Distractor heterogeneity as the cause of the linear separability effect.

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Can target-distractor similarity and distractor heterogeneity also predict search performance in heterogeneous search in CIELAB color space?

**Introduction**

The linear separability effect: Visual search performance improves when there exists a linear boundary in feature space that can separate the target feature from the distractor features (D’Zmura, 1991).

Using orientation search, Xu et al. (2021)

- Hypothesized that the increased search difficulty in non-separable condition might be due to the larger distractor heterogeneity in linearly non-separable than separable conditions.
- The results showed that target-distractor similarity and distractor heterogeneity were able to predict 95-98% of the variance in heterogeneous search performance, without including any factor indexing the linear separability rule per se.

**General Question**

Can the Linear Separability effect be explained by distractor heterogeneity?

**Step 1: Extract slopes from homogeneous search**

- Exp1: Homogeneous displays
  - Distractor: green; Distractor: pink
  - Distractor: red
  - Unitary orientation feature space

**Step 2: Use models to predict RT in heterogeneous search based on parameters from homogeneous search**

1. **Distractor Rejection Cost Model**
   \[ RT = a + D_1 \ln(N_1 + N_2) + D_2 \ln(N_1 + N_3 + 1) \]
   All distractors are rejected at their own set size. D1 is associated with set size N1. D2 is associated with set size N2.

2. **Single-Threshold Model**
   \[ RT = a + D_{max} \times \ln(N_1 + N_2 + 1) \]
   All distractors are processed in the same manner (as the distractor that is the most similar to the target, at the rate of Dmax).

3. **Sequential Parallel Rejection Model**
   \[ RT = a + D_1 \ln(N_1 + 1) + D_2 \times \ln(N_1 + N_3 + 1) \]
   Distractors are rejected at their own rates. However, the rejection of distractors is a sequential type, and distractors within one type are rejected in parallel.

**Step 3: Run heterogeneous search conditions**

- Exp2: Linearly non-separable search
  - Green & pink
  - Linearly-separable search: green & red

**Discussion**

1. The Sequential Parallel Rejection Model accounted for the largest proportion of variability in the observed data in both non-separable and separable conditions, suggesting that there is no qualitative difference between the two.
2. There are quantitative differences between non-separable and separable conditions that are captured by the multiplicative factor (slope β of the prediction model).
3. Observers process distractors by subsets (one color first, then the other). Maybe the availability of color labels allows for this strategy which is different than the one observed in orientation dimension.

**References**