



## REVIEW ARTICLE

## Facial Manipulations, Emotional Empathy, and Facial Feedback

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### Abstract

According to the facial feedback hypothesis (FFH) one's own facial expressions have a corresponding impact on the subjective experience of emotion. Inspired by Strack, et al. [1] participants in the present study hold a wooden stick between the teeth (forming a smile) or between the lips (forming a sulky face) while rating humorous films. In contrast to the FFH it was found that people scoring *low* in emotional empathy rated humorous films as less funny in a happy versus a sulky facial manipulation whereas people high in emotional empathy did not differ between the two facial manipulations. However, in Experiment 2 the "Voluntary facial action technique" [2] was applied in which the participants were required to specifically smile or frown to the different films. The results demonstrated that participants low as well as high in emotional empathy reacted as predicted by the facial feedback hypothesis. In conclusion, emotional empathy is suggested to be related to effects of facial feedback in some facial manipulations but not in others.

### Keywords

Facial manipulations, Emotional empathy, Facial feedback, Facial expressions, Empathy

hypothesis since facial feedback was found to modulate central circuitries of emotion in the brain.

Facial expressions have been suggested to have an evolutionary origin and to be in part controlled by biologically given affect programs [9,11-13]. There also seems to be an inherent tendency to imitate human facial expressions from the day we are born [14,15] and this tendency has also been found in adults in response to pictures of emotional facial expressions [16-18]. Interestingly, it has been reported that people not only imitate facial expressions, but they also report themselves to experience a corresponding emotion [16,17,19]. It has further been proposed that this induction of emotion in the receiver could derive from feedback from the receivers own facial expression and that this emotional transfer may be involved in forming empathic reactions referred as emotional empathy [20-23].

To have emotional empathy is commonly described as being able to become emotionally aroused on the basis of the state of another [20,24,25]. Consistent with the hypothesis that reactions in the facial muscles are involved in empathic reactions, it has been found that people rated to be high as compared to low in emotional empathy spontaneously respond with more distinct mimicking reactions when exposed to pictures of emotional facial expressions [26-30]. This indicates that the amount of activity in the facial muscles in response to emotional facial expressions is related to emotional empathy. In summary, several studies indicate that there may be an intimate link between

### General Introduction

The facial feedback hypothesis states that the expression of one's own face has an impact on the subjective experience of emotion [3-8]. The facial feedback hypothesis can be traced back to Darwin [9] who suggested expressed emotions to intensify emotions and repression of emotional expressions to reduce emotions. A study by Hennenlotter, et al. [10] found additional support of the facial feedback



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emotional empathy, activity in the facial muscles and facial feedback.

To investigate if people with high as compared to low emotional empathy differ in sensitivity to facial feedback Andréasson and Dimberg [31] developed a method inspired by Strack, Martin and Stepper [1]. The participants in the study by Strack, et al. [1] were told that the researchers were developing tools for handicapped people to be able to use the mouth instead of the hand when writing. This was a cover story used to conceal the true aim of the study. In one “happy” condition, the participants held a pen between their teeth. This led to contraction of the zygomaticus major muscles, used when smiling. In one “sulky” condition, the participants held a pen between their lips which made it impossible to contract the zygomaticus major muscles and further resulted in a sulky facial expression. In this study participants were found to rate humorous cartoons as funnier in the happy than in the sulky facial condition.

Andréasson and Dimberg [31] wanted to simplify the method used by Strack, et al. [1] without losing its efficiency to prevent participants to see through the true purpose of the study. First, as a cover story, they told the participants that they wanted to measure amylase in the saliva in the mouth with a wooden stick covered with a web. In a happy condition, the participants held the wooden stick between the teeth. Furthermore, in a sulky condition, they held the wooden stick between the lips. Second, the participants rated four short humorous films with respect to funniness to get a measure of the facial feedback effect. The procedure to rate films was supposed to be less vulnerable to experimental demand effects than asking the participants directly how they felt. The underlying assumption was that the feedback from the facial muscles in the happy condition would influence emotion in a positive direction, which in turn would lead to higher funniness ratings of the films. In the sulky condition, the feedback was supposed to influence the emotion in a negative direction, which would lead to lower funniness ratings of the films.

The study by Andréasson and Dimberg [31] revealed that there was an interaction effect between empathy and the feedback conditions. This interaction effect was due to the fact that the high empathic group tended to react, although not significantly, in line with what the facial feedback hypothesis predicts while the low empathic group reacted significantly in the opposite direction to the one proposed by the facial feedback hypothesis. In Andréasson and Dimberg [31], a sample of participants was divided at the median into two groups with reference to scores on the Questionnaire Measure of Emotional Empathy (QMEE). The procedure to divide a sample of participants at the median with reference to scores on the QMEE may not give sufficient difference in emotional empathy between the two groups to

differentiate emotional responses. Consequently, this may be one explanation why the group with high emotional empathy only tended to react in line with the facial feedback hypothesis but did not reach statistical significance in Andréasson and Dimberg [31].

## The present experiments

Experiment 1 investigated if the results from Andréasson and Dimberg [31] would be further clarified if people with extraordinary high and low degree of emotional empathy were compared.

Experiment 2 explores if the results from Andréasson and Dimberg [31] and experiment 1 could be extended to other types of facial manipulations. One technique proved to induce corresponding feedback effects is “*The voluntary facial action technique*” which was developed by Dimberg and Söderkvist [2]. With this technique the participants are specifically required to smile and frown.

## Experiment 1

The aim of experiment 1 was to investigate if the differences between people with high and low scores on QMEE found in Andréasson and Dimberg [31] would be further accentuated if people with extremely high and low scores on the QMEE were selected and compared. Furthermore, in order to achieve higher power to detect differences between conditions, a within-subjects design was used.

With reference to the results from the study by Andréasson and Dimberg [31] the first hypothesis states that there will be a reaction in line with what the facial feedback hypothesis predicts for the group with high emotional empathy. This means that the humorous films will be rated as funnier in a condition with a wooden stick between the teeth (happy condition) than in a condition with a wooden stick between the lips (sulky condition). With reference to the results from the study by Andréasson and Dimberg [31], the second hypothesis states that the group with low emotional empathy will react in the opposite direction to the one suggested by the facial feedback hypothesis. This means that the humorous films will be rated less funny in a condition with a wooden stick between teeth (happy condition) than in a condition with a wooden stick between the lips (sulky condition). Note however, that this later prediction is not based in the theory of facial feedback but is rather based in earlier empirical findings [31].

## Method

### Participants and questionnaire

A Swedish translation of the QMEE [32] of the Questionnaire Measure of Emotional Empathy (QMEE) developed by Mehrabian and Epstein [24] was used to measure emotional empathy. In a review of empathy measures, the QMEE was found to have sufficient validity [33] which is also true for the Swedish version [28].

To form groups with extraordinary high and low emotional empathy, the participants were selected from a large sample into two groups with reference to scores on the QMEE. The mean QMEE rating was 69 ( $SD = 15$ ) for the 48 individuals in the high empathic group and 7 ( $SD = 17$ ) for the 48 individuals in the low empathic group. Since females in general rate themselves higher than males, the selection of participants to the high and the low group was made separately for females and males. The participants ranged in age from 18 to 32 years with a mean of 22 ( $SD = 2.4$ ) and were rewarded with a movie ticket.

### Procedures and material

The participants were recruited by asking groups of students to complete the Questionnaire Measure of Emotional Empathy (QMEE) and to participate in an experiment in which they would be exposed to films while their physiological responses were going to be measured.

In the experimental situation, the participants were sitting on a chair with a distance of 2m from a TV. The experimenter was sitting 1.5 m behind and 1 meter beside the participant, out of the participant's field of vision.

Four humorous films from a Swedish TV-program named "Lösnäsan" ("Detachable nose") from 1975 were used as stimuli. The films were 14, 23, 38 and 42 s long and were shown on a 59 cm TV with a DVD-player. The names of the films were: "Take off", "Korv" ("Sausage"), "Pingis" ("Table tennis") and "Jukebox" and the orders of the four films were balanced.

As a part of the cover story the participants were informed that the purpose of the study was to examine physiological responses while they were watching a

few short films. Further, the participants were told that two different physiological responses were going to be measured, skin conductance and the level of the enzyme amylase in the saliva. Electrodes were attached to two fingers of the left hand to measure skin conductance and a wooden stick covered with a web was placed in the mouth to measure amylase in the saliva. In actual fact none of these measures was performed.

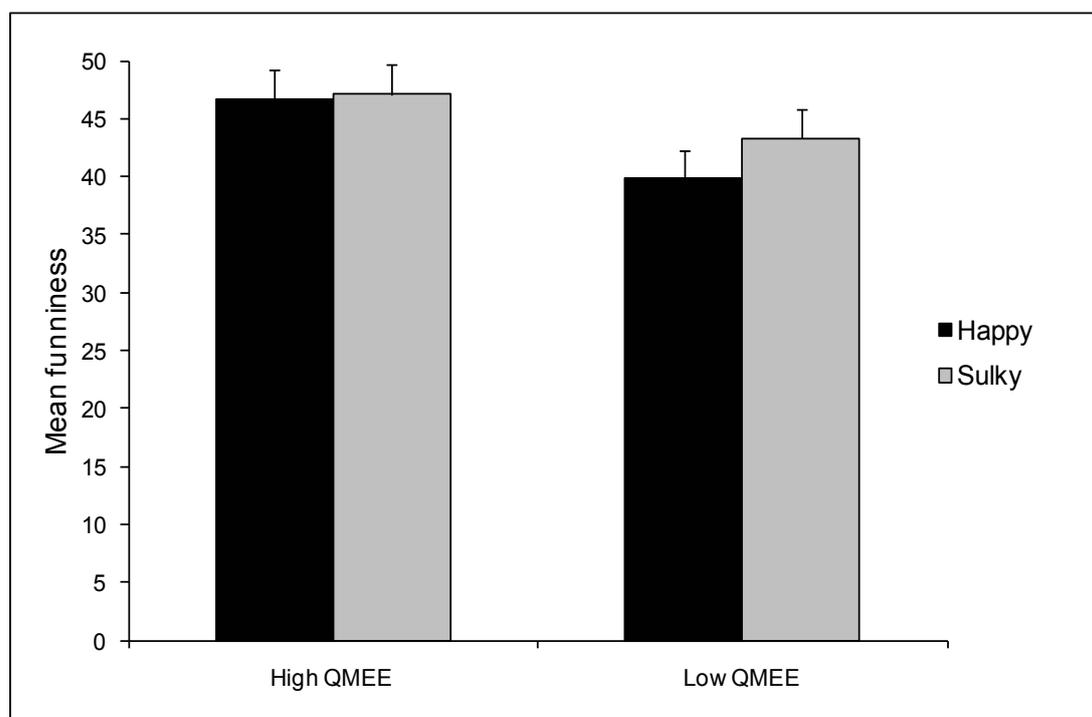
In the happy condition, the participants held a wooden stick between their teeth and were told to keep their lips away from the stick. This condition forced the participants to contract facial muscles associated with a smile at near to a maximum level. In the sulky condition, the participants held a wooden stick between their lips with the lips put forward. This condition made it impossible to contract facial muscles associated with a smile and gave a sulky expression. The experimenter corrected the participant if necessary and demonstrated the correct way to hold the stick. The two conditions are illustrated in [Figure 1](#).

After watching each film, the participants made a mark on a 100 mm long line according to how funny they thought the film was. The left end point of the scale was "not funny" and the right end point was "very funny". The distance from the left end of the scale to the mark was later measured with a ruler in millimeters in order to transfer the marks on the scale to numerical values.

When the participants had made their mark on the scale the next film was started by the experimenter. The participants kept the wooden stick in their mouth throughout the time they watched and rated the films. The time to watch and rate the four films was less than 3 minutes. Hereafter the same four films were shown again in the same order with a new wooden stick in the other of the two positions in the mouth. Note that the



**Figure 1:** Illustration of the happy (left) and the sulky (right) conditions. With kind permission from Springer Science+Business Media: Journal of Nonverbal Behavior, Emotional empathy and facial feedback, 32, 2008, page 219, Per Andréasson and Ulf Dimberg, figure number 1.



**Figure 2:** Mean funniness ratings (+SE) for the high QMEE-group and the low QMEE-group for the happy and the sulky condition.

orders of the films were balanced. After the fourth film had been shown, the participants were interviewed in order to find out if they had seen through the cover story. Fourteen participants saw through the cover story and were thus replaced with other participants. After the interview, the participants were told about the true purpose of the study.

### Statistical analysis

An analysis of variance was performed with emotional empathy (high or low) as between-subjects factor and condition (happy or sulky) and trial as within-subjects factors. To detect and estimate differences between conditions for the high and the low empathic group *t*-tests were conducted and effect sizes were calculated. Cohen [34] proposes effect sizes (*d*) of 0.20, 0.50, and 0.80 to be interpreted as small, medium, and large effects. An alpha level of 0.05 was used for all statistical tests.

### Results

The analysis of variance revealed an overall significant main effect of condition in the opposite direction to the one suggested by the facial feedback hypothesis  $F(1,94) = 4.45, p = 0.038$  partial  $\eta^2 = 0.045$ . There were no other significant main or interaction effects in the analyses of variance.

As can be seen in Figure 2, the first hypothesis was not confirmed since the group with high emotional empathy did not rate the films significantly funnier in the happy condition than in the sulky condition,  $t(94) = -0.30, p > 0.05, d = 0.05$ .

However, as also can be seen in Figure 2, the second hypothesis was confirmed since the group with low emotional empathy rated the films as less funny in the happy condition than in the sulky condition,  $t(94) = -2.68, p < 0.05, d = 0.35$  (Figure 2).

### Discussion

The first hypothesis which states that humorous films will be rated as funnier in the happy condition than in the sulky condition for the group with high emotional empathy was not confirmed. The second hypothesis, which predicted the group with low emotional empathy to rate the humorous films as funnier in a sulky condition than in a happy condition was confirmed. Thus, the results from experiment 1 replicates the results from the study by Andréasson and Dimberg [31] where a group with low emotional empathy was found to react significantly contrary to what the facial feedback hypothesis predicts. Note also that the selection of people with extraordinary high or low levels of emotional empathy did not generate more distinct differences between the groups than the median split did in Andréasson and Dimberg [31]. Thus, the present selection procedure did not accentuate possible reaction differences among high and low empathic groups.

Interestingly, the present results showed that the tendency among low empathic people to react contradictory to what the facial feedback hypothesis predicts, seems to be a reliable ability. Note, however, that even if the phenomenon is reliable, we have so far, no theoretical explanation to why low empathic people should react in this way. It is therefore interesting that

earlier studies have reported that people with low versus high emotional empathy differ in spontaneous facial reactions when exposed to pictures of emotional facial expressions [26-30]. Even if it is not self-evident that these spontaneous contractions of facial muscles are comparable with manipulated facial expressions, as used in the study by Andréasson and Dimberg [31] and experiment 1, it is interesting to note that it has been found that low empathic persons could react with a tendency to smile when reporting negative feelings [29] as well as when exposed to an angry facial expression [30]. Together these findings may be interpreted as meaning that low compared to high empathic people differ in emotional reactions.

One could question whether the level of control of the facial muscles is sufficient in experiment 1. However, as can be seen in Figure 1, it is quite evident that the manipulation with the wooden stick in the mouth does not allow the participants in the high versus the low empathic group to react differently with their facial muscles. This means, that in the happy condition, it was almost impossible to further contract the relevant facial muscles. Furthermore, in the sulky condition, it was impossible to contract the facial muscles involved in a smile. Consequently, it does not seem likely that the difference between the groups in experiment 1 could be explained by different levels of facial muscle activity.

As discussed before in Andréasson and Dimberg [31], one could argue that a better design would have been to include a neutral group without a wooden stick in the mouth, as a control group in experiment 1. However, in such a “neutral” condition it would not have been any control over spontaneously evoked facial muscle activity, and it would consequently not be possible to draw any conclusion from this condition.

In experiment 1, the emotional experiences of the stimuli films were measured instead of asking participants directly about their emotions. As mentioned in the introduction a number of earlier studies indicate that this indirect technique is an effective method to measure the effect of facial feedback and there is no reason to believe that this method should not be effective in experiment 1.

However, there was no main effect of facial condition in the direction proposed by the facial feedback hypothesis in experiment 1. Even if the group with high emotional empathy tended to react in line with the facial feedback hypothesis in the study by Andréasson and Dimberg [31] there was no such tendency in experiment 1. This means that even if the facial manipulations in some respects are similar to the facial manipulations used by Strack, et al. [1], which reported facial feedback effects in line with the facial feedback hypothesis, it could after all be the case that the facial manipulations used in experiment 1 and Andréasson and Dimberg [31] are not effective enough to induce facial feedback

effects in line with what the facial feedback hypothesis predicts.

Nevertheless, there is one very interesting and startling effect detected in experiment 1. That is, identically to the results from Andréasson and Dimberg [31], the group with low emotional empathy reacted significantly in the opposite direction to the one proposed by the facial feedback hypothesis. This means that the results from Andréasson and Dimberg [31] are replicable, and it demonstrates that the facial manipulations used in experiment 1 and Andréasson and Dimberg [31] are effective to induce facial feedback effect in the low empathic group in exactly the opposite way as proposed by the facial feedback hypothesis.

## Experiment 2

In Andréasson & Dimberg [31] it was found some support for the facial feedback hypothesis for the high empathic group, but no such support was found in experiment 1. Interestingly however, and contrary to what the facial feedback hypothesis predicts, the low empathic groups in both studies rated the films as funnier with a sulky than with a happy facial expression. Thus, these results could not overall be interpreted as support for the facial feedback hypothesis but rather for the opposite for the low empathic groups. The results are also in contrast with the results from e.g., Strack, et al. [1] who reported facial feedback effect in line with the facial feedback hypothesis with facial manipulations that at least in some respects were similar to the facial manipulations used in Andréasson and Dimberg [31] and experiment 1.

Note that the results from Andréasson and Dimberg [31] and experiment 1 are in contrast not only with the results from Strack, et al. [1] but also to a number of earlier studies who have obtained support for the facial feedback hypothesis [3,4].

Even if the group with high emotional empathy tended to react in line with the facial feedback hypothesis in Andréasson and Dimberg [31], there was no such tendency in experiment 1. One could therefore rather question if the facial manipulations used in these two studies are effective enough to reliably induce feedback effects in line with what the facial feedback hypothesis predicts.

For instance, even if the technique used seems to effectively manipulate relevant facial muscles, it could still be the case that the facial manipulations did not resemble naturally occurring facial muscle actions and therefore were too artificial to form the basis for feedback effects in line with what the facial feedback hypothesis predicts.

A smile versus a frown as facial manipulations has repeatedly been demonstrated to induce facial feedback effects in line with what the facial feedback hypothesis predicts [2,35-40]. One alternative method

to induce facial feedback effects could therefore be to use “*The voluntary facial action technique*” which was developed by Dimberg and Söderkvist [2] and in which they successfully induced corresponding facial feedback effects by specifically using a smile versus a frown as facial manipulations. This technique has also later been successfully applied in further studies [41-43] and the technique has also been used by other researchers [44,45].

When using the “*The voluntary facial action technique*” the participants are instructed to quickly elevate their cheeks (increased zygomatic muscle activity as when people smile) or to wrinkle their eyebrows (increased corrugators muscle activity as when looking angry) when exposed to different types of visual stimuli.

One way to follow up the studies by Andréasson and Dimberg [31] and experiment 1 could therefore be to apply more established facial manipulations such as a smile versus a frown to induce facial feedback and to do this in an in other respects similar experimental setting to the one used in Andréasson and Dimberg [31] and experiment 1.

Consequently, in experiment 2, the participants, were instructed to voluntarily elevate their cheeks or wrinkle the eyebrows while seeing and rating how funny they experienced films which they were exposed to. Based on the results in earlier studies [2] it was predicted that these facial manipulations should be effective to induce a feedback effect in line with the facial feedback hypothesis. Consequently, this would be demonstrated as that the humorous films will be rated as funnier in the happy condition (smile) than in the angry condition (frown). Particularly, this effect should be more distinct in the group high in emotional empathy. Based on the empirical results obtained by Andréasson and Dimberg [31] and experiment 1 the second question was if the participants low in emotional empathy, even with an alternative facial manipulation still would react in the opposite direction to the one suggested by the facial feedback hypothesis. In such case the humorous films would be rated as less funny in the happy condition than in the angry condition.

## Method

### Participants and questionnaire

The eighty-eight participants (43 males and 45 females) varied in age from 19 to 29 years with a mean age of 22 ( $SD = 2.0$ ). The participation was rewarded with a movie ticket.

Scores on a Swedish translation of the Questionnaire Measure of Emotional Empathy (QMEE) [32] were used to divide the participants at the median into a high and a low empathy group. The mean QMEE rating was 22 ( $SD = 24$ ) for the 44 individuals in the low empathic group and 52 ( $SD = 17$ ) for the 44 individuals in the high

empathic group. Since males in general rate themselves lower than females do, the division into high and low groups at the median were made separately for males and females.

### Procedures and material

The procedure and material in experiment 2 was the same as in experiment 1 but with the following exceptions.

As a cover story the participants were told that the purpose of the study was to examine physiological responses while they were watching a few short films and that changes in their sweat gland activity of the fingers were going to be measured. Furthermore, the participants were told that earlier studies have revealed that activity in different types of muscles could affect sweat gland activity in the hands. Consequently, electrodes were attached to two fingers of the left hand. This “measure” was a part of the cover story and not performed in actual fact. An interview after the experiment revealed that 10 participants saw through the cover story and were thus excluded from the experiment.

The participants were randomly assigned to start with a happy or an angry facial manipulation. In accordance to “*The voluntary facial action technique*” [2] the participants were instructed to either lift the corners of the mouth or to lower their eyebrows when watching and rating the films.

These positions forced the participants to contract the facial muscles associated with either a smile (happy condition) or with a frown (angry condition). The experimenter demonstrated the correct way to hold the facial muscles and corrected the participant if necessary.

### Statistical analysis

An analysis of variance was performed with condition and trial as within subject’s factors and emotional empathy as between subjects’ factor. To detect and estimate differences between conditions for the high and low empathic group  $t$ -tests were conducted and effect sizes were calculated. According to Cohen [34] effect sizes ( $d$ ) of 0.20, 0.50, and 0.80 are to be interpreted as small, medium, and large effects. The alpha level 0.05 was used for all statistical tests.

## Results

The analysis of variance indicated an overall significant main effect of condition in the direction suggested by the facial feedback hypothesis  $F(1,86) = 14.19$   $p < 0.001$  partial  $\eta^2 = 0.14$ . There were no other significant main or interaction effects in the analyses of variance.

As illustrated in Figure 3, the prediction for the high QMEE-group was confirmed since they rated the films significantly funnier in the happy condition than in the

angry condition  $t(86) = 2.14, p < 0.05$  with an effect size at a small level ( $d = 0.31$ ). Note also that even the low QMEE-group rated the films significantly funnier in the happy than in the angry condition,  $t(86) = 3.18, p < 0.05$  and the effect size was at a medium level ( $d = 0.50$ ), see Figure 3.

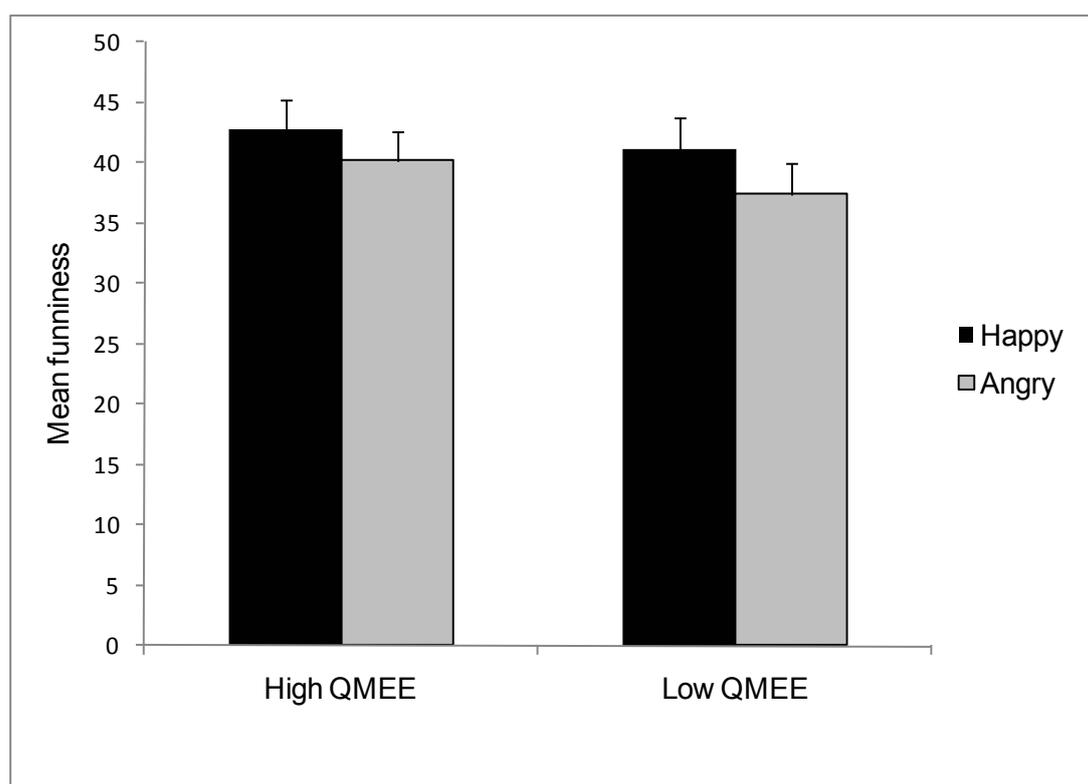
## Discussion

As predicted the group with high emotional empathy rated the stimulus films as funnier with a happy than with an angry manipulated facial expression. Interestingly, it was found that even the group with low emotional empathy rated the stimulus films as funnier with a happy than with an angry facial expression. Thus, the group with high as well as low emotional empathy reacted in line with the facial feedback hypothesis.

## General Discussion

The results from experiment 2 are in sharp contrast to the results from the studies by Andréasson and Dimberg [31] and experiment 1. In these two studies people with low emotional empathy were found to react in the opposite direction to the one predicted by the facial feedback hypothesis. On the other hand, people with high emotional empathy tended to react as predicted by the facial feedback hypothesis in Andréasson and Dimberg [31] but it was no such tendency in experiment 1 in the present study. As was proposed in the introduction, this may be taken as an indication for that the facial manipulations used in these studies are not effective enough to reliably

induce consistent facial feedback effects. Furthermore, as pointed out in the introduction the main difference between experiment 2 and Andréasson and Dimberg [31] and experiment 1 was the facial manipulations. That is, in accordance with the *Voluntary facial action technique* [2] the participants in experiment 2 were instructed to either lift the corners of the mouth (happy condition) or to lower their eyebrows (angry condition) whereas in the other two studies the participants either had a wooden stick between their teeth (happy condition) or between their lips (sulky condition). Thus, one critical difference with experiment 2 was the manipulation of the brows. The lowering of the brow is controlled by the corrugators supercillii muscle and it is a well known fact that an increased activity in this facial muscle is intimately related to negative expressions [46] and negative emotional reactions [47,48]. As also mentioned in the introduction, earlier research has demonstrated that the voluntary contraction of this muscle effectively induces negative facial feedback effects [2,36,38,39] and particularly when this effect is contrasted to the positive effects induced when smiling (contracting the zygomatic major muscle). It is therefore important to note that these manipulations effectively induced facial feedback effects in line with what the facial feedback hypothesis predicts and that this is true for people low as well as high in emotional empathy. In conclusion, emotional empathy seems to be related to the facial feedback effect in some facial manipulations but not in others. Why emotional empathy is crucial for the facial feedback effect in some facial manipulations



**Figure 3:** Mean funniness ratings (+SE) for the high QMEE-group and the low QMEE-group for the happy and the angry condition.

but not in others is not specifically clear or can be concluded from results obtained in the present paper. However, note that there was no consistent overall support for the facial feedback hypothesis with the manipulations used in Andréasson and Dimberg [31] and experiment 1 in the present study. Thus, even if the facial manipulations applied in those studies in some respects resemble the facial manipulations used by Strack, et al. [1] it could still be the case that some subtle methodological differences, such as the facial manipulation with a wooden stick rather than with a pencil [1], did not result in a natural facial configuration which was able to form the basis for feedback effects in line with the facial feedback hypothesis. Thus, even if the facial manipulations used by Strack, et al. [1] on one level look as artificial as that in experiment 1 and Andréasson and Dimberg [31] it nevertheless resulted in feedback effects in line with what is predicted by the facial feedback hypothesis.

In a replication report [49] regarding the study from Strack, et al. [1], with 17 different laboratories, it was concluded that all laboratories reported confidence intervals that overlapped with zero. This indicates that the feedback effect reported in Strack, et al. [1] seems to be difficult to replicate. On the other hand, it has been suggested [50] that the Facial Feedback effect was eliminated in the replication studies because the participant felt observed when they were filmed in the experimental settings.

In a study by Söderkvist, et al. [43] it was found that the feedback effect from a smile versus a frown is equally strong. Furthermore, it was found that the feedback effect was only present when the facial action was incongruent with an induced emotion. For experiment 2 in the present study this would indicate that the facial feedback effect comes from the frown since the stimuli (humorous films) had a positive valence.

Andréasson and Dimberg [31] suggested emotional empathy to be one possible key to understand individual differences in effects of facial feedback. With reference to the results from the present experiments it could be added that this is true for some facial manipulations such as used in, Andréasson and Dimberg [31] and experiment 1, but not in general.

## Author Note

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