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	10
black.on.white	12	6
black.on.white	13	8
black.on.white	14	8
black.on.white	15	8
black.on.white	16	6
black.on.white	17	9
black.on.white	18	8
black.on.white	19	8
black.on.white	20	8
black.on.white	TOTAL	79
white.on.black	1	6
white.on.black	10	8
white.on.black	2	8
white.on.black	3	8
white.on.black	4	8
white.on.black	5	8
white.on.black	6	9
white.on.black	7	8
white.on.black	8	10
white.on.black	9	9
white.on.black	TOTAL	82
students		
black.on.white	11	3
black.on.white	12	4
black.on.white	13	3
black.on.white	14	3
black.on.white	15	2
black.on.white	16	3
black.on.white	17	2
black.on.white	18	2
black.on.white	19	3
black.on.white	20	2
black.on.white	TOTAL	27
white.on.black	1	2
white.on.black	10	2
white.on.black	2	2
white.on.black	3	3
white.on.black	4	2
white.on.black	5	2
white.on.black	6	2
white.on.black	7	3
white.on.black	8	2
white.on.black	9	3
white.on.black	TOTAL	23

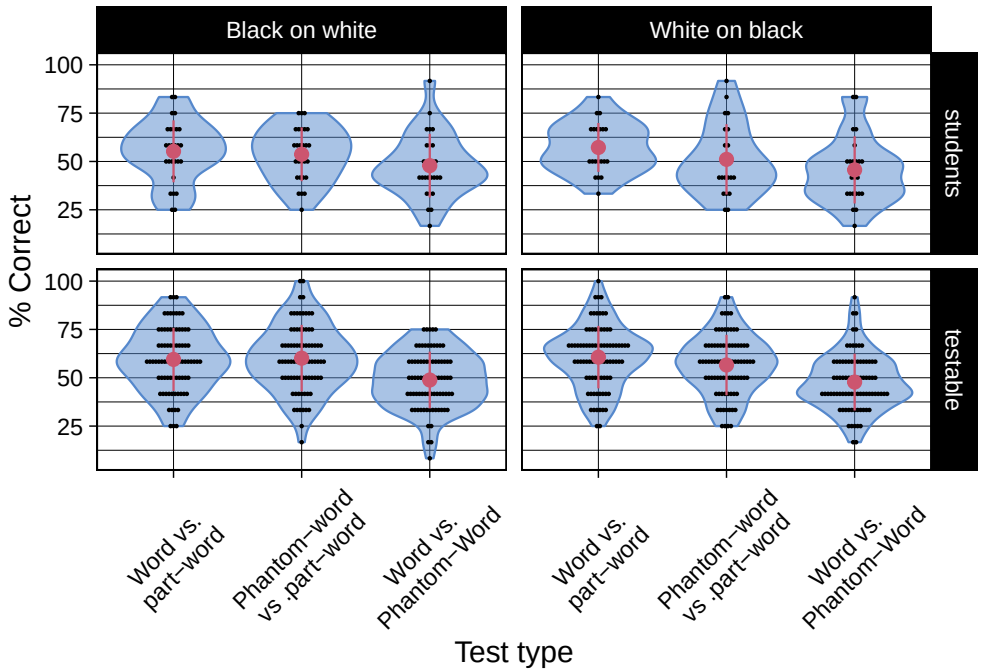
Table 2: Descriptives in the naming experiment. *d* represent difference scores.

	N	*M*	*SE*	*p.wilcoxon*
testable - black.on.white				
w.pw	79	59.494	1.849	0.000
w.phw	79	48.840	1.660	0.869
phw.pw	79	60.127	1.951	0.000
d.relative.w.pw.w.phw	79	0.101	0.023	0.000
d.relative.w.pw.ph.pw	79	-0.003	0.021	0.701
d.absolute.w.pw.w.phw	79	10.654	2.306	0.000
d.absolute.w.pw.ph.pw	79	-0.633	2.250	0.904
students - black.on.white				
w.pw	27	55.247	3.145	0.196
w.phw	27	47.840	3.224	0.601
phw.pw	27	53.704	2.732	0.146
d.relative.w.pw.w.phw	27	0.072	0.045	0.135
d.relative.w.pw.ph.pw	27	0.009	0.032	0.716
d.absolute.w.pw.w.phw	27	7.407	4.212	0.088
d.absolute.w.pw.ph.pw	27	1.543	3.301	0.466
testable - white.on.black				
w.pw	82	60.671	1.795	0.000
w.phw	82	47.764	1.633	0.495
phw.pw	82	56.606	1.738	0.000
d.relative.w.pw.w.phw	82	0.120	0.022	0.000
d.relative.w.pw.ph.pw	82	0.034	0.019	0.147
d.absolute.w.pw.w.phw	82	12.907	2.250	0.000
d.absolute.w.pw.ph.pw	82	4.065	2.213	0.250
students - white.on.black				
w.pw	23	57.246	2.695	0.012
w.phw	23	45.652	3.706	0.182
phw.pw	23	51.087	3.874	0.793
d.relative.w.pw.w.phw	23	0.131	0.039	0.004
d.relative.w.pw.ph.pw	23	0.071	0.043	0.130
d.absolute.w.pw.w.phw	23	11.594	3.662	0.009
d.absolute.w.pw.ph.pw	23	6.159	4.828	0.254

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	0.967	0.038	*
w.phw	0.959	0.013	*
phw.pw	0.977	0.166	
d.relative.w.pw.w.phw	0.991	0.870	
d.relative.w.pw.ph.pw	0.987	0.612	
d.absolute.w.pw.w.phw	0.974	0.103	
d.absolute.w.pw.ph.pw	0.974	0.104	
students - black.on.white			
w.pw	0.952	0.241	
w.phw	0.957	0.314	
phw.pw	0.949	0.200	
d.relative.w.pw.w.phw	0.967	0.515	
d.relative.w.pw.ph.pw	0.977	0.778	
d.absolute.w.pw.w.phw	0.928	0.062	.
d.absolute.w.pw.ph.pw	0.939	0.116	
testable - white.on.black			
w.pw	0.968	0.039	*
w.phw	0.957	0.008	**
phw.pw	0.967	0.033	*
d.relative.w.pw.w.phw	0.985	0.476	
d.relative.w.pw.ph.pw	0.944	0.001	**
d.absolute.w.pw.w.phw	0.966	0.029	*
d.absolute.w.pw.ph.pw	0.933	0.000	***
students - white.on.black			
w.pw	0.949	0.280	
w.phw	0.929	0.103	
phw.pw	0.937	0.154	
d.relative.w.pw.w.phw	0.980	0.901	
d.relative.w.pw.ph.pw	0.978	0.878	
d.absolute.w.pw.w.phw	0.948	0.263	
d.absolute.w.pw.ph.pw	0.949	0.280	



2.2.1 Acurracy by difference scores

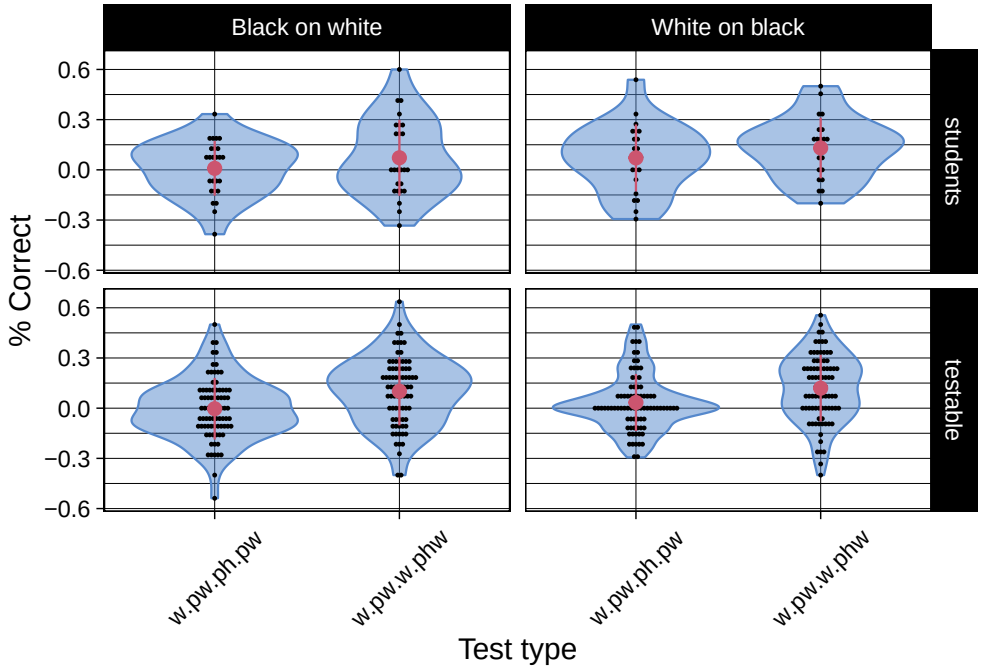


Table 4: ANOVA for accuracy scores in the naming experiment

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	26	3.21e+01	3683	0.227	0.638		0.003
testable - Black on white - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.type	1	78	1.58e+01	15401	0.080	0.778		0.000
students - Black on white - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.type	1	26	7.41e+02	5995	3.212	0.085		0.051
testable - Black on white - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.type	1	78	4.48e+03	16176	21.619	0.000	*	0.107
students - White on black - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.type	1	22	4.36e+02	5640	1.702	0.206		0.039
testable - White on black - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.type	1	81	6.78e+02	16059	3.417	0.068		0.016
students - White on black - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.type	1	22	1.55e+03	3246	10.478	0.004	*	0.132
testable - White on black - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.type	1	81	6.83e+03	16608	33.310	0.000	*	0.150
students - Both - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
color.type	1	48	2.37e+00	13189	0.009	0.926		0.000
test.type	1	48	3.68e+02	9323	1.897	0.175		0.016
color.type:test.type	1	48	1.32e+02	9323	0.681	0.413		0.006
testable - Both - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
color.type	1	159	1.11e+02	53460	0.329	0.567		0.001
test.type	1	159	2.37e+02	31459	1.198	0.275		0.003
color.type:test.type	1	159	4.44e+02	31459	2.244	0.136		0.005
students - Both - Word vs. Part-Words vs. Words vs. Phantom-Words								
color.type	1	48	2.19e-01	14636	0.001	0.979		0.000
test.type	1	48	2.24e+03	9241	11.646	0.001	*	0.086
color.type:test.type	1	48	1.09e+02	9241	0.565	0.456		0.005
testable - Both - Word vs. Part-Words vs. Words vs. Phantom-Words								
color.type	1	159	2.08e-01	43437	0.001	0.978		0.000
test.type	1	159	1.12e+04	32784	54.161	0.000	*	0.128
color.type:test.type	1	159	1.02e+02	32784	0.495	0.483		0.001

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	-0.027	0.095	[-0.214, 0.16]	0.973	0.093	[0.807, 1.17]	-0.286	0.775
students - Black on white - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.063	0.159	[-0.249, 0.376]	1.065	0.170	[0.78, 1.46]	0.398	0.690
testable - Black on white - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.437	0.093	[0.254, 0.62]	1.548	0.145	[1.29, 1.86]	4.675	0.000
students - Black on white - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.302	0.159	[-0.00958, 0.614]	1.353	0.215	[0.99, 1.85]	1.900	0.057
testable - White on black - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.171	0.093	[-0.0101, 0.353]	1.187	0.110	[0.99, 1.42]	1.851	0.064
students - White on black - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.249	0.172	[-0.0869, 0.585]	1.283	0.220	[0.917, 1.8]	1.454	0.146
testable - White on black - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.530	0.092	[0.35, 0.711]	1.700	0.156	[1.42, 2.04]	5.763	0.000
students - White on black - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.476	0.173	[0.136, 0.816]	1.609	0.279	[1.15, 2.26]	2.744	0.006
testable - Both - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	-0.027	0.095	[-0.213, 0.159]	0.973	0.092	[0.808, 1.17]	-0.285	0.775
color.typewhite.on.black	-0.151	0.109	[-0.364, 0.0624]	0.860	0.093	[0.695, 1.06]	-1.385	0.166
test.typew.pw:color.typewhite.on.black	0.200	0.133	[-0.0609, 0.46]	1.221	0.162	[0.941, 1.58]	1.502	0.133
students - Both - Word vs. Part-Words vs. Phantom-Words vs. Part-Words								
test.typew.pw	0.063	0.159	[-0.248, 0.374]	1.065	0.169	[0.78, 1.45]	0.397	0.691
color.typewhite.on.black	-0.106	0.176	[-0.452, 0.239]	0.899	0.159	[0.636, 1.27]	-0.602	0.547
test.typew.pw:color.typewhite.on.black	0.188	0.234	[-0.271, 0.647]	1.207	0.283	[0.763, 1.91]	0.804	0.421
testable - Both - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.437	0.093	[0.254, 0.62]	1.548	0.145	[1.29, 1.86]	4.677	0.000
color.typewhite.on.black	-0.044	0.099	[-0.238, 0.151]	0.957	0.095	[0.788, 1.16]	-0.440	0.660
test.typew.pw:color.typewhite.on.black	0.093	0.131	[-0.163, 0.35]	1.098	0.144	[0.849, 1.42]	0.713	0.476
students - Both - Word vs. Part-Words vs. Words vs. Phantom-Words								
test.typew.pw	0.303	0.159	[-0.00928, 0.614]	1.353	0.215	[0.991, 1.85]	1.902	0.057
color.typewhite.on.black	-0.090	0.183	[-0.448, 0.269]	0.914	0.167	[0.639, 1.31]	-0.489	0.624
test.typew.pw:color.typewhite.on.black	0.172	0.235	[-0.288, 0.633]	1.188	0.279	[0.749, 1.88]	0.733	0.463