Continuous tracking is a new technique in which participants track a randomly moving object. Task performance is measured by cross-correlating the cursor and stimulus movements. We have previously shown that the same technique can be extended to study numerosity perception. Here, this procedure allowed us to investigate if numerosity perception is dependent on density of items and vice versa.

**Experimental Procedure**

Participants observed a cloud of dots of random sizes changing in numerosity, area and density every 200 ms or 800 ms. Changes in density and numerosity were uncorrelated with each other. Each dot had a maximum presentation time of 100ms.

**Results**

Numerosity tracking (left column) was independent of changes in density, both with high (200 ms, panel A) and slow (800 ms, panel B) changes.

However, tracking of density (right column) was strongly dependent on numerosity (panels C and D).

Results from each participant: correlation with density (dark and light green) was small when participants tracked numerosity (dark and light blue bars).

On the contrary, when participants tracked density, correlation with numerosity was high.

**Virtual Observer**

By simulating a virtual observer with a fixed impulse response function that responds to a variable percentage of changes in numerosity and density, we can compare the results from the virtual observer to those from real participants.

1. When asked to track numerosity, real participants behave similarly to a virtual observer responding mostly to changes in numerosity (panel A), both for fast (200ms) and slow (800ms) changes;

2. When asked to track density, participants behave similarly to a virtual observer responding approximately to half to changes in numerosity and half to changes in density (panel C); when changes were slow, participants responded slightly more to changes in density than when changes are rapid (panel D).

**Conclusion**

These results indicate that numerosity is perceived spontaneously, without the need to rely on other perceptual features; on the other hand, density perception is strongly affected by numerosity perception.