The effects of quantity, order, and spatial proximity of elements on subjective complexity judgment

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INTRODUCTION

Visual complexity is multidimensional. Previous studies took some factors of visual complexity, showing inconsistent results. By taking a multidimensional approach, the present study aimed to investigate factors influencing subjective complexity judgments.

Aims of this study:
[1] to identify several features of complexity: quantity, spatial proximity, and order
[2] to examine the processing stage of complexity: presentation durations

METHODS

Participants

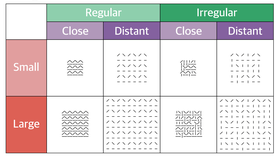
Experiment 1: 62 participants (35 females, 25 males, 2 no responses)
Experiment 2: 37 participants (20 females, 16 males, 1 no response)

Stimuli

Visual arrays of line segments were manipulated with quantity, spatial proximity, and order

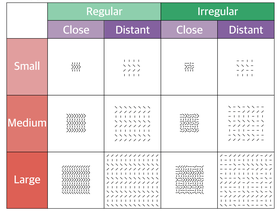
Experiment 1

quantity: small (6x6) / large (10x10)
spatial proximity: close / distant between elements
order: regular (replication of ⌒) / irregular (addition of vertical lines)

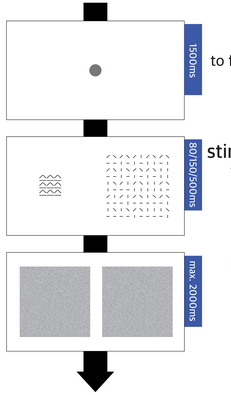


Experiment 2

quantity: small (4x4) / medium (8x8) / large (12x12)
spatial proximity: same with Exp. 1
order: regular (replication of ⌇) / irregular (addition of horizontal lines)



Procedures

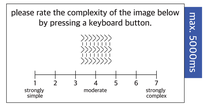


fixation
to fixate on the center dot

stimulus presentation
two different stimuli presented laterally for 80/150/500ms

comparision task
to choose the more 'complex' stimulus (2AFC)

additional procedure in Exp.2



rating task
to report the degree of complexity (7-point Likert scale)

RESULTS

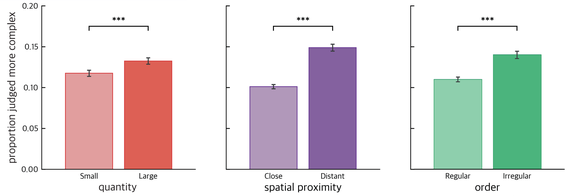
Experiment 1

Presentation Durations

Stimulus presentation durations did not influence subjective complexity judgment.

- No main effects of stimulus durations ($F = 0.102$, $p = 0.903$)

Main Effects of Features



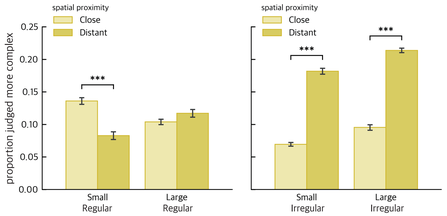
Large, distant, and irregular stimuli were judged more complex more frequently.

quantity ($F = 56.156$, $p < 0.001$)
spatial proximity ($F = 170.870$, $p < 0.001$)
order ($F = 66.831$, $p < 0.001$)

small < large ($t = 7.494$, $p < 0.001$)
close < distant ($t = 8.175$, $p < 0.001$)
regular < irregular ($t = 13.072$, $p < 0.001$)

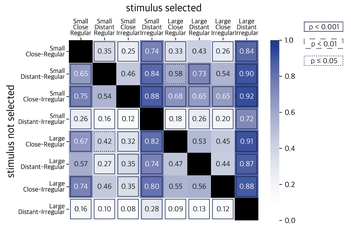
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Interactions across Features



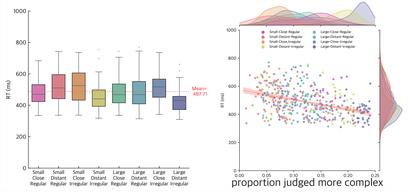
Interplays of the three features had effects on complexity judgments.

- A significant three-way interaction ($F = 42.095$, $p < 0.001$)
- Small-Close-Regular stimulus was judged more complex despite the fact that each individual level was judged less complex.



Tendency of complexity judgement was consistent over paired comparisons.

* Each cell indicates the proportion of stimulus selected (x-axis). compared to stimulus not selected (y-axis).
* Each choice proportion was compared to the chance level (0.5).

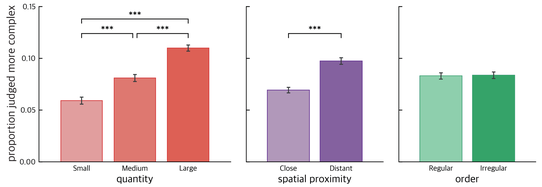


The more frequently the stimulus was chosen as more complex, the faster the response was.

A significant negative correlation between the proportion of subjective complexity judgments and reaction times.
($r = -0.397$, $p < 0.001$)

Experiment 2

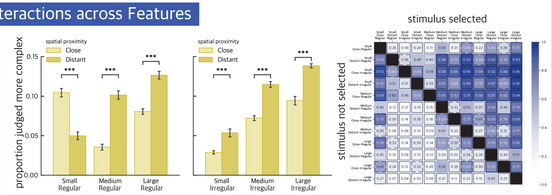
Main Effects of Features



Large and distant stimuli were judged more complex more frequently, but the order did not influence complexity.

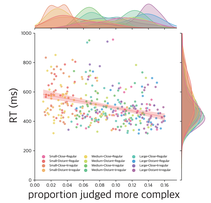
- Significant main effects of quantity and spatial proximity ($p < 0.001$), but no effect of order.

Interactions across Features



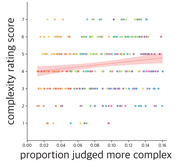
Interplays of the three features had effects on complexity judgments.

- A significant three-way interaction ($F = 103.824$, $p < 0.001$)



Negative correlation between complexity judgments and RT
($r = -0.328$, $p < 0.001$)

2AFC vs. Rating



Positive correlation between binary choice and rating responses ($r = 0.125$, $p = 0.007$)

DISCUSSIONS

- The findings from the two experiments have replicated the effects of both quantity and spatial proximity on complexity judgments.
- Regarding the order, the way regularity is difined may matter in complexity judgments.
- Small-Close-Regular stimulus was often perceived as complex, whereas each individual factor of small, close, and regular was deemed less complex. This result tends to be consistent in both Experiments 1 and 2. This might be related to how the stimulus is perceptually organized.

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