# Discrimination of facial expressions of basic emotions and pain through different viewing distances

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## Context

Due to its important communicative function, a growing body of research has focused on the effective recognition of the facial expression of pain. Recent studies suggest that low spatial frequencies (SFs) are particularly important for the visual processing of the facial expression of pain (Wang et al., 2015; 2017). However, these studies used arbitrary cut-off to isolate the impact of low (under 8 cycles per faces (cpf)) and high (over 32 cpf) SFs, thus removing any contribution of the mid- SFs. However, our own work using the Bubbles method suggests that mid-to-high spatial frequencies are the most useful to categorize pain (Guérette, VSS 2018). In order to clarify these inconsistent results, we used a method that manipulates the viewing distance of facial stimuli therefore changing the availability of spatial frequencies as stimuli appeared further away.

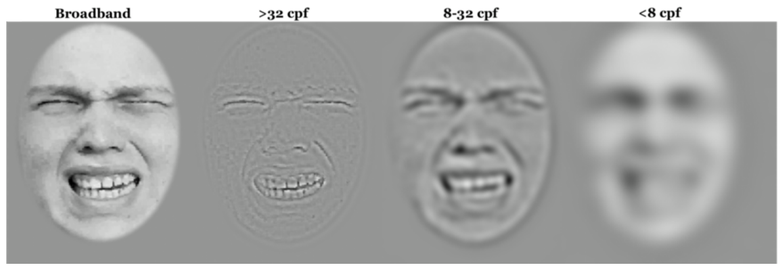


*Figure 1* – Example of stimuli used to investigate the role of high SFs (> 32 cycle/face) and low SFs (<8 cycle/face) in experiments conducted on facial expression perception and spatial frequencies. Note that Mid-SFs (8-32 cycle/face) are usually not included in these experiments.

## Method

Twenty participants took part in an 8-expression categorization task (2400 trials per participant) using the STOIC (Roy et al., 2007) facial expression database. Stimuli were presented 300ms and were created with the Laplacian Pyramid toolbox (Burt & Adelson, 1983), a method that recursively removes the highest SFs of an image while down-sampling the residual image by a factor of two in order to create six reduced-size images simulating increasing viewing distances.

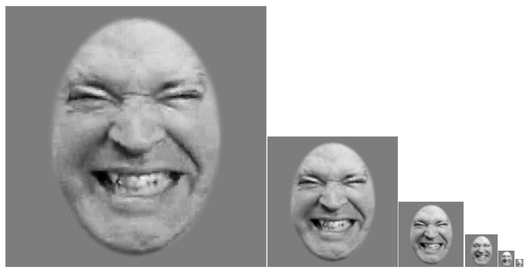

*Figure 2* – Example of stimuli created with the Laplacian Pyramid toolbox (Burt & Adelson, 1983) simulating increasing viewing distances (i.e. 3.26, 1.63, .815, .41, .20, .10 degree of visual angle or 1.2, 2.4, 4.8, 9.6, 19.2, and 38.4 meters).

## Analysis & Results

A 6 x 8 (Distance x Emotion) repeated measures ANOVA revealed a significant interaction $F(10.98, 208.69) = 21.079$, $p < .001$ ($\eta^2 = .53$). Separate repeated measure ANOVAs looking at the effect of Emotion for each Distance were conducted and follow-up paired sample t-tests (corrected $p = 0.05/28$) revealed significant differences between expressions. At the two most proximal distances (1.2 and 2.4 m), we found significant effects of Emotion $F(7, 133) = 42.22$, $p<.001$ ($\eta^2 = .69$) and $F(4.4, 83.6) = 39.64$, $p < .001$ ($\eta^2 = 0.68$) where happiness and angry were the two best-recognized emotions (all p's<.005) and where all other emotions (neutral, disgust, pain, fear, surprise and sadness) were not significantly different with each other. Interestingly, we found surprise and happiness to be the best-recognized expressions (all p's<.05) at further distances (9.6 and 19.2 m). Most importantly, recognition of pain decreased with increasing viewing distances and was never significantly different from disgust, fear, neutral and sadness. The mid-point value (max-min/2) of each psychophysics curve was calculated to compare pain recognition with the mean of all facial expressions. Very similar mid-point values were obtained, corresponding to a viewing distance of 14.5m for the mean of all facial expressions and 15.67m for pain ($t(19)=1.016$ $p = .322$), which suggest that pain is processed in a similar way than the mean of all facial expressions.

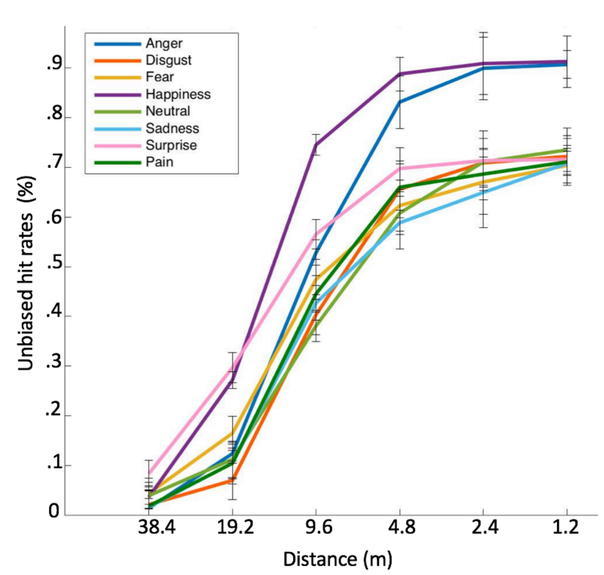


*Figure 3* – Unbiased hit rates for each expression as a function of viewing distance. Error bars show 1 standard error across participants.

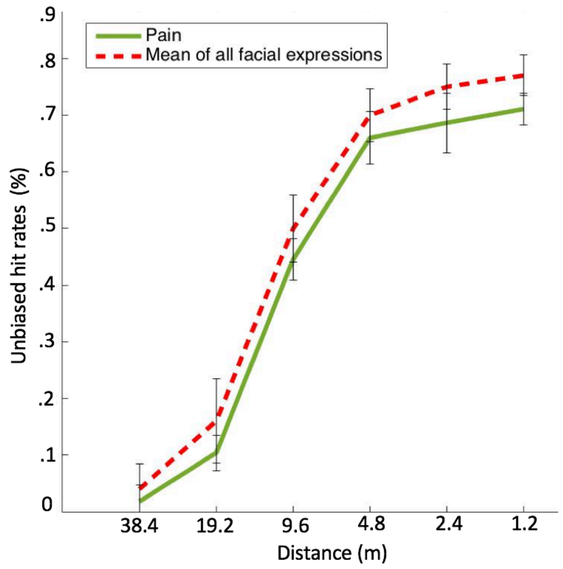


*Figure 4* – Unbiased hit rates for pain and the mean of all facial expressions as a function of viewing distance. Error bars show 1 standard error across participants.

## Discussion and Conclusion

Taking into account that changes in viewing distance modulate the spatial frequency content available to an observer by progressively peeling off high SFs as the stimulus moves further away, we observed that :

- Surprise and happiness are the best-recognized expressions at further distances (9.6 and 12.2m) which is consistent with previous findings suggesting that categorization and discrimination of these facial expressions are associated with low SFs (Charbonneau et al., VSS 2018) and are considered as distal expressions (Smith & Schyns, 2009).
- Pain recognition is very similar to many other facial expressions (disgust, fear, neutral and sadness) which are not well recognized at further distances. These results are consistent with recent findings suggesting that pain categorization and discrimination rely mostly on mid-SFs (Guérette et al., VSS 2018) rather than low SFs (Wang et al., 2015; 2017).

## References

1. Wang, S., Eccleston, C., & Keogh, E. (2015). Pain, 156(9), 1670-1682. Wang, S., Eccleston, C., & Keogh, E. (2017); Pain, 158(11), 2233-2242. 2. Guérette et al., VSS (2018). 3. Roy et al. (2007) STOIC database 4. Burt & Aldeson, (1983) IEEE Transactions on communications, 31(4), 532-540. 5. Wagner (1993)Journal of Nonverbal Behavior, 17(1), 3-28. 6. Smith & Schyns (2009) Psychological Science, 20(10), 1202-1208. 7.. Charbonneau et al., VSS (2018)

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