles, 2020). However, from the data we collected, we also concluded that we failed to replicate the significant effect of demand characteristics from the original study.

We try to explain the finding that we failed in replicating the original study by Coles et al.
For this, we explore multiple possibilities. We grouped these possibilities and narrowed them down to three possible, but certainly not exclusive, reasons:
(1) Our hypothesis about the facial feedback hypothesis is true, but the demand characteristics do not have a significant effect, in contrast to the original study by Coles et al. This is an indication that the replication study counteracts the original study. It could be that there were mishaps in the original study, or that the sample yielded an accidental significant result

(2) The differences in the way we ran our study were too large with the original one, so that the data was not in line with the data from the original study. There are multiple differences we can attribute to this possibility. One of the main differences is the part of the population that is represented in the sample. While the sample used by Coles did not have any clear boundaries on the demographics, the sample used by this study consisted purely of TU/e students. Most of these students were Psychology & Technology students, which narrows the representativeness of the sample.
(3) A statistical fluke could also be a cause for the problems. The amount of data points has changed in two ways. The fact that the angry face condition was no longer included in the replication as well as using more data points for the happy and neutral conditions. Because of this, a part of interaction effects are gone, which could not only influence the data points, but also the experience of the participants during the survey.

To conclude, we get multiple findings that could have led to the failure to replicate the original study by Coles et al. and some findings that create possibilities for future studies. A sample that is just university students, a sample that is just students of the same faculty or influences like the change in everyday life during the Corona pandemic, are all set possibilities that were certainly bound to have an influence on the data gathering part of this study. Where we fail to replicate the effect of demand characteristics, we see a replication of the original facial feedback hypothesis effect. The fact that participants reported feeling angrier in the happy condition than in the neutral condition is a good reason for a future study on this specific effect.

5. References

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6. Appendix

6.1 Copy of the consent form:

Information form for participants

This study is performed by Peder M. Isager, a PhD student of the Human-Technology Interaction group at Eindhoven University of Technology.

Before participating, you should understand the procedure followed in this study, and give your informed consent for voluntary participation. Please read this document carefully.

About this study

This study has the goal to examine the effect of physical movement on experience. If you volunteer to participate in this study, we will ask you to complete several simple movements of your hands, feet, or face. After each movement, we will ask you about your experiences.

This study will take less than 30 minutes to complete. Participating in this study should not involve any risks or uncomfortable experiences.

Voluntary Participation

You will participate in this study for educational purposes. On the next page you can indicate whether or not you agree to also use your data for scientific purposes, which is completely voluntary. You can stop participation at any time. You can also withdraw your permission to use your data up to one week after completing this study.

Confidentiality and use, storage, and sharing of data.

This study has been approved by the Ethical Review Board of Eindhoven University of Technology. In this study personal data (age and gender) and experimental data (self-reported experiences and self-reported beliefs) will be stored. To protect your privacy, all data that can be used to personally identify you will be stored on an encrypted server of the Human Technology Interaction group for at least 10 years. The anonymized dataset that, to the best of our knowledge and ability will not contain information that can identify you, will be made publicly available.

Further information

If you want more information about this study, the study design, or the results, you can contact Peder M. Isager (contact email: p.isager@tue.nl). You can report irregularities related to scientific integrity to confidential advisors of the TU/e, whose contact information can be found on www.tue.nl.

Certificate of consent

Please click the arrow at the bottom of the screen to indicate that you have read this consent form and consent to participate in the study.

6.2 Copy of the debriefing:

Before the study, we mentioned that we would not tell you about some aspects of the study until the end. Please read the debriefing below for that information and other information about the study. We are interested in whether posing facial expressions can influence your emotions. For over a century, psychologists have speculated that smiling can make us happy, frowning can make us sad, etc. Researchers have provided a lot of evidence for this facial feedback hypothesis over the years. Recently, a meta-analysis provided evidence for the facial feedback but it left some lingering questions. One lingering question is whether facial feedback effects are due to participants simply telling researchers what they think the researchers want to hear. If participants think that researchers want to provide evidence that smiling makes them happy, they might report feeling happy even if they aren't actually happier. More specifically, we are interested in how your expectations may shape these effects. To investigate this, we are telling different participants different things about our own expectations. Some participants are being told that we expect posing facial expressions to influence their emotions. Some are being told that we do not expect posing facial expressions to influence their emotions. We did not tell you the true purpose of the experiment from the start because you may have behaved differently if you were aware of the true purpose of the study. Because of this same reason, we ask that you not share the details of this study. We greatly appreciate your time, and we hope that taking part in research will help you better understand how psychology works. Thank you again for participating in this study.