# Spatial frequencies for detection of pain facial expressions revealed by reverse correlation

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## Context

The ability to detect pain facial expressions is a crucial step before help can be provided. Because of the biological importance of this skill, it is plausible to expect that an observer can detect that expression even from a relatively large distance. At VSS2019, we presented a study showing that pain facial expression detection relies on low spatial frequencies (SF; Guérette et al., 2019); low SF are available from farther away than high SF. These results were obtained using posed facial expressions, with a method that involves repeating the same stimuli.

## Method and analyses

In the present study, we used a Reverse Correlation method (Mangini & Biederman, 2004) to reveal the mental representation of three facial expressions : pain, fear and happiness. On each trial, a neutral face was used as background, on which sinusoidal white noise was added. The participants (n = 10) were asked to choose which of two noisy faces (2AFC) was the best representation of the target emotion (1000 trials/emotion/participant; block design).

To determine the SF tuning for each emotion, we computed the proportion of the diagnostic pixels for each SF band relatively to all five SF bands. A Gaussian density function was fitted on these proportions to determine the peak and bandwidth of the SF tuning.

**A. Background stimulus** **B. 2AFC example**

*Figure 1. A.* The background neutral face. B. Example of a trial (2AFC task).

## Classification images

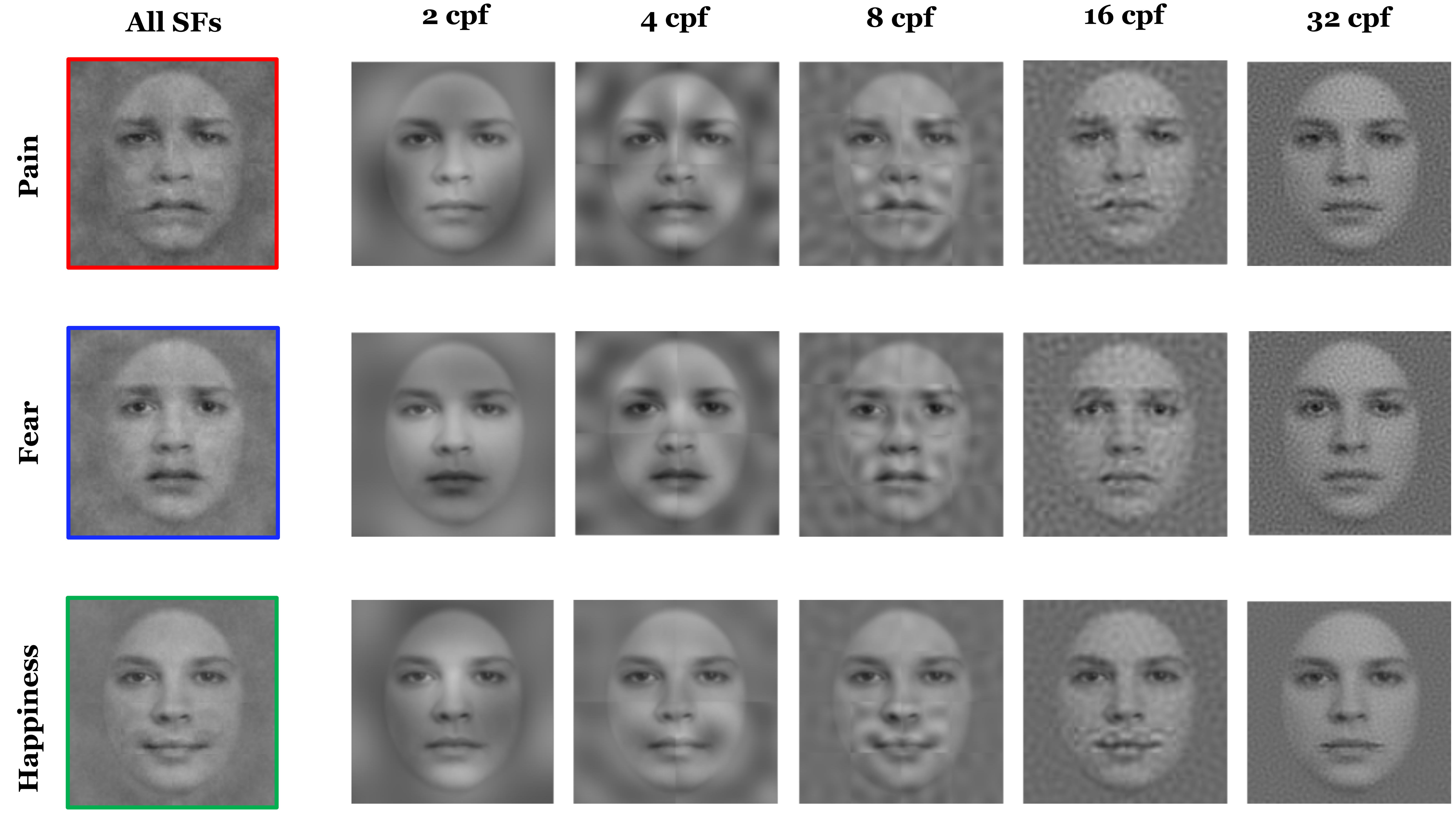


*Figure 2.* Classification images of pain, fear and happiness. Global CIs are presented in red (pain), blue (fear) and green (happiness). Classification images of 5 SF bands (2, 4, 8, 16 and 32 cycles per face (cpf)) are also presented for each emotion.

## Results

Classification images (CIs) show mental representation of emotions for 5 SF bands. Mental representations of pain involved SF ranging from 1.1 to 12.3 cycles per face (cpf), peaking at 3.8 cpf and spanned 3.4 octaves. Fear and happiness relied on a similar range of SF : from 1.2 to 13.7 cpf for fear, peaking at 4.2 and spanned 3.4 octaves; from 0.9 to 14.3 cpf for happiness, peaking at 3.6 and spanned 3.95 octaves.

## Conclusion

These results show that low SF are encoded in the mental representation of pain. This finding is congruent with previous studies showing that pain expressions can be detected from further apart. Our results also add to previous findings showing that happiness detection relies on a broader range of SF (Smith & Schyns, 2009).

## References

**(1)** Guérette, J., Cormier, S., Charbonneau, I., Blais, C. & Fiset, D. (2019). Spatial frequencies for the visual processing of the facial expression of pain. Vision Sciences Society, St-Petersburg, Florida (USA). **(2)** Mangini, M. C., & Biederman, I. (2004). Making the ineffable explicit: Estimating the information employed for face classifications. Cognitive Science, 28(2), 209-226. **(3)** Wang, S., Eccleston, C., & Keogh, E. (2015). The role of spatial frequency information in the recognition of facial expressions of pain. Pain, 156(9), 1670-1682. (4) Smith, F. W., & Schyns, P. G. (2009). Smile through your fear and sadness: transmitting and identifying facial expression signals over a range of viewing distances. Psychological Science, 20(10), 1202-1208.

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