Supplemental Materials

Relating Feature Congestion to Subjective Clutter

Objective clutter estimates from the feature congestion model (Rosenholtz, Li, & Nakano, 2007) differed significantly between the three scene types, $F(2, 58) = 484.04, p < .001$. On average, urban scenes (mean = 5.54) were more congested than both suburban (mean = 5.21, $p < .001$) and rural scenes (mean = 3.29, $p < .001$), and suburban scenes were more congested than rural scenes ($p < .001$). Feature congestion also correlated with city maturation. As each city matured, they tended to become more congested ($R^2 = .42, .52, and .09$; for rural, suburban, and urban scenes, respectively; all $p < .05$). Finally, feature congestion correlated with subjectively perceived clutter for the rural ($R^2 = .53, p < .001$), suburban ($R^2 = .69, p < .001$), and urban ($R^2 = .17, p < .05$) cities. This suggests that estimates from the feature congestion model can reliably predict clutter perception, at least for the moderately cluttered rural and suburban scenes used in this study.

Relating Feature Congestion to Reaction Time

The figure below plots RT as a function of the clutter estimates from the feature congestion model. Similar to edge density, RTs tended to increase with feature congestion (compare to Figure 3b). This was particularly true for the rural ($R^2 = .35, p < .005$) and suburban ($R^2 = .34, p < .005$) cities. For the more densely cluttered urban city the correlation between feature congestion and RT was not significant ($R^2 = .06, p = .2$). To determine whether subjective clutter ratings and estimates from the feature congestion model were capturing different sources of RT variability, we conducted a multiple regression analysis for each scene type, with subjective clutter and feature congestion being predictor variables and RT being the dependent variable. When variability due to feature congestion was partialed out, we still found highly significant correlations between subjective clutter and RT ($R_{\text{partial}} = .52, .53, and .71$ for the rural, suburban, and urban scenes, respectively; all $p < .005$). However, when variability due to subjective clutter was partialed out, these correlations disappeared ($R_{\text{partial}} = .14, -.05$, and -.09 for the rural, suburban, and urban scenes, respectively; all $p > .46$). Variability in search times attributable to feature congestion can be accounted for by subjective clutter, but variability in search times attributable to subjective clutter cannot be accounted for by feature congestion.
Relating Feature Congestion to Scan Path Ratio

The figure below plots scan path ratio as a function of the clutter estimates from the feature congestion model. The results once again are highly similar to those found for edge density (compare to Figure 4b). Although scan path ratios tended to increase with feature congestion, this relationship was weak for both the rural ($R^2 = .18, p < .05$) and suburban ($R^2 = .13, p < .05$) cities. Scan path ratio did not correlate significantly with feature congestion for the more densely cluttered urban city ($R^2 = .08, p = .14$). Multiple regression analyses again showed that removing variability due to feature congestion left the correlations between subjective clutter and scan path ratio largely intact for the rural and urban cities ($R_{\text{partial}} = .39$, and $.67$, respectively; both $p < .05$), and a correlation for the suburban scenes that trended towards significance ($R_{\text{partial}} = .30, p = .11$). However, the converse relationship again failed to hold; removing the factor of subjective clutter resulted in non-significant correlations between feature congestion and scan path ratio ($R_{\text{partial}} = .04, -.03$, and 0 for the rural, suburban, and urban scenes, respectively; all $p > .84$). Feature congestion is a poor predictor of search guidance for the city scenes used in this study.
Feature Congestion and Final Saccade Amplitude

As in the case of edge density, final saccadic amplitude failed to correlate reliably with feature congestion for any scene type (all \( p > .51 \)).

Feature Congestion and Target Verification Time

Again similar to edge density estimates of clutter, feature congestion correlated reliably with target verification time for rural (\( R^2 = .32, p < .005 \)), suburban (\( R^2 = .32, p < .005 \)), and urban (\( R^2 = .50, p < .005 \)) cities. Current objective methods of estimating clutter are reasonably good predictors of the time taken to make a detection decision following the fixation of a target during search.

Conclusion regarding Feature Congestion

Based on the above analyses, and the analyses of edge density reported in the main text, we conclude that the feature congestion model, despite being more complex, is usually no better
than a simple count of edges in predicting the subjective perception of clutter or the effects of clutter on search (see Henderson, Chanceaux, and Smith, 2009, for a similar conclusion).