Abstract. A correlation between myopia and visuo-spatial attention is reported. More severe myopia was found to be associated with better ability to quickly narrow the focus of visual attention to a small region of space (assessed via interference from spatial proximity of to-be-ignored inverted half-faces), in a task where local focus was explicitly required. There was no myopia association with size of the default attentional window, when the need to respond to either small local or larger global regions was equally likely (in a particular Navon figure task). Results suggest that myopics might allocate attention more narrowly than individuals with normal eyesight in certain functionally important visual tasks (eg reading) but not others (eg driving).

As an aside to a larger project, we observed a relationship between myopia and visuo-spatial attention. In making the input to the retina blurry, myopia may lead to changes in the way visual attention is allocated in space. Here, we are interested in the ability to form a narrow focus of attention when required to do so, and also the preference for narrow versus broad allocation when observers are left to themselves to choose.

One perhaps ‘obvious’ proposal might be that myopic individuals—who have spent much of their life seeing only in low spatial frequencies (ie with fine details lost)—would become accustomed to adopting a more global attentional focus than those with normal vision. Intriguingly, however, the only previous study of spatial attention in myopia suggests the reverse. Turatto et al (1999) found myopics to be slower than normal-vision controls in detecting a small target when it appeared in the periphery, but not when it appeared close to fixation, implying that myopics had narrow attentional distribution around fixation. Also, in a visual-search task, myopics’ reaction times increased as the number of distractors increased, despite the task producing a ‘popout’ pattern in controls; Turatto et al interpreted this as myopics using serial search of items in a focused mode as opposed to more parallel search in a diffuse mode. It thus seems that a more plausible proposal regarding the effects of a lifetime of blurry retinal input is that this might lead myopics to compensate by improving their cortical ability to focus visual attention on small regions of space.

Here, we tested this proposal using a task requiring observers to name a half-face in the presence of competing information from a to-be-ignored half that was either closer to (aligned condition) or further away from (misaligned condition) the target half (figure 1a). Crucially, faces were presented inverted (upside down). Readers may note that our task is the ‘composite face task’. For upright faces, that task is affected by holistic perceptual processing, which forces attention to expand beyond the target half, regardless of subjects’ general attentional ability. For inverted faces, however, holistic processing does not occur (eg there is no part-whole effect—Tanaka and Farah 1993). For inverted faces, therefore, the half-face task provides a pure measure of ability to narrow the focus of spatial attention.

The specific attention requirements of our task are as follows. First, the subject must find the stimulus on the screen (location of the entire stimulus was jittered slightly by 0.8 deg from trial to trial). Then, the subject must rapidly focus attention down to
the small target half and inhibit attention to the distractor half. If the subjects can do this sufficiently accurately and rapidly, their reaction time to name the target half will be unaffected by the proximity in space of the to-be-ignored half. Alternatively, to the extent that the subject is unable to focus attention narrowly, a close distractor half will interfere with target-half identification more than will a more remote distractor half (figure 1c), thus producing an ‘alignment interference effect’.

Our subjects were twenty-five Asian-Australians aged 18–26 years whose optical correction ranged from 0 dioptre (normal vision) to $-6.25$ dioptres (high myopia). Asian-Australians were selected for reasons connected with the larger project, but are a useful group to test here because (a) on average they show a significant alignment interference effect in our paradigm, allowing for study of individual differences in the strength of the effect, and (b) this group shows a broad range of myopia levels (Morgan and Rose 2005).

Experimental testing was conducted with optical correction in place, giving at least 20/20 acuity on the Snellen test. Results of the half-face task (figure 1b) show a correlation between myopia and size of the alignment interference effect ($r = 0.521$, $p < 0.01$), such that individuals with more severe myopia had a better ability to focus attention on the small target half (figure 1c).

We now turn to a quite different task. Our half-face task tested subjects’ ability to restrict attention locally under instruction. We also tested subjects’ natural preferences for allocating attention locally or globally, using a particular version of a Navon task that divides attention between levels (figure 2a—Yovel et al 2001). Subjects were to look for target letters (E and H) that could appear unpredictably, but equally often, as either the
small letter or the large letter. This procedure gives no instruction or motivation either to focus-down or to expand attention, but instead assesses individual global or local preference.

Results showed no correlation between degree of myopia and strength of local versus global bias (r = -0.4, p > 0.8—figure 1b; note N = 22 owing to 3 computer failures). Importantly, this lack of association with myopia was obtained in the context of evidence that other individual-difference variables can strongly affect the global ^local bias revealed on exactly the present task (race: Aimola Davies et al, in preparation) or on other Navon figure tasks (autism-spectrum status—Behrmann et al 2006).

Results of both our tasks reject the ‘obvious’ hypothesis that myopics become accustomed to adopting a more global allocation of attention than non-myopics. Instead, our findings support the idea that lifetime exposure to blurred input leads to some compensation via improved ability to focus spatial attention. Importantly, we also found task differences. It seems that myopia is associated with stronger ability to attend locally, but only where the task explicitly requires local attention: this is the situation in our half-face task plus the two tasks of Turatto et al (1999) that produced agreeing results. The results of our Navon task argue that myopics do not show a default setting of a narrower focus than non-myopics. In terms of everyday visual activities, this suggests that myopics might use a narrower focus of visual attention than controls in reading, where small/local attention is explicitly required, but not in driving, where a broader distribution of attention across the scene is ideal.

---

**Figure 2.** (a) Examples of the Navon figures task. Target letters (E and H) could appear randomly at either the global or local level, allowing the observer’s default (ie uninstructed) preference for one level or the other to be assessed. The measure was reaction time to respond “present” at each level. Procedure on each trial was central fixation cross (size 0.1 deg) for 500 ms, lateralised stimulus for 150 ms with inside edges 1.5 deg from fixation, pattern mask (8×9 array of letters each 0.15 deg × 0.1 deg) to both visual fields for 1000 ms. Stimuli were: Et Ev Hx Hl Lx Lh Tx Tl Vx Vl Lh Te Xh Ve (coded as GLOBALlocal). Number of trials per subject was 240 (50% target absent), plus 48 practice trials. Size of global letter = 2.3 deg × 3.9 deg; size of local letter = 0.4 deg × 0.5 deg. Viewing distance was 57 cm. Subjects were right-handed and responded with right hand. (b) Results, showing no correlation between level of myopia and degree of bias towards attending to the global (large) or local (small) levels. y-axis: positive = global/large bias (global faster than local); negative = local/small bias (local faster than global). x-axis: 0 = no myopia; increasingly negative = increasingly severe myopia.
Acknowledgment. Supported by Australian Research Council grant DP0450636 to EM.

References
Aimola Davies A, McKone E, Fernando D, Wickramariyaratne T, Leung H, in preparation, “Asia has the global advantage: race and visual attention”
McKone E, 2008 “Configural processing and face viewpoint” Journal of Experimental Psychology: Human Perception and Performance 34 310 – 327
Morgan I, Rose K, 2005 “How genetic is school myopia?” Progress in Retinal and Eye Research 24 1 – 38
Conditions of use. This article may be downloaded from the Perception website for personal research by members of subscribing organisations. Authors are entitled to distribute their own article (in printed form or by e-mail) to up to 50 people. This PDF may not be placed on any website (or other online distribution system) without permission of the publisher.