Supplemental Material

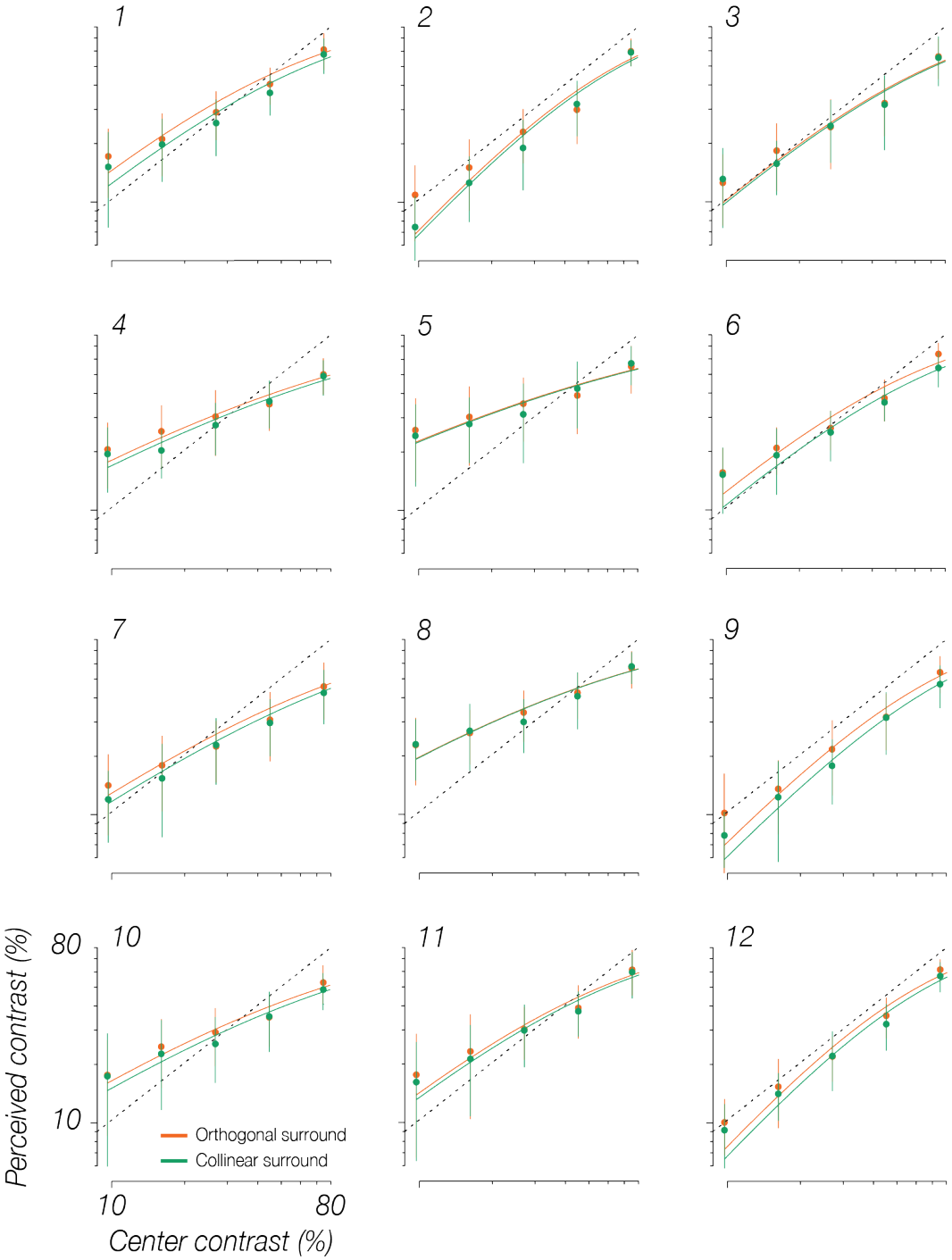


Figure S1. Experiment 1: Individual observers perceived contrast estimates and model fits for the simultaneous condition, across 12 subjects. Data points reflect perceived contrast as a function of physical center stimulus contrast, and the lines reflect the best model fit for the two different surround conditions, per observer. Error bars represent ±1 s.e.m.

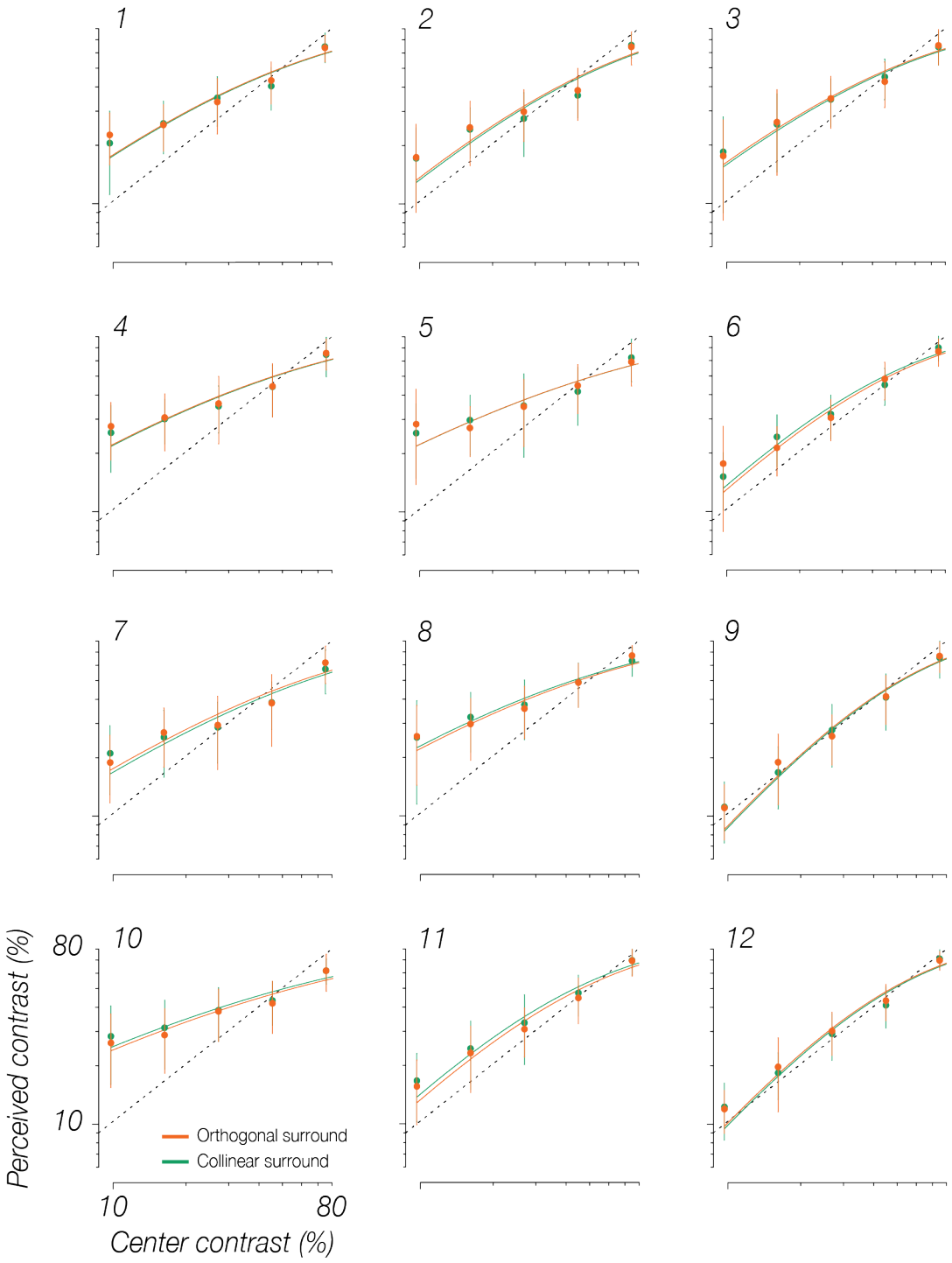


Figure S2. Experiment 1: Individual observers perceived contrast estimates and model fits for the sequential condition, across 12 subjects. Data points reflect perceived contrast as a function of physical center stimulus contrast, and the lines reflect the best model fit for the two different surround conditions, per observer. Error bars represent ±1 s.e.m.

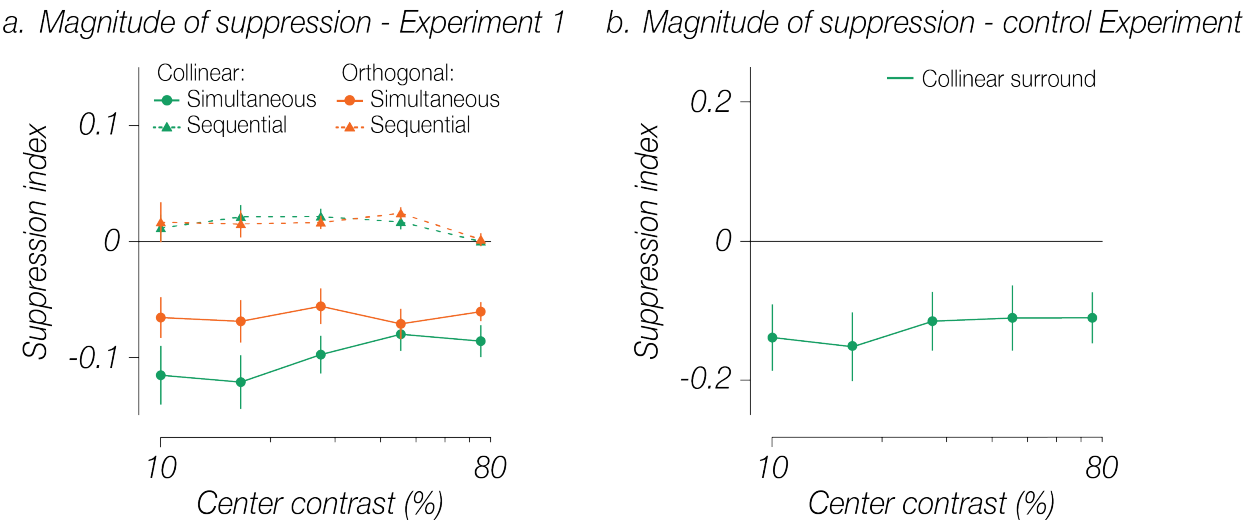


Figure S3. **a.** Experiment 1: Indices of the magnitude of suppression. *Suppression index = (surround – no surround) /(surround + no surround.* Negative suppression indices indicate that adding a surround stimulus dampened the perceived contrast of the center stimulus (i.e. the center contrast was estimated to be lower when compared to the no surround condition). Both collinear and orthogonal surround configurations resulted in a negative suppression index within the simultaneous condition, while this was not the case for the sequential condition. **b.** Control experiment suppression indices. In a control experiment (n = 5), we confirmed that suppression could be observed *in perception* when the surround stimulus was presented 1000 ms after the onset of the center stimulus. In this control experiment, the timing of surround onset matched the sequential condition of Experiment 1, but the center and surround stimuli were visible together, as in the simultaneous condition of Experiment 1. We observed suppression in our control experiment, suggesting that the absence of suppression in the sequential condition could not be attributed to the delayed onset of the surround stimulus.*)*. Error bars represent ±1 s.e.m.

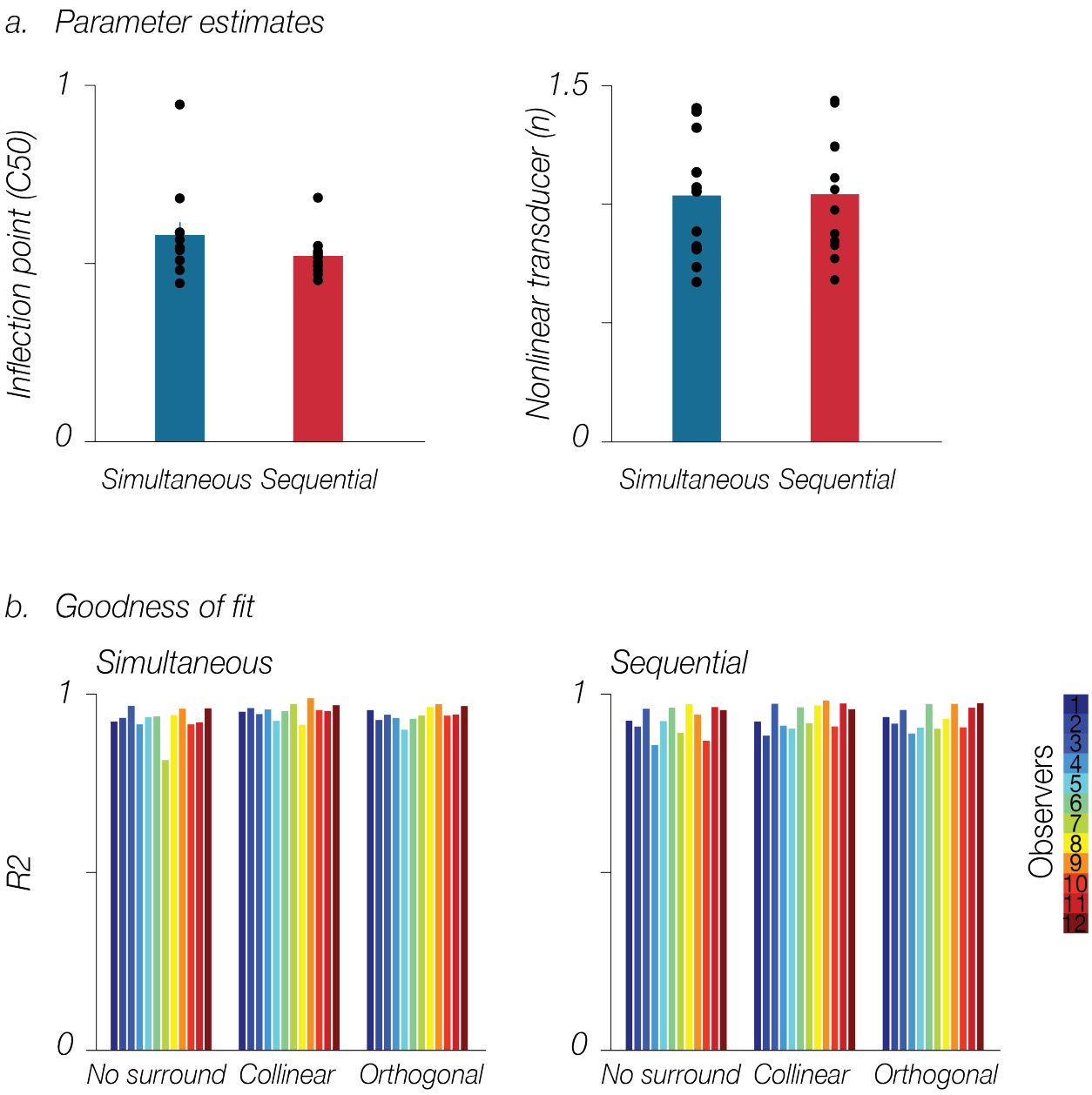


Figure S4. Experiment 1: Normalization model parameter estimates. **a.** The inflection point ($C50$) and nonlinear transducer (n) parameter estimates derived from the normalization model. **b.** The goodness of fit across individual observers for the normalization model. Each graph illustrates R^2 values for the model for each surround condition in the simultaneous and sequential conditions all observers. Data points reflect individual observers, error bars represent ±1 s.e.m.

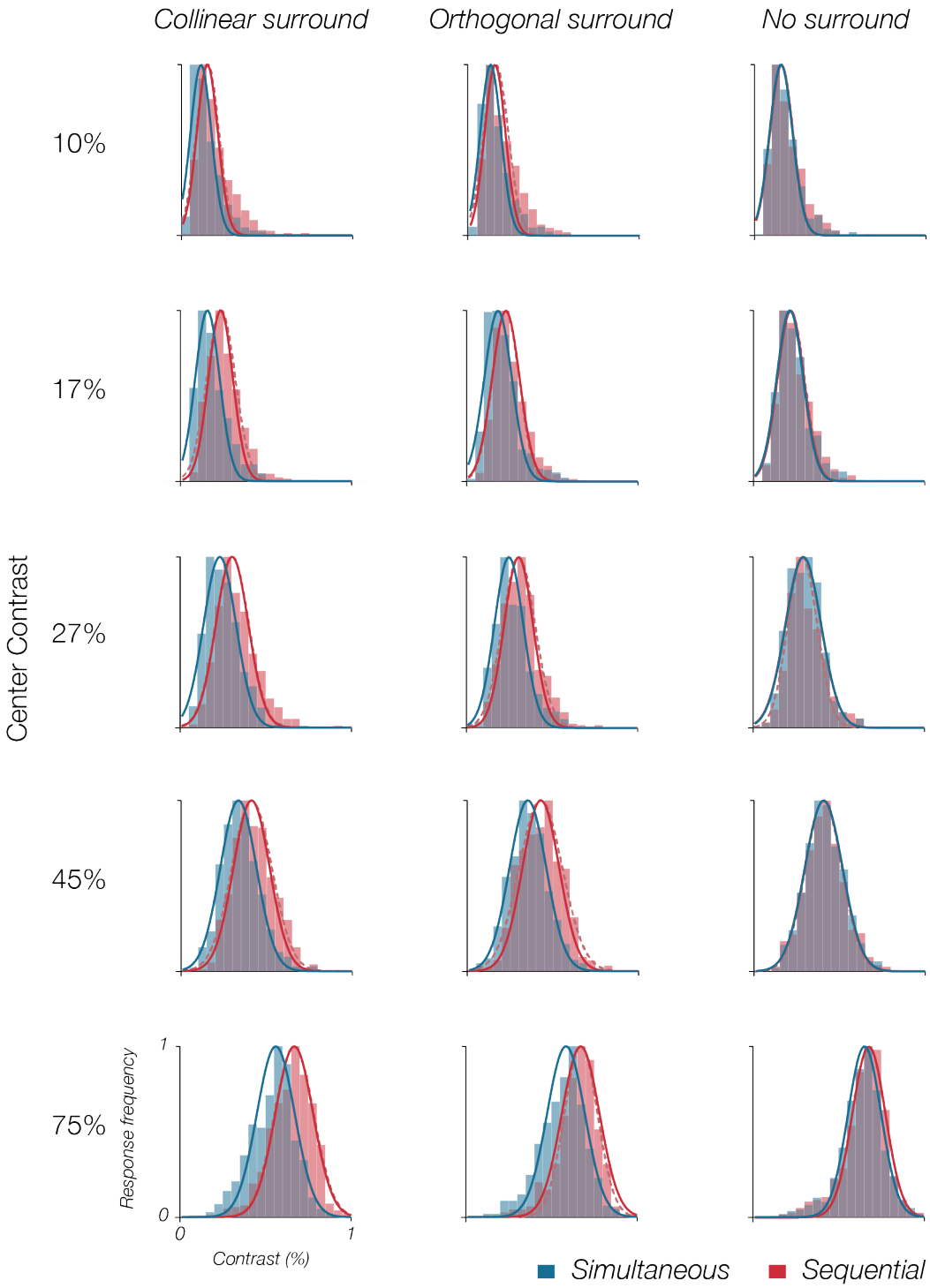


Figure S5. Precision within perception and visual memory for Experiment 1. Response distributions for the simultaneous (blue) and sequential (red) conditions for all contrast and surround configurations. Perceived contrast responses were combined over all observers (*N* = 12) and split into 20 bins (steps of 5% between 0-100% contrast), after which the response frequency was normalized. To quantify whether the response precision varies between our experimental conditions, we fitted a Gaussian model (free mean and width) to the simultaneous and two Gaussian models to the sequential condition. For the sequential condition, one model contained free parameters for both the mean and the width of the distribution (full model), while the other model was constrained in that the model could only could vary the mean while the

width was taken from the simultaneous condition (constrained model). Lines indicate the best model fit for the simultaneous (blue solid; model goodness of fit R^2 = .96, SD = 0.027); sequential full model (red dashed; model goodness of fit R^2 = .95, SD = 0.032); and sequential constrained model (red solid; model goodness of fit R^2 = .94, SD = 0.035). A nested F-ratio test between the constrained and full model revealed that for most contrast/surround conditions the constrained model outperformed the full model, indicating that response precision between the simultaneous and sequential conditions are comparable (Collinear: 10% contrast $F(1,17) = 0.96$, $p = 1$; 17% contrast $F(1,17) = 12.50$, $p = 0.038$; 27% contrast $F(1,17) = 0.18$, $p = 1$; 45% contrast $F(1,17) = 8.63$, $p = 0.138$; 75% contrast $F(1,17) = 0.79$, $p = 1$. Orthogonal: 10% contrast $F(1,17) = 2.60$, $p = 1$; 17% contrast $F(1,17) = 0.40$, $p = 1$; 27% contrast $F(1,17) = 10.40$, $p = 0.075$; 45% contrast $F(1,17) = 15.87$, $p = 0.014$; 75% contrast $F(1,17) = 13.46$, $p = 0.029$. No surround: 10% contrast $F(1,17) = 0.02$, $p = 1$; 17% contrast $F(1,17) = 0.39$, $p = 1$; 27% contrast $F(1,17) = 13.97$, $p = 0.025$; 45% contrast $F(1,17) = 1.74$, $p = 1$; 75% contrast $F(1,17) = 0.06$, $p = 1.$; all p-values are Bonferroni corrected).

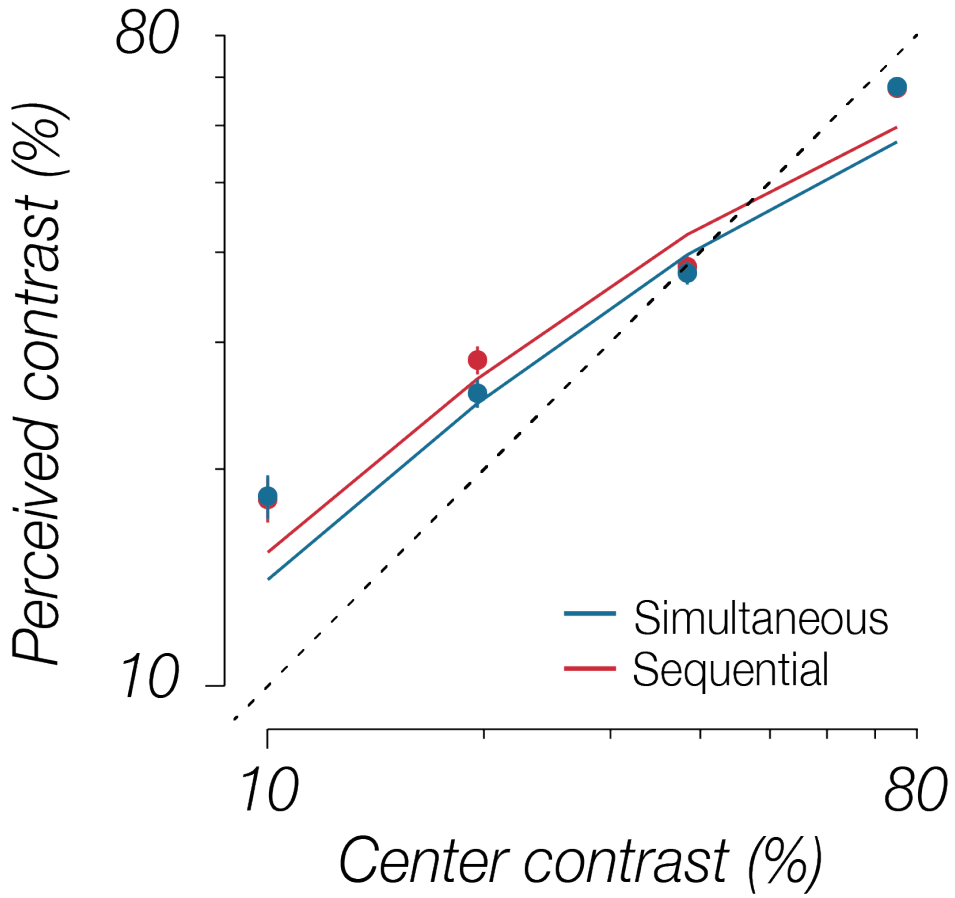


Figure S6. Memory fidelity comparison between Experiment 1 and Experiment 2. A no surround condition was collected during Experiment 2, where observers only maintained a representation of the center contrast when no surround stimulus was presented. These perceived center contrast measurements were compared with the average model fits for the no surround condition in Experiment 1, for both simultaneous (dark grey) and sequential (light grey) conditions (note that during these trials no surround was presented, hence there should be no difference between estimates within simultaneous and sequential conditions). Perceived contrast in Experiment 2 could be explained by the model parameters obtained in Experiment 1 (R^2 simultanous: 0.9; R^2 sequential: 0.93). Error bars denote ± 1 s.e.m. (note that in some cases the error bars are smaller than the data point symbols).

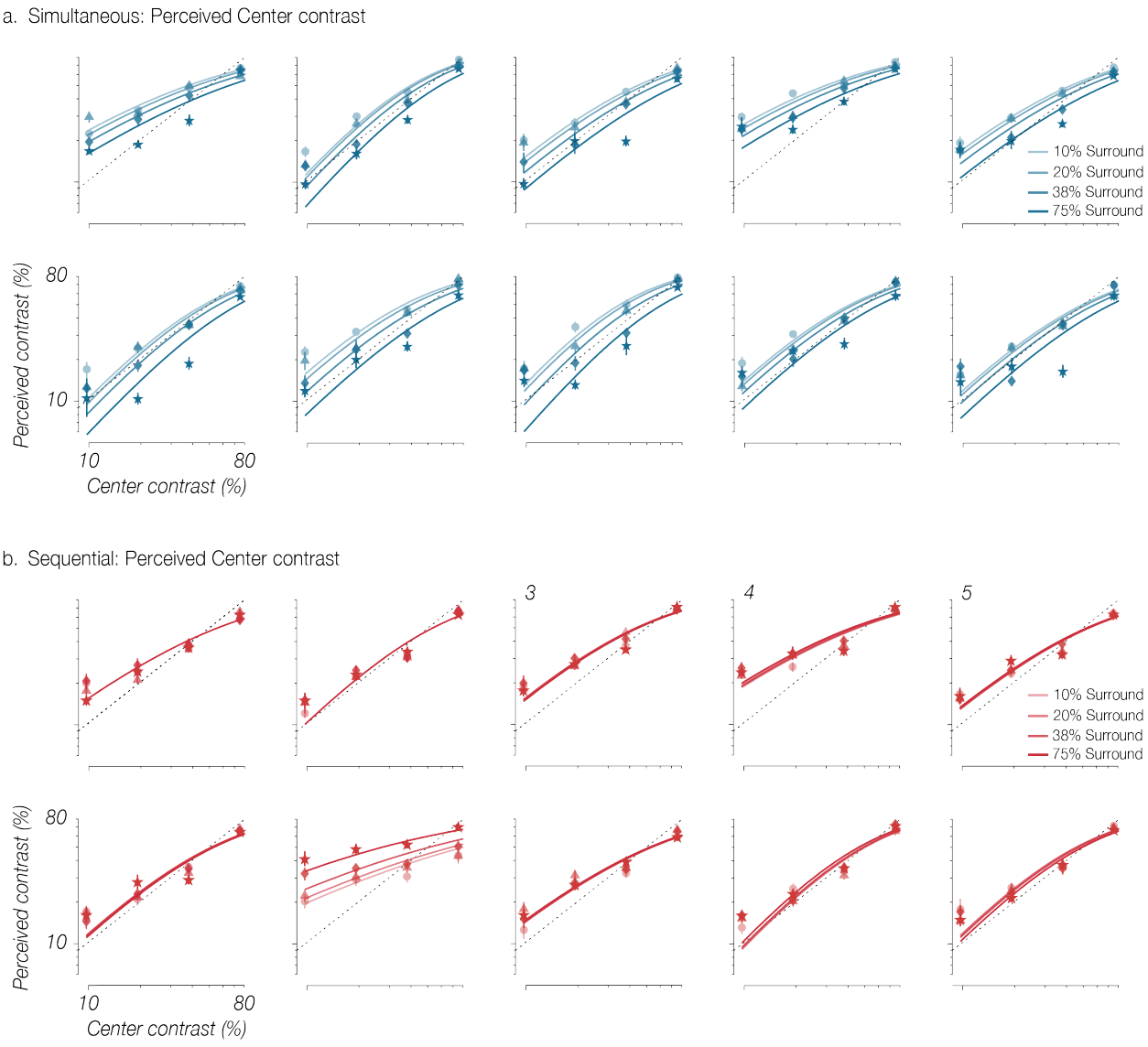


Figure S7. Experiment 2: Individual observers perceived center contrast and model fits. **a.** Simultaneous condition: data points reflect the perceived center contrast estimates across all contrast levels, for each surround condition. Lines reflect the model fit for each observer. **b.** Sequential condition: data points reflect the perceived center contrast estimates across all contrast levels, for each surround condition. Lines reflect the model fit for each observer. (10% surround = circles; 20% surround = triangles; 38% surround = triangles; 75% surround = stars). Error bars denote ± 1 s.e.m. (note that in some cases the error bars are smaller than the data point symbols).

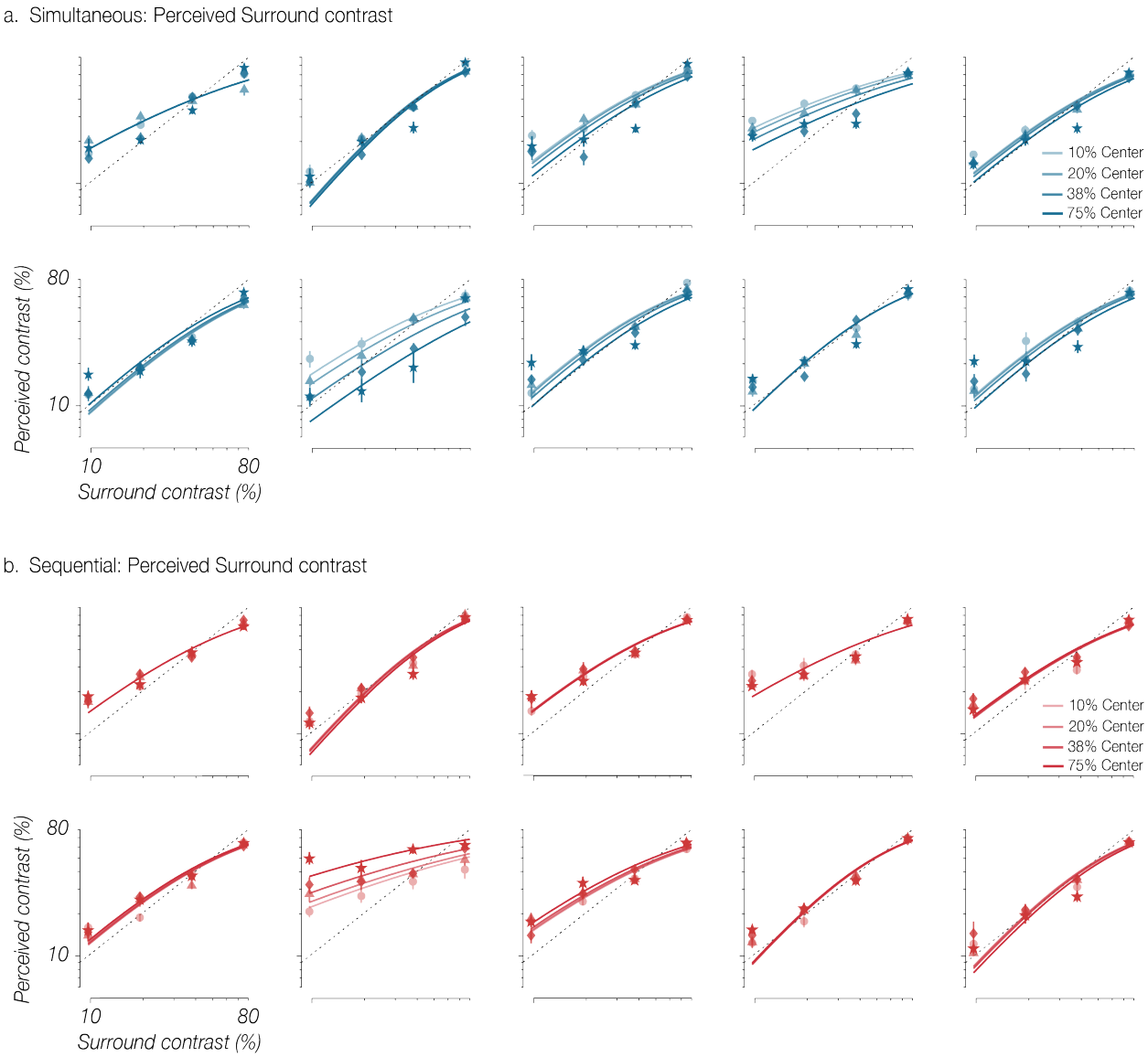


Figure S8. Experiment 2: Individual observers perceived surround contrast and model fits. **a.** Simultaneous condition: data points reflect the perceived surround contrast estimates across all contrast levels, for each center condition. Lines reflect the model fit for each observer. **b.** Sequential condition: data points reflect the perceived surround contrast estimates across all contrast levels, for each center condition. Lines reflect the model fit for each observer. (10% center = circles; 20% center = triangles; 38% center = triangles; 75% center = stars). Error bars denote ± 1 s.e.m. (note that in some cases the error bars are smaller than the data point symbols).

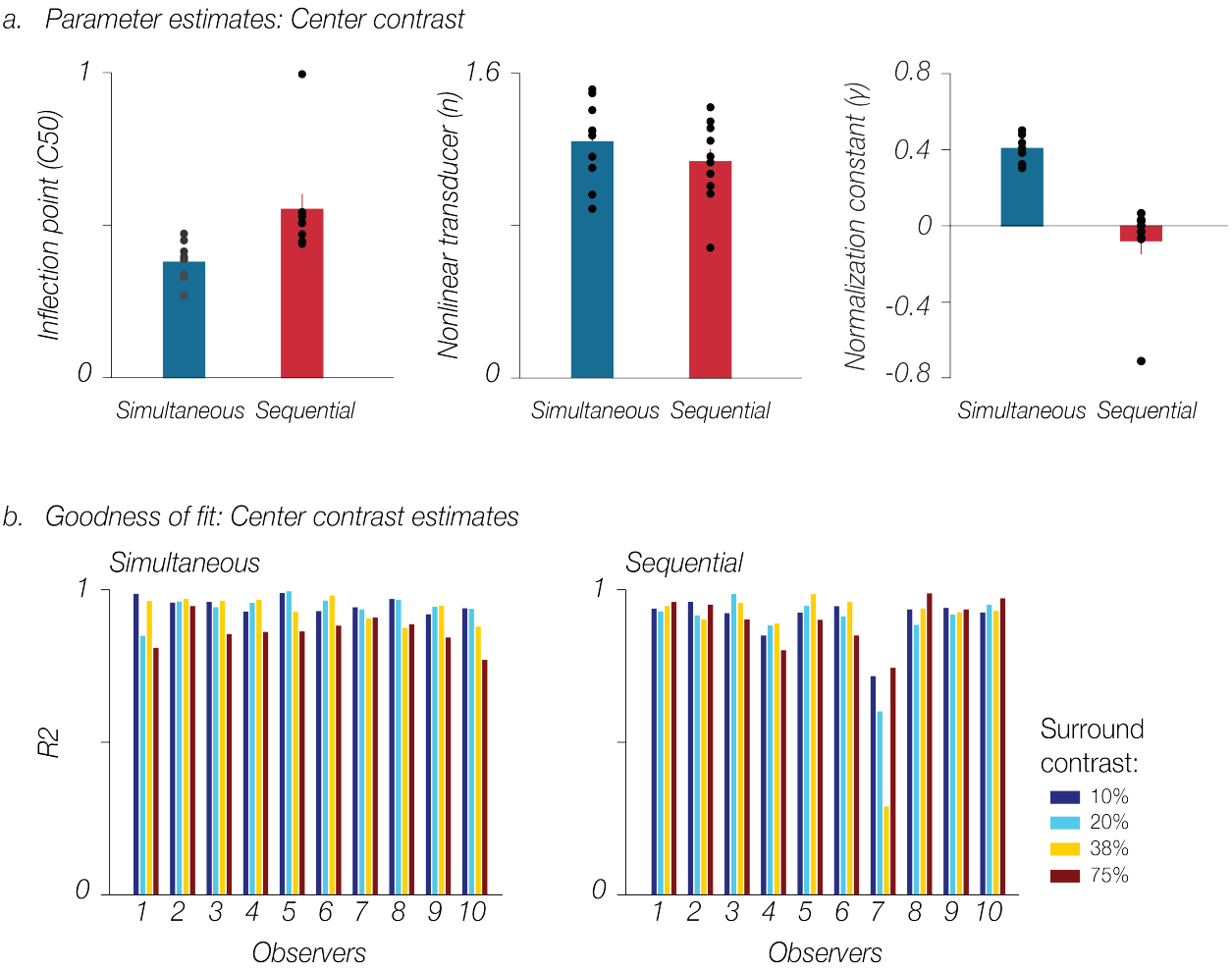
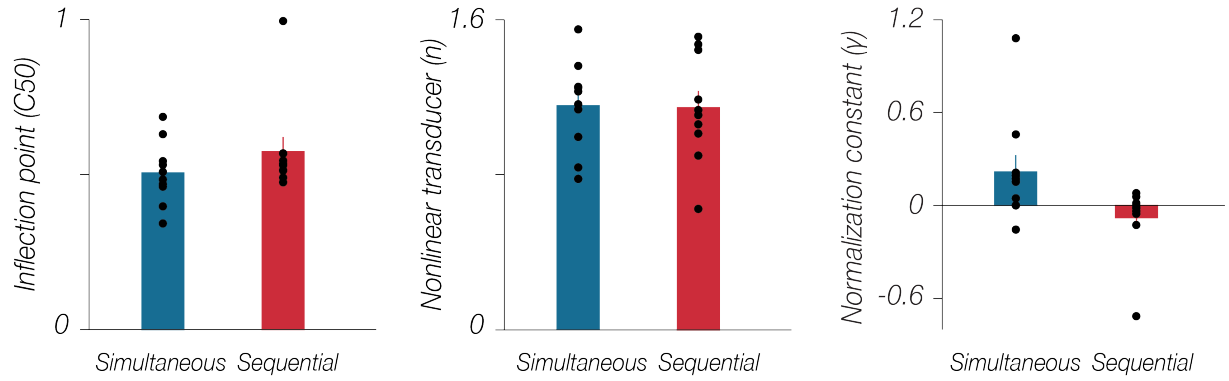


Figure S9. Experiment 2: Normalization model parameter estimates for the center stimulus. **a.** The inflection point ($C50$), nonlinear transducer (n), and normalization constant (γ) parameter estimates derived from the normalization model. **b.** Goodness of fit for individual observers. Each graph illustrates R^2 values for the model for each surround contrast level for simultaneous (left) and sequential (right) conditions for all observers; different colored bars represent the different surround contrasts (dark blue = 10%; light blue = 20%; yellow = 38%; red = 75%). Data points reflect individual observers, error bars represent ±1 s.e.m.

a. *Parameter estimates: Surround contrast*



b. *Goodness of fit: Surround contrast estimates*

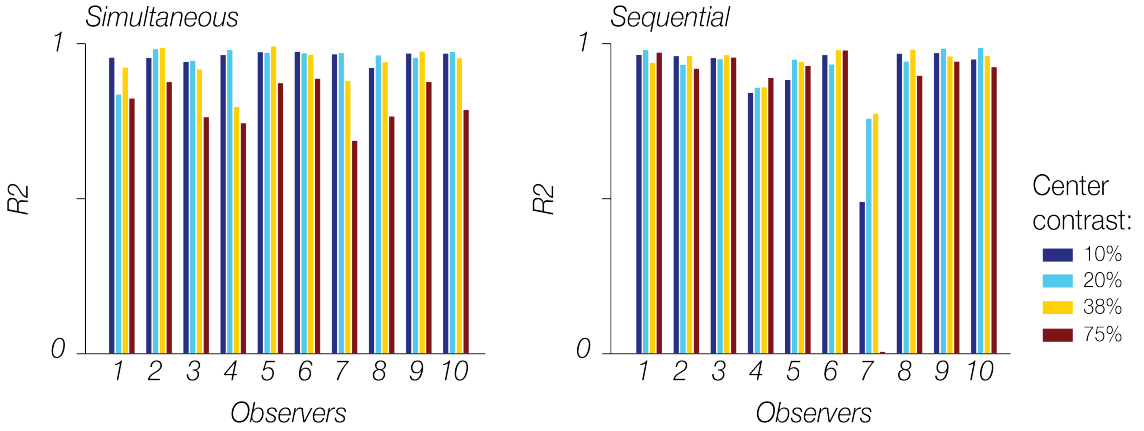


Figure S10. Experiment 2: Normalization model parameter estimates for the surround stimulus. **a.** The inflection point ($C50$), nonlinear transducer (n), and normalization constant (γ) parameter estimates derived from the normalization model. **b.** Goodness of fit for individual observers. Each graph illustrates R^2 values for the model for each center contrast level for simultaneous (left) and sequential (right) conditions for all observers; different colored bars represent the different Center contrasts (dark blue = 10%; light blue = 20%; yellow = 38%; red = 75%). Data points reflect individual observers, error bars represent ±1 s.e.m.