Recognition of Stretched Faces

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Recognition of Vertically Stretched Faces

Quite remarkably, the stretched versions of these faces are recognized as quickly and as accurately as the originals.

Specifically, RTs and accuracy for "famous/not famous" judgments are unaffected by up to two times vertical stretch (Hole, 2002).

Here we address the following questions:

1. Can invariance to vertical stretch be extended to 4x stretch?
2. Are highly familiar faces more invariant to stretch?
3. Is invariance to stretch mediated by un-stretching a face to match a standard template?
4. How large are the physical image differences between an un-stretched and a stretched versus a different face?

Experimental Task

Subjects judged whether a headshot (original, stretched 2x, or 4x) was that of a celebrity or not. After completing the task, subjects rated their familiarity with the faces (listed by name) of the 66 celebrities in the experiment.

References

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Moran, J. & Desimone, R. (1985). Selective attention gates visual processing in the extrastriate cortex. *Science*, 229, 782-784.
Mueller, N.G. & Kleinschmidt, A. (2003). Dynamic interaction of object-and space-based attention in retinotopic visual areas. *Journal of Neuroscience*, *23*, 9812-9816.
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Acknowledgements

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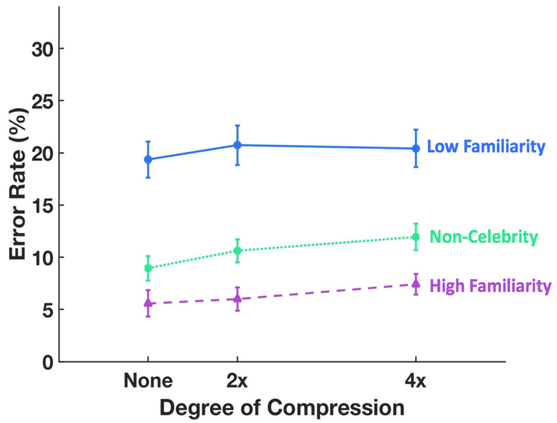
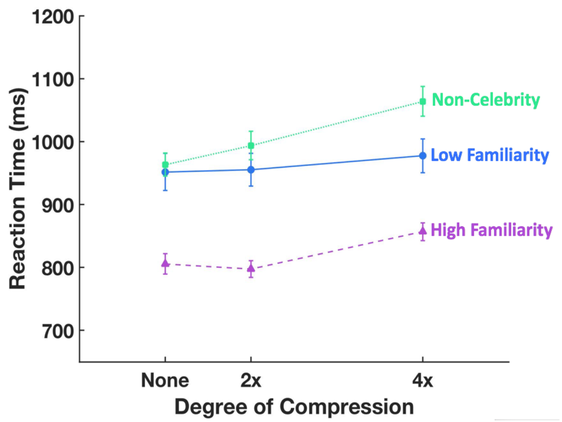
Results

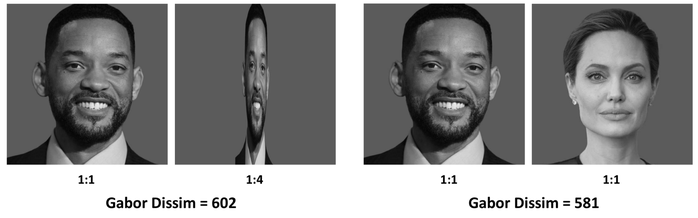




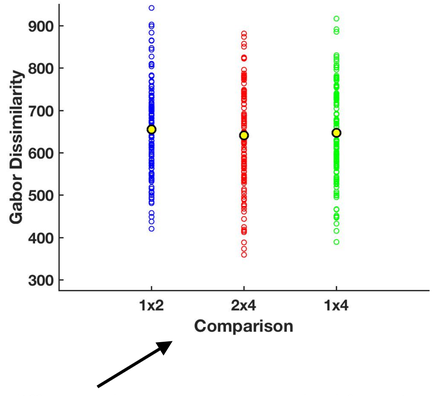
Both RTs and error rates were largely invariant to vertical stretch up to a factor of 4 (the max tested). The invariance was not mediated by degree of familiarity with the celebrity's face suggesting that invariance to stretch is not a result of repeated exposures to a face under various orientations.

How different is an un-stretched face from its stretched counterpart in terms of scaled image (Gabor jet) differences between familiar faces?

Gabor dissimilarity of a pair of faces is highly correlated (r = mid .90s) with their psychophysical discriminability (Yue et al, 2012).

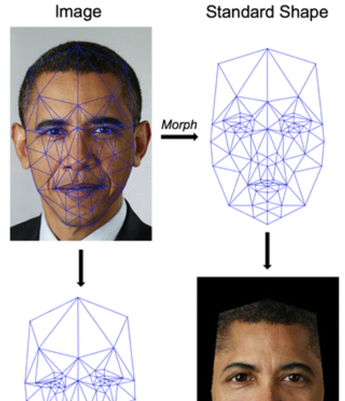


Vertically stretching a face by a factor of 4 has a huge effect in terms of the Gabor dissimilarity. The effect of stretching Will Smith's face is as large as the difference between Will Smith's and Angelina Jolie's faces.



Quite remarkably, the magnitude, in terms of Gabor dissimilarity, of the difference between two stretched faces is largely invariant to the extent of the differences in their degree of stretch. While this does not explain invariance to stretch, it is consistent with the invariance over varying degrees of stretch. This requires further investigation.

Is invariance to stretch mediated by un-stretching a face to match a standard template?



Warping a face to match an average face shape distorts the face's features rendering it unrecognizable. Thus, it is unlikely that such a representation is employed in recognizing stretched faces. Instead, templates of an average face may be employed for detecting the presence of a face rather than its individuation.

Image from Kramer et. al. (2017)

Empirical Conclusions

1. Face recognition is invariant to vertical stretch up to at least a factor of 4.
2. The invariance to stretch is independent of face familiarity.
3. It is not the case that stretching a face produces only a small effect on image dissimilarity. Note the Will Smith and Angelina Jolie example.
4. It is unlikely that stretched faces are compared to an average face template, as warping features to match average shape eliminates useful information for identification.

Theoretical Speculation

The attentional modulation of receptive fields, as illustrated by Moran and Desimone's demonstration of "shrink-wrapping" in V4 (1985) and object-based attentional effects (Mueller & Kleinschmidt, 2003), may also allow the stretching of receptive fields in face-selective cortical areas. This could explain the lack of an effect of stretching a face on its recognition. The elongated envelope of a stretched face could be a signal for the receptive fields to assume a similar elongation. Obviously, a matter in need of investigation.