Spatial frequencies for the visual processing of the facial expression of pain

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Theoretical context

Recent studies suggest that low spatial frequencies (SFs) are particularly important for the visual processing of the facial expression of pain (Wang & al., 2015; 2017). These studies used arbitrary cut-off to isolate the impact of low (< 8 cycles per faces (cpf)) and high (> 32 cpf) SFs, removing any contribution of the mid-SFs; thus leaving us with an incomplete picture about the role of SFs in pain recognition. Considering the human contrast sensitivity function, those mid-SFs could have a significant impact on pain recognition (or any facial expressions for that matter; see Charbonneau et al., poster 345).

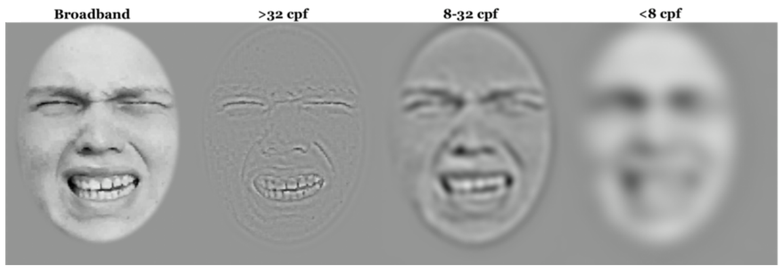

Figure 1. Examples of stimuli with high (> 32 cpf), mid (8-32 cpf) and low (< 8 cpf) SFs.

Method and analysis

We used the SF Bubbles (Willenbockel et al., 2010), to examined the utilization of SFs for pain recognition in two tasks (20 participants per task) :

1) a facial expression recognition task with all basic emotions and pain
2) a facial expression discrimination task where one target expression needed to be discriminated from the others

- SF tunings were obtained by conducting what amount to multiple regression analysis on the SF filters and accuracies across trials.
- A weighted sum of SF filters were calculated by allocating positive or negative weights (z-scored accuracies) to filters that led to correct/incorrect responses, respectively.

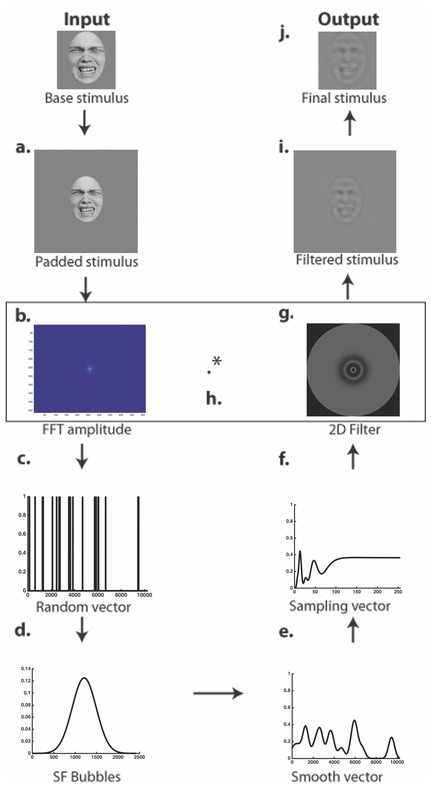

Figure 2. Procedure for creating a stimulus with the frequency bubble method.

Results : Classification vectors

1) In the first task (see Figure 3), accurate categorization of pain was correlated with the presence of a large band of SFs ranging from 4.3 to 52 cpf peaking at 14 cpf (Zcrit = 3.45, p<.05 for all analysis).
2) In the second task (see Figure 4), the correct discrimination of pain was correlated with the presence of a band of SFs ranging from 5 to 20 cpf peaking at 11 cpf.

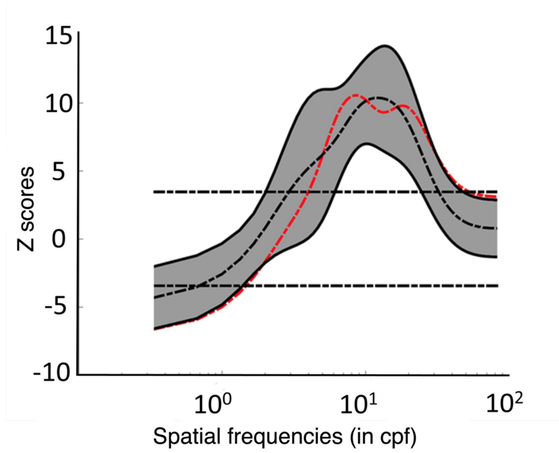

Figure 3. Categorization of pain (in red) peaking at 14 cpf and the mean of the 6 basic emotions (black dotted line; +/- 1 SD shown in grey).

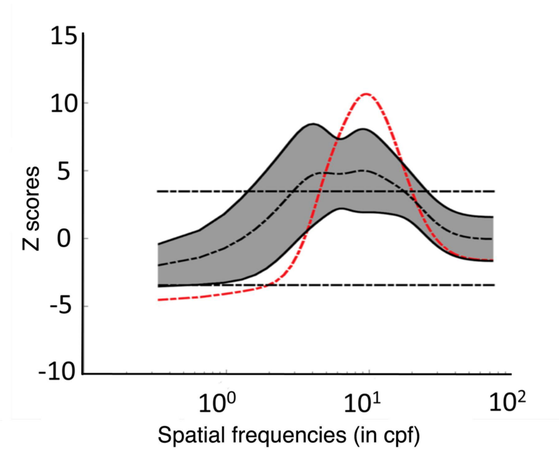

Figure 4. Discrimination of pain (in red) peaking at 11 cpf and the mean of the 6 basic emotions (black dotted line; +/- 1 SD shown in grey).

Conclusion

Our results :

- Highlight the importance of the mid-SFs in the visual processing of the facial expression of pain.
- Show that any method removing mid-SFs offers an incomplete account of SFs diagnosticity.

However, our classification vectors show that more diagnostic SFs are present < 8 cpf than > 32 cpf thus replicating Wang and coll (2015; 2017).

References

Willenbockel, V., Fiset, D., Chauvin, A., Blais, C., Arguin, M., Tanaka, J., Bub, D.N., & Gosselin, F. (2010). Journal of Experimental Psychology: Human Perception and Performance, 36(1), 122-135.
Wang, S., Eccleston, C., & Keogh, E. (2015). Pain, 156(9), 1670-1682.
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