Supplementary Materials for

Do perceptual biases emerge early or late in visual processing?

Decision-biases in motion perception

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Supplementary Figure 1 — Behavioural results for fine discrimination task

Psychometric curves for the fine discrimination task for all subjects. Each panel shows, for one subject, the proportion of clockwise (CW) responses as a function of the direction of motion of the stimuli relative to the reference (negative values, counter-clockwise directions; positive values clock-wise directions). Different colours indicate data obtained at four different coherence levels (blue, 4 %; green, 7 %; yellow, 13 %; red, 25 %). For all subjects, performance improved with increasing coherence (red curves are steepest; blue curves are shallowest). To quantify this, we fitted cumulative Gaussian distributions (non-linear least squares, Nelder-Mead). The steepness of the psychometric curves, as quantified by the standard deviation (σ) of the cumulative Gaussian distribution, is inversely related to thresholds. Because the discrimination task was identical for the *reference present* and *reference absent* conditions, we pooled data for these plots.

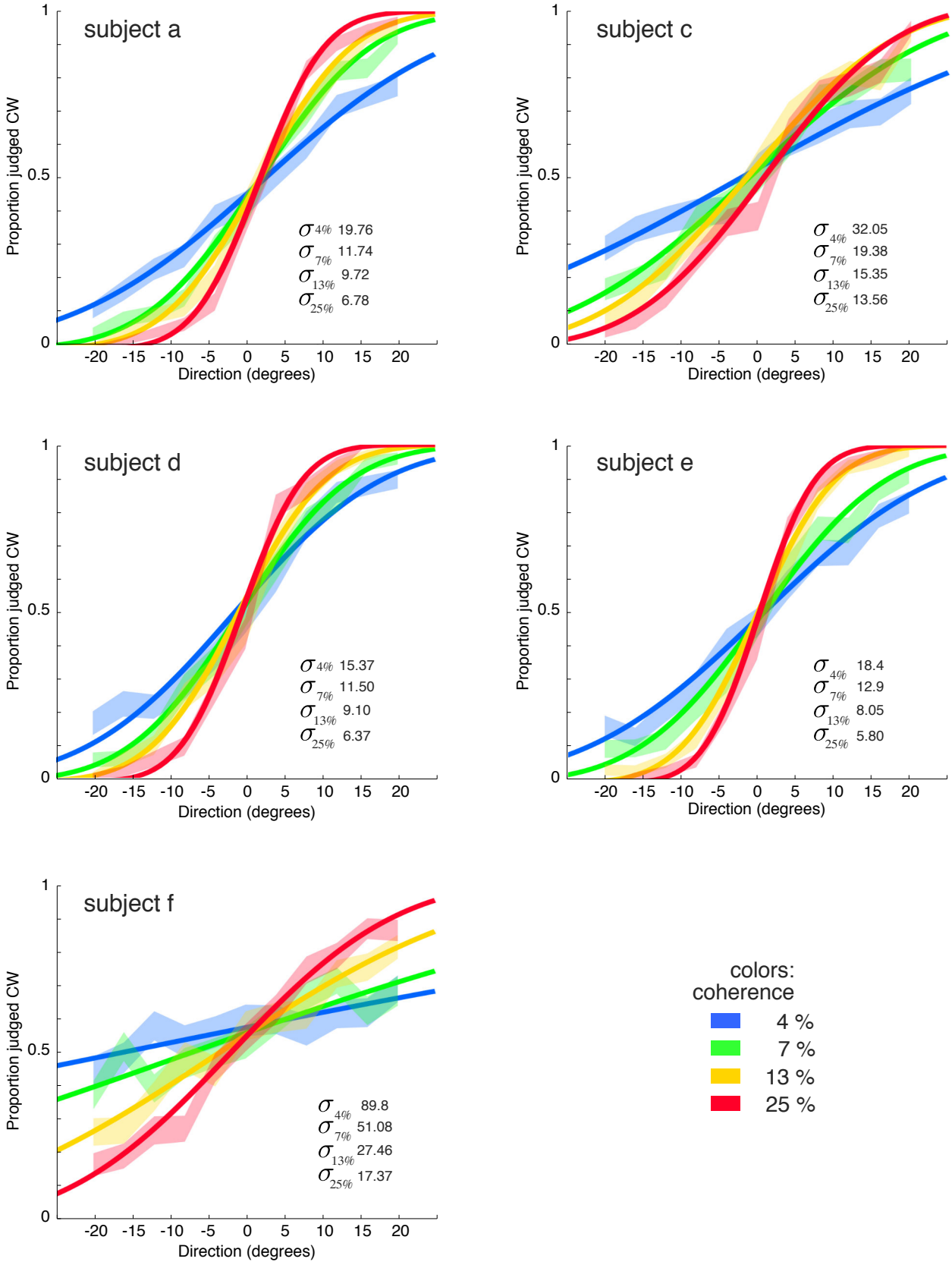
subject a
Proportion judged CW
Direction (degrees)
σ4% 19.76
σ7% 11.74
σ13% 9.72
σ25% 6.78
subject c
σ4% 32.05
σ7% 19.38
σ13% 15.35
σ25% 13.56
subject d
σ4% 15.37
σ7% 11.50
σ13% 9.10
σ25% 6.37
subject e
σ4% 18.4
σ7% 12.9
σ13% 8.05
σ25% 5.80
subject f
σ4% 89.8
σ7% 51.08
σ13% 27.46
σ25% 17.37
colors:
coherence
4 %
7 %
13 %
25 %

Figure 1

Supplementary Figure 2 — Behavioural results for estimation task

Joint histograms showing percentage of direction estimates as function of (true) stimulus direction. Rows 1-5 show data from individual subjects for four different coherence levels and *reference present / reference absent* conditions. Row 6 shows the grand average across subjects. Grey scale images were derived as for Figure 2. Across all coherence levels, for all subjects, direction estimates were biased in the *reference present* condition. For the *reference absent* conditions, no consistent biases were apparent. To aid visualization, we marked the local maxima for the distribution of estimates for each stimulus direction (treating the joint histograms column-wise) with a red symbol. Regression lines through those points for reference absent data (red solid lines), indicate that responses were on average unbiased: across all conditions, they are close to the identity line (dashed white line). It is worth noting, that the slightly increased variability in the direction estimates of subjects c and f is also reflected in the psychometric curves for the fine discrimination task (see Supplementary Figure 1). This indicates poorer performance overall for those particular subjects.

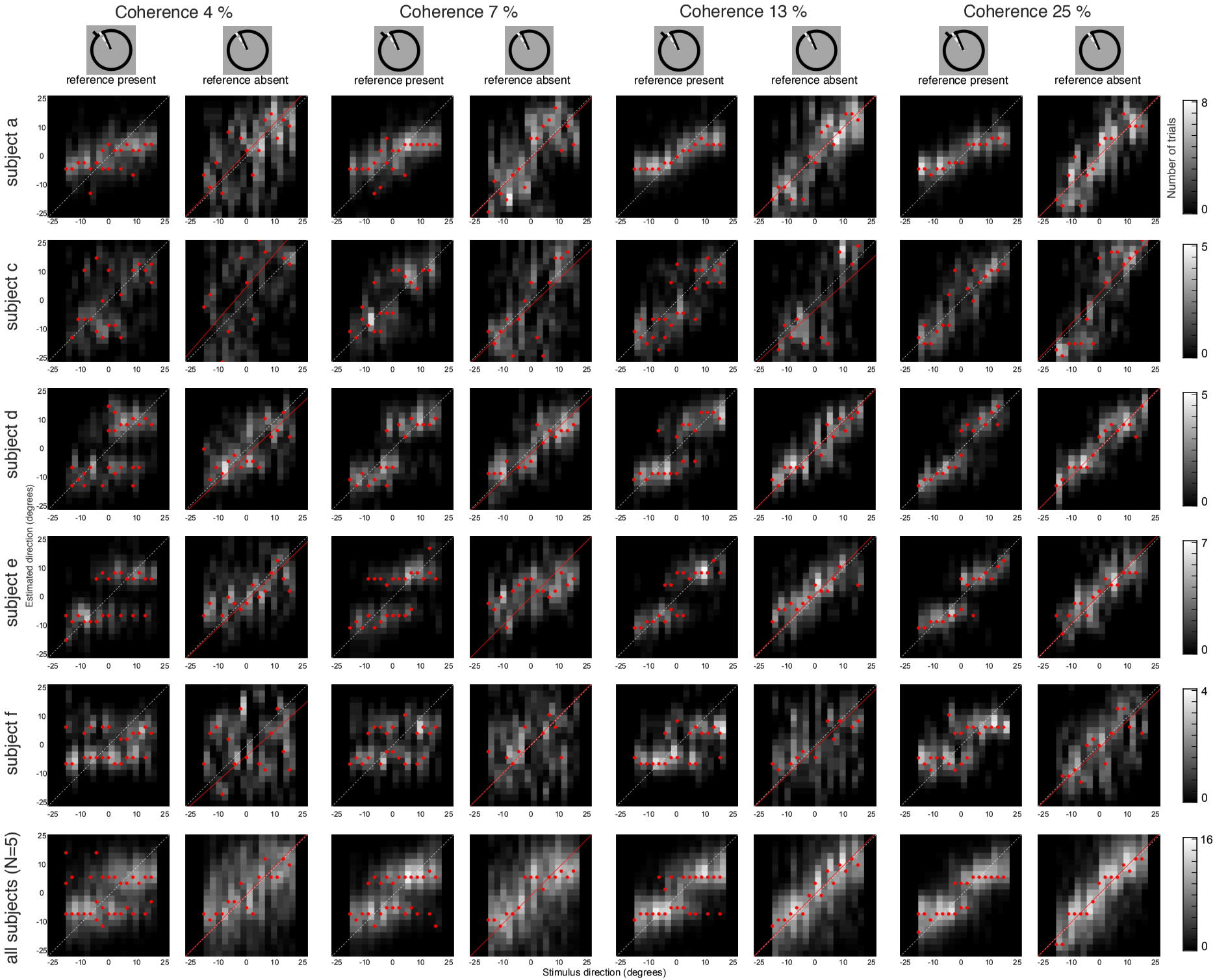
Coherence 4 %
Coherence 7 %
Coherence 13 %
Coherence 25 %
reference present
reference absent
reference present
reference absent
reference present
reference absent
reference present
reference absent
subject a
subject c
subject d
subject e
subject f
all subjects (N=5)
Estimated direction (degrees)
Stimulus direction (degrees)
Number of trials
8
5
5
7
4
16
0
25
10
0
-10
-25

Figure 2