Phantom-Words with simultaneous visual presentation - Results

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Abstract

Abstract (to be written)

1 Predictions

The predictions for the current experiment were unclear. On the one hand, it is plausible that observers might encode entire scenes when they are presented simultaneously. If so, they should not accept phantom-words. On the other hand, statistical learning might operate similarly for simultaneous as for sequential presentation. If so, the results with sequential presentations should be replicated, especially because the shapes appear as distinct individual shapes rather than wholes. Further, presenting the shapes as whole in an object (i.e., in the white on black presentation) might encourage observers to process the combination of shapes as a single hole, leading to the rejection of phantom words.

REMOVED INTERACTION TERM IN GLMM

MAKE SEPARATE TABLES FOR GLMMS

2 Analysis

2.1 Demographics

In the current population, about a third of the sample usually needs to be excluded from analysis due to insufficient attention. Unfortunately, the present experiment does not offer a clear performance-based criterion, as participants might genuinely be unable to perform the task. However, as we are mainly interested in the performance on trials involving phantom-words, and rely on the earlier literature to show that participants can learn statistical relations *in principle*, we exclude those participants not exceeding an accuracy of 50% on word vs. part-word trials. This criterion led to the removal of 23 and 53 participants from the students and testable samples, respectively.

The demographics of the remaining participants is given in Table 1; age and gender were not recorded due to experimenter error.

2.2 Analysis by accuracy

In the analyses, below we will ask three sets of questions.

1. Do participants learn? We compare accuracy and difference scores in all cells to their respective baselines.
2. Is it harder to discriminate between words and phantom-words than between words and part-words?
   - Difference score
   - One-way ANOVA
3. Is it harder to reject part-words with respect to words compared to phantom-words?
   - Difference score
   - One-way ANOVA

Table 1: Demograpics for Experiment 1. Age and gender have not been recorded due to experimenter error

color.type	subjectGroup	N
testable		
black.on.white	11	7
black.on.white	12	4
black.on.white	13	7
black.on.white	14	7
black.on.white	15	5
black.on.white	16	2
black.on.white	17	7
black.on.white	18	5
black.on.white	19	3
black.on.white	20	4
black.on.white	TOTAL	51
white.on.black	1	3
white.on.black	10	5
white.on.black	2	7
white.on.black	3	6
white.on.black	4	6
white.on.black	5	3
white.on.black	6	6
white.on.black	7	5
white.on.black	8	7
white.on.black	9	9
white.on.black	TOTAL	57
students		
black.on.white	11	2
black.on.white	12	3
black.on.white	13	2
black.on.white	14	2
black.on.white	15	1
black.on.white	16	2
black.on.white	19	2
black.on.white	20	1
black.on.white	TOTAL	15
white.on.black	10	1
white.on.black	2	1
white.on.black	3	3
white.on.black	5	2
white.on.black	7	2
white.on.black	8	1
white.on.black	9	2
white.on.black	TOTAL	12

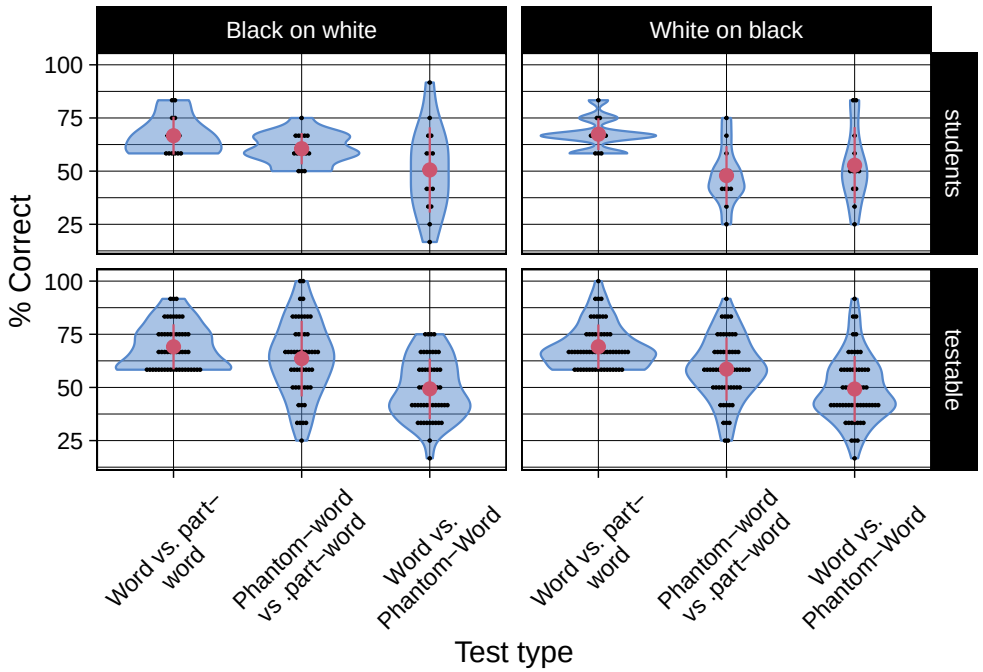
Table 2: Descriptives in the naming experiment. *d* represent difference scores.

	N	*M*	*SE*	*p.wilcoxon*
testable - black.on.white				
w.pw	51	69.118	1.496	0.000
w.phw	51	49.346	2.012	0.985
phw.pw	51	63.562	2.516	0.000
d.relative.w.pw.w.phw	51	0.178	0.021	0.000
d.relative.w.pw.ph.pw	51	0.056	0.021	0.026
d.absolute.w.pw.w.phw	51	19.771	2.309	0.000
d.absolute.w.pw.ph.pw	51	5.556	2.568	0.037
students - black.on.white				
w.pw	15	66.667	2.381	0.001
w.phw	15	50.556	5.355	0.875
phw.pw	15	60.556	1.968	0.002
d.relative.w.pw.w.phw	15	0.165	0.058	0.018
d.relative.w.pw.ph.pw	15	0.047	0.029	0.143
d.absolute.w.pw.w.phw	15	16.111	5.980	0.018
d.absolute.w.pw.ph.pw	15	6.111	3.714	0.111
testable - white.on.black				
w.pw	57	69.152	1.395	0.000
w.phw	57	49.269	2.065	0.905
phw.pw	57	58.626	1.985	0.000
d.relative.w.pw.w.phw	57	0.182	0.021	0.000
d.relative.w.pw.ph.pw	57	0.091	0.021	0.000
d.absolute.w.pw.w.phw	57	19.883	2.332	0.000
d.absolute.w.pw.ph.pw	57	10.526	2.521	0.001
students - white.on.black				
w.pw	12	67.361	2.262	0.002
w.phw	12	52.778	5.392	0.623
phw.pw	12	47.917	4.167	0.765
d.relative.w.pw.w.phw	12	0.141	0.051	0.019
d.relative.w.pw.ph.pw	12	0.180	0.045	0.004
d.absolute.w.pw.w.phw	12	14.583	5.580	0.041
d.absolute.w.pw.ph.pw	12	19.444	4.831	0.006

4. Do any of these effects interact with color.type?

Table 3: Shapiro-Wilk test results for the different cells.

test.type	W	p.value	p<=.05
testable - black.on.white			
w.pw	0.855	0.000	***
w.phw	0.946	0.021	*
phw.pw	0.971	0.251	
d.relative.w.pw.w.phw	0.979	0.512	
d.relative.w.pw.ph.pw	0.965	0.135	
d.absolute.w.pw.w.phw	0.967	0.168	
d.absolute.w.pw.ph.pw	0.967	0.159	
students - black.on.white			
w.pw	0.826	0.008	**
w.phw	0.979	0.963	
phw.pw	0.888	0.063	.
d.relative.w.pw.w.phw	0.939	0.365	
d.relative.w.pw.ph.pw	0.913	0.151	
d.absolute.w.pw.w.phw	0.924	0.221	
d.absolute.w.pw.ph.pw	0.910	0.136	
testable - white.on.black			
w.pw	0.854	0.000	***
w.phw	0.952	0.025	*
phw.pw	0.966	0.114	
d.relative.w.pw.w.phw	0.979	0.405	
d.relative.w.pw.ph.pw	0.884	0.000	***
d.absolute.w.pw.w.phw	0.956	0.035	*
d.absolute.w.pw.ph.pw	0.894	0.000	***
students - white.on.black			
w.pw	0.865	0.056	.
w.phw	0.926	0.338	
phw.pw	0.952	0.663	
d.relative.w.pw.w.phw	0.972	0.933	
d.relative.w.pw.ph.pw	0.914	0.237	
d.absolute.w.pw.w.phw	0.948	0.603	
d.absolute.w.pw.ph.pw	0.872	0.069	.



2.2.1 Acurracy by difference scores

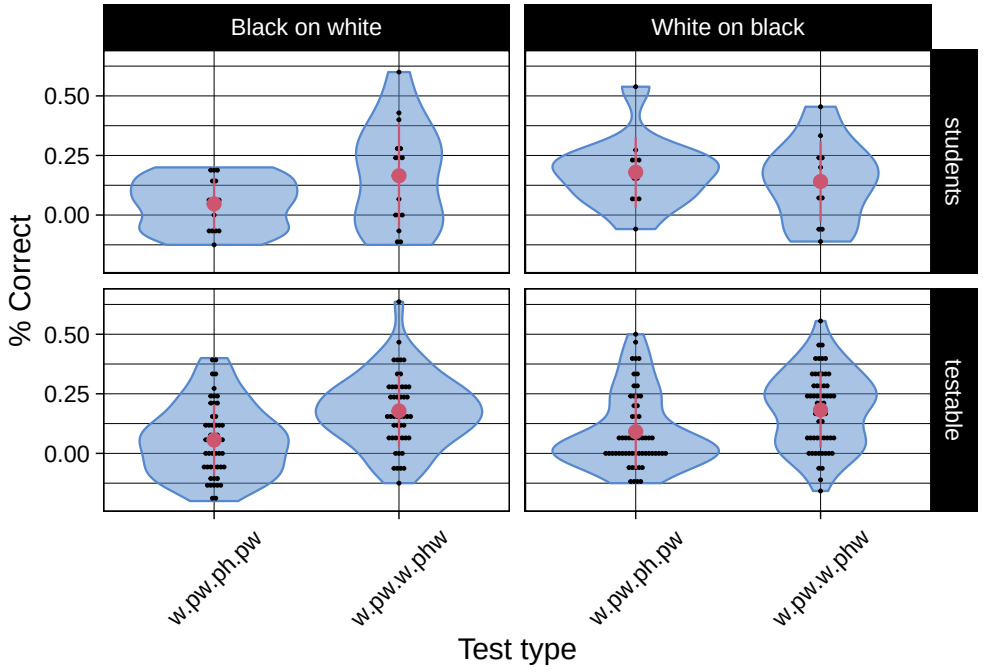


Table 4: ANOVA for accuracy scores in the naming experiment

Effect	DFn	DFd	SSn	SSd	F	p	p<.05	ges
students - Black on white - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.type	1	14	2.80e+02	1352	2.901	0.111		0.130
testable - Black on white - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.type	1	50	7.87e+02	8241	4.775	0.034	*	0.035
students - Black on white - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.type	1	14	1.95e+03	3505	7.777	0.014	*	0.224
testable - Black on white - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.type	1	50	9.97e+03	6664	74.791	0.000	*	0.388
students - White on black - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.type	1	11	2.27e+03	1412	17.672	0.001	*	0.455
testable - White on black - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.type	1	56	3.16e+03	9967	17.743	0.000	*	0.146
students - White on black - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.type	1	11	1.28e+03	1884	7.452	0.020	*	0.236
testable - White on black - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.type	1	56	1.13e+04	8525	74.016	0.000	*	0.366
students - Both - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
color.type	1	25	4.76e+02	1826	6.510	0.017	*	0.094
test.type	1	25	2.18e+03	2764	19.691	0.000	*	0.322
color.type:test.type	1	25	5.93e+02	2764	5.360	0.029	*	0.114
testable - Both - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
color.type	1	106	3.23e+02	21679	1.581	0.211		0.008
test.type	1	106	3.48e+03	18208	20.263	0.000	*	0.080
color.type:test.type	1	106	3.33e+02	18208	1.936	0.167		0.008
students - Both - Word vs. Part-Words vs. Words vs. Phantom-Words								
color.type	1	25	2.84e+01	5481	0.129	0.722		0.003
test.type	1	25	3.14e+03	5388	14.571	0.001	*	0.224
color.type:test.type	1	25	7.78e+00	5388	0.036	0.851		0.001
testable - Both - Word vs. Part-Words vs. Words vs. Phantom-Words								
color.type	1	106	2.50e-02	20004	0.000	0.991		0.000
test.type	1	106	2.12e+04	15189	147.693	0.000	*	0.376
color.type:test.type	1	106	1.68e-01	15189	0.001	0.973		0.000

Table 5: Binary mixed model results

	Log-odds			Odd ratios				
term	Estimate	SE	CI	Estimate	SE	CI	t	p
testable - Black on white - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.254	0.122	[0.0138, 0.493]	1.289	0.158	[1.01, 1.64]	2.073	0.038
students - Black on white - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.264	0.220	[-0.166, 0.695]	1.303	0.286	[0.847, 2]	1.204	0.229
testable - Black on white - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.832	0.119	[0.598, 1.07]	2.297	0.274	[1.82, 2.9]	6.982	0.000
students - Black on white - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.674	0.218	[0.246, 1.1]	1.961	0.428	[1.28, 3.01]	3.089	0.002
testable - White on black - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.459	0.113	[0.236, 0.681]	1.582	0.180	[1.27, 1.98]	4.042	0.000
students - White on black - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.808	0.244	[0.33, 1.29]	2.243	0.547	[1.39, 3.62]	3.315	0.001
testable - White on black - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.836	0.113	[0.616, 1.06]	2.308	0.260	[1.85, 2.88]	7.422	0.000
students - White on black - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.613	0.244	[0.135, 1.09]	1.847	0.450	[1.15, 2.98]	2.516	0.012
testable - Both - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.250	0.121	[0.0119, 0.488]	1.284	0.156	[1.01, 1.63]	2.058	0.040
test.typephw.pw:color.typewhite.on.black	-0.209	0.117	[-0.437, 0.02]	0.812	0.095	[0.646, 1.02]	-1.788	0.074
test.typew.pw:color.typewhite.on.black	0.002	0.123	[-0.239, 0.242]	1.002	0.123	[0.788, 1.27]	0.012	0.990
students - Both - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.264	0.220	[-0.166, 0.695]	1.303	0.286	[0.847, 2]	1.204	0.229
test.typephw.pw:color.typewhite.on.black	-0.512	0.226	[-0.955, -0.0691]	0.599	0.135	[0.385, 0.933]	-2.265	0.023
test.typew.pw:color.typewhite.on.black	0.031	0.238	[-0.435, 0.498]	1.032	0.245	[0.647, 1.64]	0.132	0.895
testable - Both - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.832	0.119	[0.598, 1.07]	2.297	0.274	[1.82, 2.9]	6.982	0.000
test.typew.phw:color.typewhite.on.black	-0.003	0.111	[-0.221, 0.215]	0.997	0.111	[0.802, 1.24]	-0.028	0.978
test.typew.pw:color.typewhite.on.black	0.002	0.120	[-0.234, 0.238]	1.002	0.121	[0.791, 1.27]	0.013	0.989
students - Both - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.672	0.218	[0.245, 1.1]	1.958	0.426	[1.28, 3]	3.088	0.002
test.typew.phw:color.typewhite.on.black	0.089	0.226	[-0.354, 0.532]	1.093	0.247	[0.702, 1.7]	0.394	0.693
test.typew.pw:color.typewhite.on.black	0.031	0.240	[-0.439, 0.502]	1.032	0.248	[0.645, 1.65]	0.131	0.896