“Microsaccades precisely relocate gaze in a high visual acuity task.” Hee-kyoung Ko, Martina Poletti and Michele Rucci

SUPPLEMENTARY MATERIALS

Supplementary Figure 1

Supplementary Figure 1: Eye movements in successful and unsuccessful trials. (a) Mean instantaneous frequency of microsaccades. Rates were higher during the last 2.5 s of a trial than during the initial 2.5 s (*; p < 0.001; paired t-test). (b) Distribution of saccade amplitudes. (c–d) Probability distributions of microsaccades and adjustments after microsaccades. Microsaccades in (c) and adjustments in (d) are subdivided according to the region of the scene (thread, needle, or background) in which the microsaccade relocated the line of sight. * marks significant differences (paired z-test with Bonferroni corrections, p < 0.05). Data refer to saccades smaller than 20’. To collect a sizeable number of error trials, the contrast of the stimulus in this experiment was adjusted to yield 50% performance.
Supplementary Results

In the experiment described in Figs. 2-6, the contrast of the stimulus was individually adjusted to yield successful completion of the task in approximately 85% of the trials. Subjects consistently moved the thread in the direction that reduced the misalignment with the needle (only 4% of the adjustments were in the wrong direction), and failure to accomplish the task typically occurred because the thread was positioned right at the edge of the needle’s aperture.

In order to study the influence of microsaccades on performance, we increased the difficulty of the task and compared the patterns of eye movements in the successful and unsuccessful trials. Supplementary Figure 1 shows results obtained when the contrast of the stimulus was decreased to yield correct alignment in approximately 50% of the trials. In this experiment, observers no longer systematically moved the thread in the correct direction, but frequently increased the misalignment between the thread and the needle (percentage of adjustments in the wrong direction: 25%).

As shown in Supplementary Figure 1a, microsaccades continued to occur frequently, and their rates increased as the thread approached the needle like in the previous experiment. Microsaccades were slightly more frequent in the error trials—the trials in which the thread was not properly aligned with the needle—than in the correct trials, as the average amplitude of all saccades was somewhat smaller in these trials (Supplementary Fig. 1b). However, in the error trials, many microsaccades moved the center of gaze to empty areas of the background. Supplementary Figure 1c shows the distributions of microsaccades as a function of their landing position for the two types of trials. The probability of using a microsaccade to position the line of sight on the thread was significantly higher in the correct trials than in the error trials. In contrast, in the error trials, microsaccades were significantly more likely to land far from both the thread and the needle. The distributions of adjustments following a microsaccade also differed in successful and unsuccessful trials (Supplementary Fig. 1d). In the error trials, adjustments made after microsaccades toward empty areas of the background were more frequent, and fewer adjustments occurred while fixating on either the thread or the needle.

These data provide further evidence for the importance of microsaccades in our experiments. By maintaining the preferred retinal region centered on the area of interest, microsaccades were used to explore the stimulus more efficiently in the trials that were concluded successfully. They often relocated the line of sight far from the thread and the needle in the trials in which errors occurred.