

## Response to Thomas: Is human face recognition ability entirely genetic?

Responding to our article on the high heritability and specificity of human face recognition ability (1), Thomas (2) agrees that our data made a strong case for high genetic influence and against significant familial environmental influence. Thomas (2) further suggests that with measurement error taken into account, there may be no reliable variation left to attribute to nonfamilial environment, rendering face recognition ability essentially all genetic.

Indeed, we agree that our data could be consistent with zero nonfamilial environmental influence. Given that nonfamilial environmental influence is taken as the reliable variation not shared between monozygotic twins, the failure of two reliability estimates—test–retest (0.70) and alternate-forms (0.76) reliabilities—to significantly exceed the 0.70 monozygotic twin correlation ( $P > 0.20$ ; one-tailed tests) appears to argue against such a nonfamilial environmental influence.

We chose to interpret these results cautiously for two reasons. First, it is difficult to rule out downward biases on these two reliability statistics caused by learning effects (test–retest) and nonequivalence between forms (alternate-forms). Second, another reliability statistic robust to such biases—Cronbach's  $\alpha$ , a measure of internal consistency—produced a higher estimate (0.89 in our twin sample) that left significant room for a nonfamilial environmental influence.

Internal consistency reliability is, however, susceptible to its own upward bias. Because internal consistency reliability is computed based on data from a single testing session, any factor that stays relatively constant within a session but varies across sessions—possible examples include alertness, motivation, and mood—could inflate internal consistency reliability relative to the monozygotic twin correlation. Why this inflation? Because such a factor contributes *signal* to internal consistency reliability (by making a person consistently different from others over the course of a single session) but contributes *noise* to the twin correlation (because twins are, by definition, tested in separate sessions).

Fortunately, there is a straightforward way to test for such biasing factors; if present, they will cause a lower reliability for data collected across two sessions than within a single session. We therefore collected both alternate-forms and split-half reliability data across and within sessions (for split-half data, three of six faces were learned and tested for each half-test). Neither form of reliability was significantly lower when measured across sessions, evidence that internal consistency reliability may provide an unbiased reliability estimate directly comparable with the monozygotic twin correlation. [Analyses: Split-half reliability, calculated as Spearman–Brown-corrected Spearman correlation, was  $r(91) = 0.86$  within and  $r(25) = 0.84$  across sessions ( $P$  of difference = 0.76). Alternate-forms reliability, calculated as Spearman correlation, was  $r(450) = 0.65$  within and  $r(80) = 0.68$  across sessions ( $P$  of difference = 0.68)].

We conclude that our cautious interpretation of our twin results was probably warranted and that there remains a possibility for some modest contribution of nonfamilial environment to human face recognition ability.

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1. Wilmer JB, et al. (2010) Human face recognition ability is specific and highly heritable. *Proc Natl Acad Sci USA* 107:5238–5241.

2. Thomas DM (2010) Is there significant nonfamilial environmental influence on human face recognition? *Proc Natl Acad Sci USA* 107:E100.

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The authors declare no conflict of interest.

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