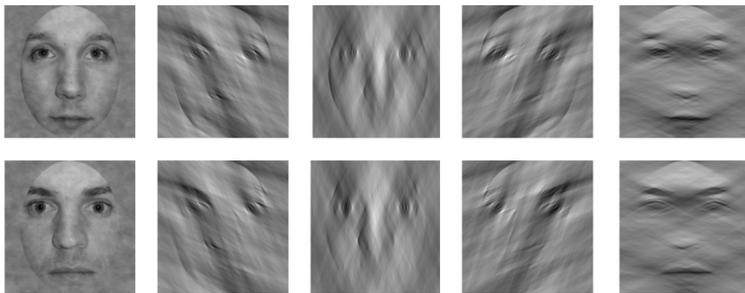


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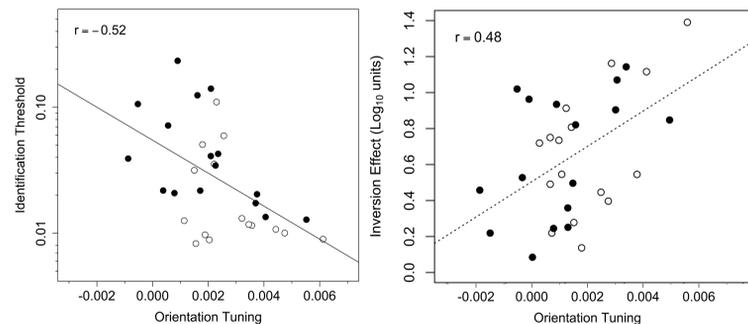
## Background

The information conveyed by horizontal structure in the Fourier domain is a highly diagnostic cue for face identification, because this information differs significantly between face identities.<sup>1,2</sup>



Two face identities filtered to retain information at 135°, 90°, 45°, and 0°, left to right (bandwidth = 60°). Note that the images retaining horizontal structure (0°) appear more distinct than any other orientation.

The degree to which individuals selectively process horizontal structure in upright faces predicts face identification performance and the magnitude of the face inversion effect.<sup>3</sup>



Data from Pachai et al.<sup>3</sup> demonstrating the relationship between orientation tuning (i.e., the extent to which observers preferentially process horizontal facial structure) and **left**: upright face identification (lower values are better) **right**: the face inversion effect (higher values indicate a larger inversion effect). Open and closed circles indicate two threshold accuracy levels (50% and 67%), measured between-subjects, that had no effect on the relationship in question and therefore represent an internal replication.

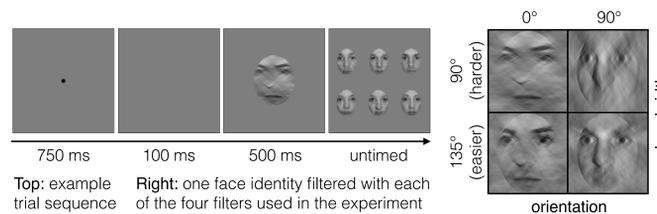
## Research questions

Are the face identification deficits observed in healthy aging and developmental prosopagnosia (e.g.<sup>4,5</sup>) associated with a decrease in selective processing of horizontal structure?

Are individual differences in face identification ability correlated with selective processing of horizontal structure in these populations?

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## Procedure and Stimulus



## Observers

**Younger controls**  
n = 16 [13 female]  
age = 20 [18 - 28]

**Older observers**  
n = 9 [5 female]  
age = 74 [70 - 80]

**Patient-matched controls**  
n = 12 [8 female]  
age = 44 [26 - 66]

**Dev. prosopagnosia**  
n = 6 [4 female]  
age = 44 [26 - 66]

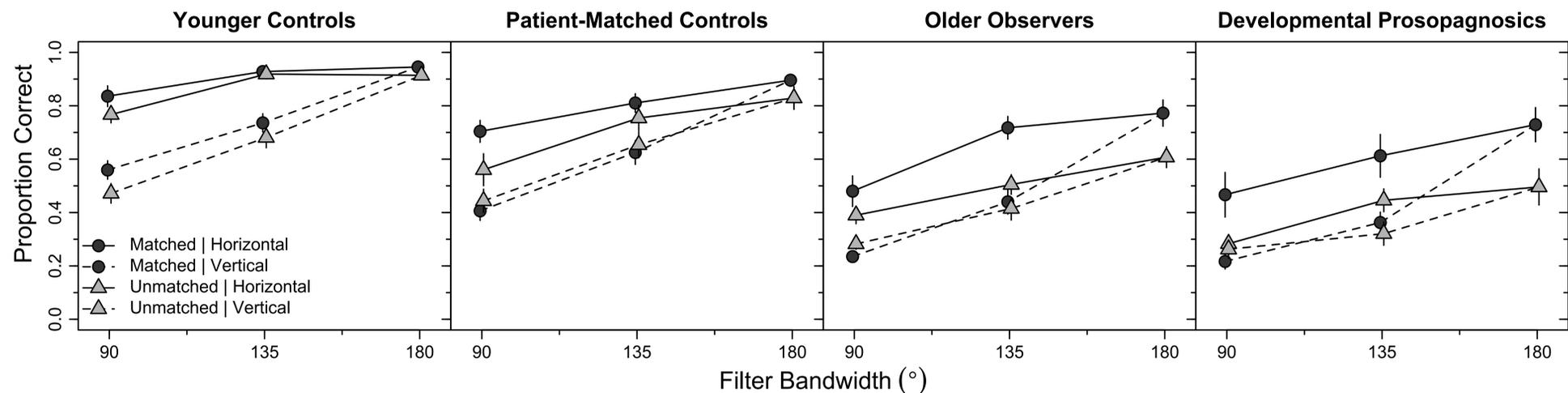
## Design

Face target matched or did not match response screen viewpoint (blocked).

Four filter conditions, plus a full-face control condition (intermixed).

40 trials/condition, 200 trials/block.

## Results



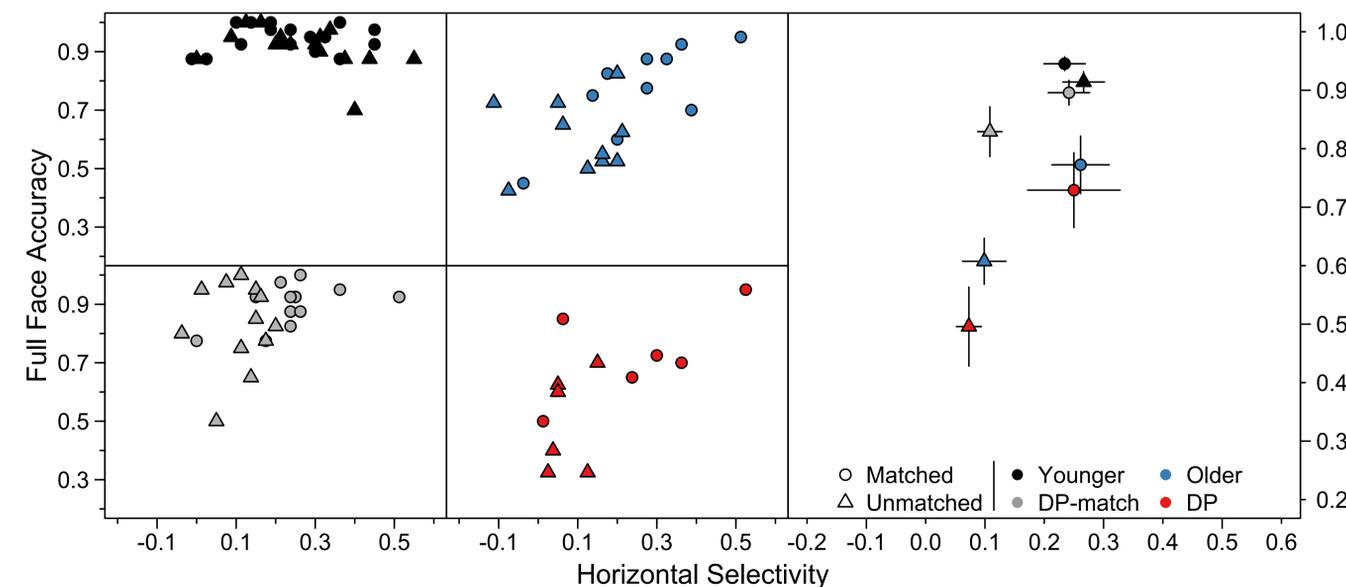
**Caption: top:** Mean proportion correct. Note that 90° is the largest bandwidth at which the horizontal and vertical filters are fully independent, and that 180° filters pass all components and correspond to full, unfiltered faces.

**Caption: right:** Raw data (leftmost four panels), and mean +/- SEM for each group (right panel). Full face accuracy is defined as proportion correct with 180° filters and horizontal selectivity is defined as the difference between horizontal and vertical filters, averaged across bandwidth.

**Statistics: full face accuracy:** A 2 (group) x 2 (viewpoint) ANOVA comparing patients and patient-matched controls revealed effects of group [ $p < 0.001$ ], viewpoint [ $p = 0.001$ ], and an interaction [ $p = 0.02$ ]. Comparing younger and older revealed effects of group [ $p < 0.001$ ], viewpoint [ $p < 0.001$ ] and an interaction [ $p < 0.001$ ]. Comparing older and patients revealed an effect of viewpoint [ $p < 0.001$ ] but no effect of group [ $p = 0.3$ ] or interaction [ $p = 0.24$ ].

**Statistics: horizontal selectivity:** Comparing patients and patient-matched controls revealed an effect of viewpoint [ $p < 0.001$ ] but no effect of group [ $p = 0.75$ ] or interaction [ $p = 0.57$ ]. Comparing younger and older observers revealed no main effects [group:  $p = 0.17$ ; viewpoint:  $p = 0.11$ ], qualified by a significant interaction [ $p = 0.001$ ].

**Statistics: individual differences:** We used linear mixed-model regressions for each group to examine the relationship between horizontal-filter accuracy and full face accuracy after controlling for fixed effects of viewpoint and vertical-filter accuracy and a random effect of observer. This relationship was significant for older observers [ $p = 0.031$ ], patient-matched controls [ $p = 0.016$ ], and patients [ $p = 0.003$ ]. The relationship was not significant for younger controls [ $p = 0.076$ ], but these data may be contaminated by ceiling effects.



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## Conclusions

Decreased horizontal selectivity cannot explain the entirety of the deficits in healthy aging and developmental prosopagnosia.

However, differential sensitivity to horizontal structure does significantly predict individual differences within these groups.