

Supplementary Information for

**Flexible Usage of Object and Global Scene Information During Human
Scene Categorization**

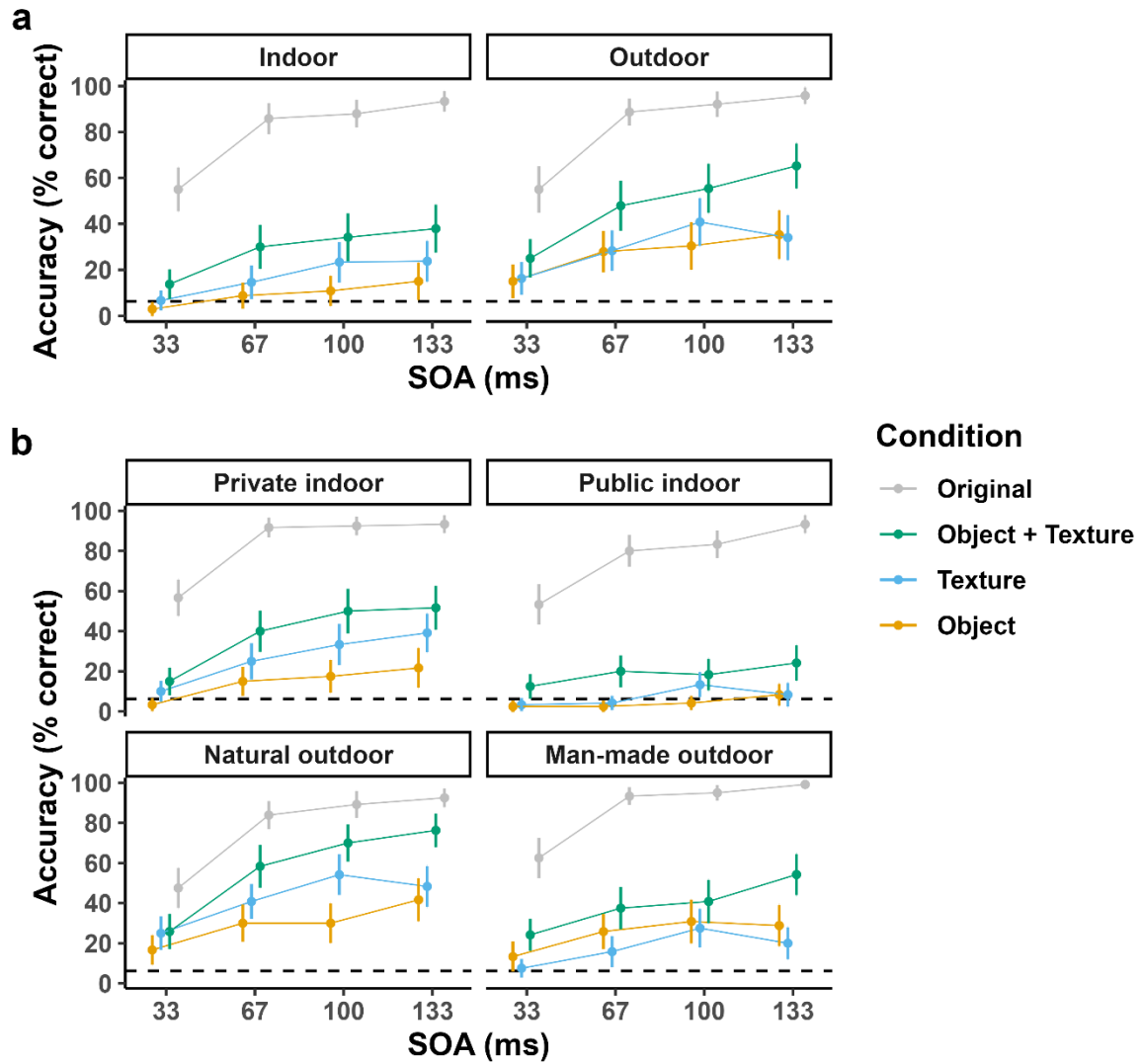
Sandro L. Wiesmann and Melissa L.-H. Vö

Department of Psychology, Johann Wolfgang Goethe-Universität, Frankfurt, Germany

Correspondence concerning this article should be addressed to Sandro L. Wiesmann,
Department of Psychology, Goethe University Frankfurt, Theodor-W.-Adorno-Platz 6, 60323
Frankfurt am Main, Germany. Email: wiesmann@psych.uni-frankfurt.de

Supplementary Figure S1

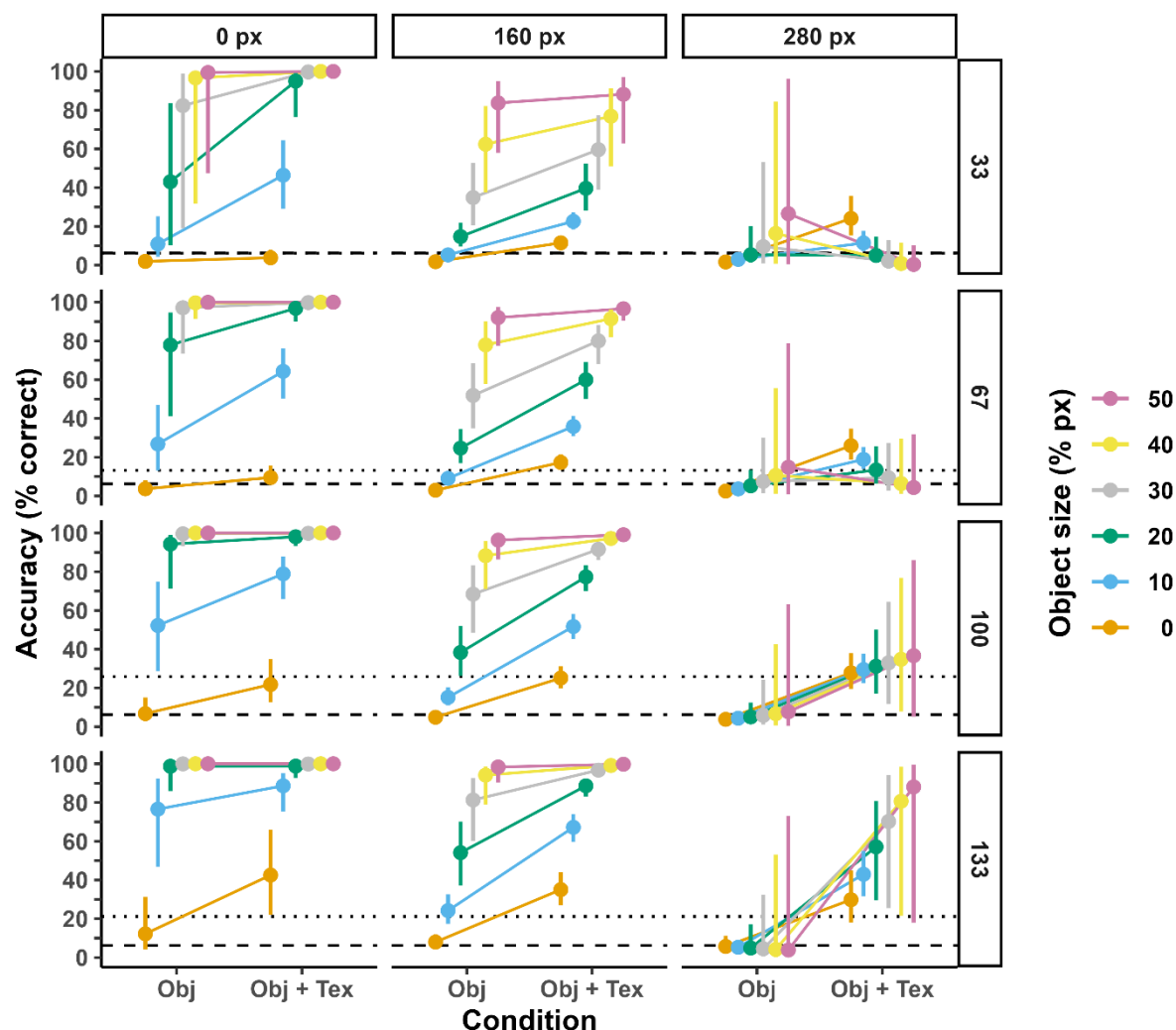
Observed Basic-Level Categorization Accuracy in Experiment 1 as a Function of Stimulus Condition and SOA for (a) Indoor and Outdoor Scenes and (b) Private Indoor, Public Indoor, Natural Outdoor and Man-Made Outdoor Scenes.



Note. Error bars represent standard errors of the mean. Dashed lines represent the chance level in the basic-level categorization task (6.25%).

Supplementary Figure S2

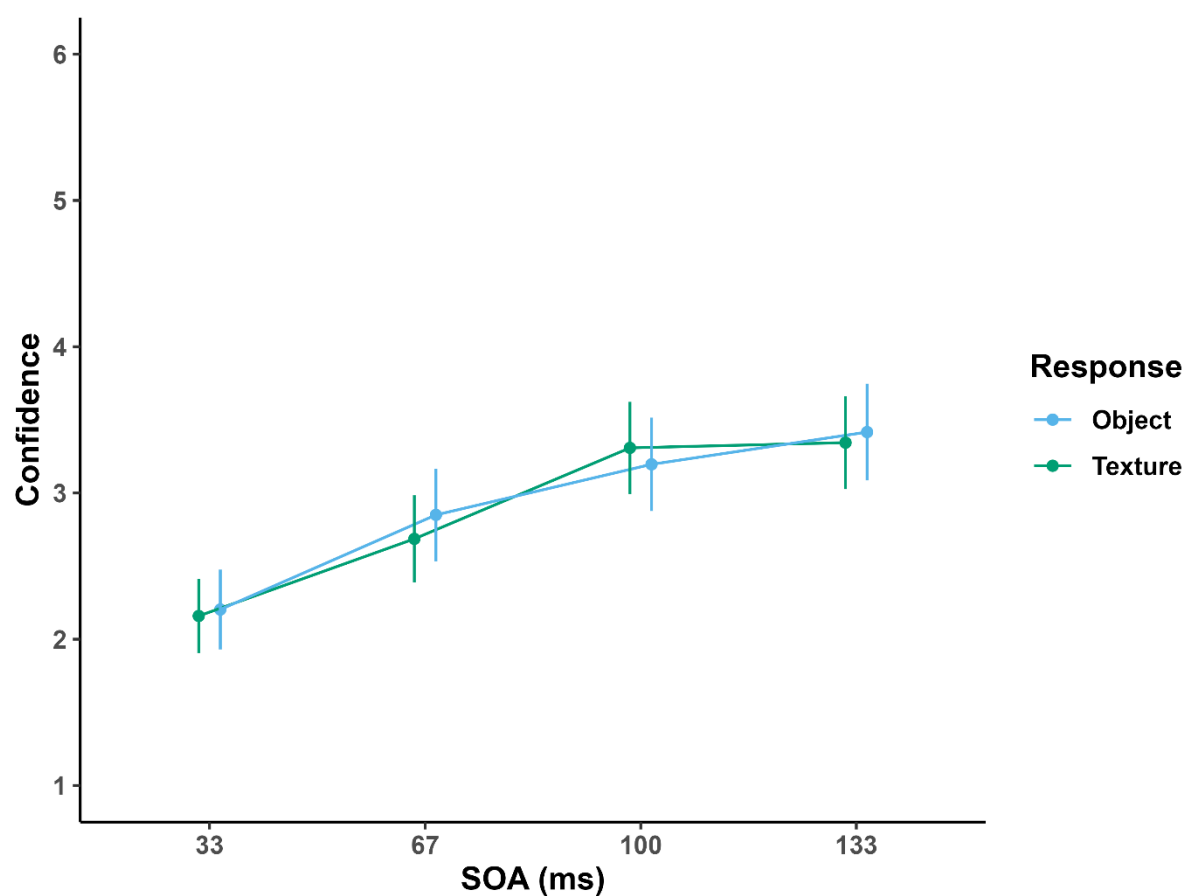
Predicted basic-level scene categorization accuracy for stimuli containing objects in Experiment 1 as a function of stimulus condition, object size, eccentricity (columns), and SOA (rows).



Note. The three selected levels of eccentricity (0, 160 and 280 px) represent the approximate minimum, mean and maximum in the stimulus set, respectively. The object sizes 0% and 50% represent the rounded minimums and maximums in the stimulus set, respectively. Error bars represent standard errors of the mean. Dashed lines represent the chance level in the basic-level categorization task (6.25%). The dotted lines represent the respective average predicted basic-level categorization accuracy for textures at each SOA (line at the 33 ms SOA overlaps with the chance line). Obj = Object, Obj + Tex = Object + Texture.

Supplementary Figure S3

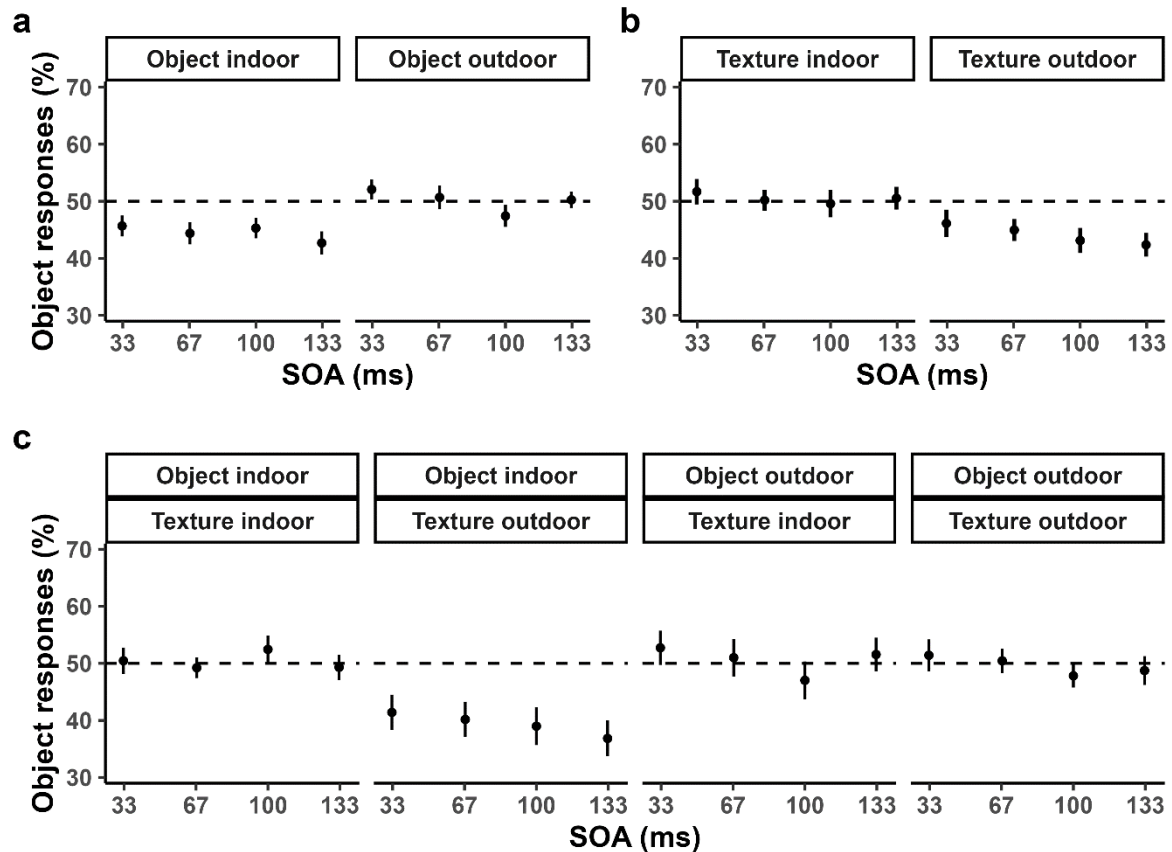
Mean confidence ratings following object and texture responses at different SOAs in Experiment 2.



Note. Texture and object response refer to the scene category selected in the 2AFC scene categorization task on stimuli containing object information from one scene (e.g., a car from a city scene) and an inconsistent global scene information texture from a scene from another category (e.g., a restaurant). In this case, categorizing the stimulus as a city would be considered an object response and categorizing it as a restaurant would be considered a texture response. Error bars represent standard errors of the mean.

Supplementary Figure S4

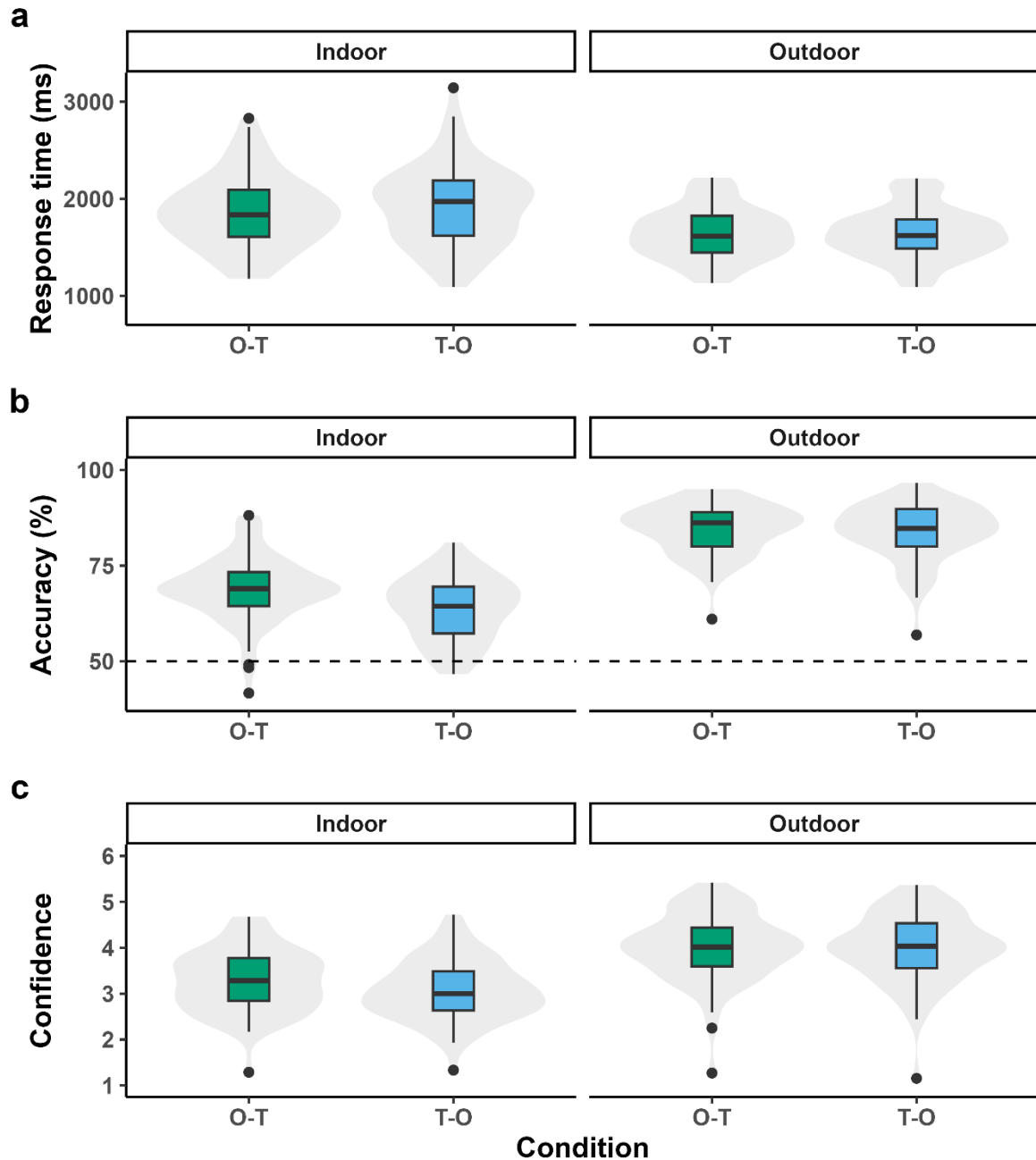
Observed Proportion of Trials in Which Participants Chose the Scene Category of the Presented Object as a Function of SOA and (a) the Superordinate-Level Category of the Object, (b) the Superordinate-Level Category of the Texture and (c) the Superordinate-Level Category of the Object and the Texture.



Note. The percentage of object responses refers to the proportion of trials in which participants chose the category of the scene the object was cut out from in the 2AFC scene categorization task. Notice that object and texture were always from two different basic-level categories, so even if both were indoor or outdoor, they conveyed different semantic meaning at the basic categorization level. Error bars represent standard errors of the mean.

Supplementary Figure S5

Observed (a) Response Time, (b) Basic-Level Categorization Accuracy and (c) Confidence Ratings for Object-Texture and Texture-Object Stimulus Sequences in Experiment 3 for Indoor and Outdoor Scenes.



Note. Single dots are data points more than 1.5 inter-quartile ranges from the first or third quartile, respectively. The dashed lines in (b) represent the chance level for the basic-level categorization task (50%). O-T = object-texture stimulus sequence, T-O = texture-object stimulus sequence.

Supplementary Table S1

Average Properties of Objects Used as Stimuli in the Experiments.

Category	Size (% px)	Eccentricity (px)	Unique objects	Diagnosticity rating	Accuracy (% correct)	Most diagnostic object
Indoor	6.6	167.0	67	4.36	71.1	
Bathroom	5.2	174.9	11	4.66	75.5	Basin
Bedroom	13.8	195.3	8	3.88	56.9	Bed
Kitchen	6.3	178.1	10	4.42	74.4	Oven, stove
Living room	6.6	170.4	9	3.93	71.0	Sofa
Classroom	5.8	159.8	6	4.52	73.9	Blackboard
Office	3.5	123.0	11	4.47	76.3	Computer
Restaurant	4.0	185.1	8	4.14	65.3	Table
Store	7.4	149.2	9	4.82	75.7	Shelf, chiller cabinet
Outdoor	9.2	151.5	40	4.74	75.6	
Beach	8.8	152.3	6	5.16	83.1	Beach chair, sunshade
Desert	11.5	140.2	6	4.19	59.2	Cactus
Forest	9.1	148.0	5	4.40	80.0	Tree
Mountain	19.0	165.0	2	5.74	94.4	Mountain
City	6.6	154.0	9	4.20	67.3	Streetlight
Highway	3.9	166.7	6	4.61	78.1	Sign
Playground	8.3	124.1	8	5.01	81.3	Slide
Train station	6.1	162.0	9	4.61	61.6	Train, rails

Note. Diagnosticity ratings, basic-level categorization accuracy and most diagnostic objects (i.e., highest scene categorization accuracy) based on data from Wiesmann & Vo (2023) Experiment 1. Multiple objects are named for ties.

Supplementary Table S2*Test of estimated basic-level categorization accuracy against chance in Experiment 1.*

SOA (ms)	Condition	Accuracy	SE	<i>z</i>	<i>p</i>
33	Obj	.04	.39	-1.09	.276
	Tex	.06	.35	-0.04	.971
	Tex+Obj	.15	.22	4.29	<.001
	Original	.57	.24	12.49	<.001
67	Obj	.12	.32	2.15	.031
	Tex	.13	.37	2.21	.027
	Tex+Obj	.35	.28	7.48	<.001
	Original	.93	.33	16.10	<.001
100	Obj	.13	.35	2.36	.018
	Tex	.26	.31	5.40	<.001
	Tex+Obj	.43	.30	8.13	<.001
	Original	.94	.31	17.55	<.001
133	Obj	.19	.28	4.48	<.001
	Tex	.21	.34	4.08	<.001
	Tex+Obj	.52	.33	8.50	<.001
	Original	.98	.47	13.80	<.001

Note. The theoretical chance level at the basic categorization level was 6.25%. We attempted to fit a model testing estimated superordinate-level categorization accuracy against chance, but the model structure was not supported by the data and the model failed to converge. Obj = Object, Tex = Texture.

Supplementary Table S3

Pairwise comparisons of categorization accuracies and confidence ratings in the different stimulus conditions in Experiment 1.

SOA (ms)	Contrast	Superordinate level				Basic level				Confidence			
		Estimate	SE	z	p	Estimate	SE	z	p	Estimate	SE	z	p
33	Tex – Obj	0.34	0.22	1.51	.393	0.41	0.42	0.98	.988	0.37	0.20	1.86	.070
	Tex+Obj – Obj	0.63	0.23	2.74	.068	1.38	0.33	4.21	<.001	1.05	0.18	5.69	<.001
	Original – Obj	2.08	0.37	5.64	<.001	3.43	0.42	8.26	<.001	3.04	0.28	10.75	<.001
	Tex+Obj – Tex	0.29	0.22	1.36	.393	0.97	0.34	2.88	.020	0.69	0.17	3.93	<.001
	Original – Tex	1.74	0.34	5.14	<.001	3.02	0.40	7.51	<.001	2.67	0.27	9.92	<.001
	Original – Tex+Obj	1.45	0.33	4.38	<.001	2.06	0.26	7.86	<.001	1.98	0.22	8.96	<.001
67	Tex – Obj	0.53	0.23	2.27	.186	0.12	0.34	0.36	1.000	0.42	0.18	2.31	.063
	Tex+Obj – Obj	1.01	0.29	3.44	.010	1.38	0.31	4.43	<.001	1.32	0.18	7.21	<.001
	Original – Obj	7.18	2.47	2.90	.048	4.59	0.41	11.27	<.001	4.19	0.27	15.49	<.001
	Tex+Obj – Tex	0.48	0.23	2.11	.246	1.25	0.26	4.73	<.001	0.89	0.14	6.24	<.001
	Original – Tex	6.65	2.47	2.69	.071	4.46	0.41	10.82	<.001	3.77	0.26	14.61	<.001
	Original – Tex+Obj	6.17	2.48	2.48	.117	3.21	0.34	9.45	<.001	2.88	0.24	12.13	<.001
100	Tex – Obj	1.19	0.29	4.07	.001	0.84	0.34	2.44	.059	0.69	0.22	3.09	.008
	Tex+Obj – Obj	1.42	0.30	4.69	<.001	1.63	0.31	5.30	<.001	1.38	0.19	7.19	<.001
	Original – Obj	6.44	1.79	3.59	.006	4.65	0.35	13.17	<.001	4.14	0.25	16.73	<.001
	Tex+Obj – Tex	0.23	0.30	0.77	.441	0.78	0.19	4.22	<.001	0.69	0.15	4.59	<.001
	Original – Tex	5.25	1.79	2.93	.047	3.81	0.42	8.98	<.001	3.45	0.29	11.88	<.001
	Original – Tex+Obj	5.02	1.76	2.85	.053	3.02	0.40	7.52	<.001	2.76	0.25	10.90	<.001
133	Tex – Obj	1.06	0.33	3.24	.019	0.12	0.30	0.39	1.000	0.50	0.24	2.11	.070
	Tex+Obj – Obj	2.37	0.42	5.69	<.001	1.51	0.25	6.16	<.001	1.49	0.22	6.92	<.001
	Original – Obj	37.44	18.47	2.03	.256	5.21	0.52	10.11	<.001	4.51	0.27	16.45	<.001
	Tex+Obj – Tex	1.31	0.44	2.98	.043	1.39	0.22	6.44	<.001	0.99	0.17	5.69	<.001
	Original – Tex	36.38	18.47	1.97	.256	5.09	0.61	8.35	<.001	4.01	0.30	13.50	<.001
	Original – Tex+Obj	35.07	18.49	1.90	.256	3.70	0.57	6.47	<.001	3.02	0.26	11.56	<.001

Note. All *p* values are corrected using the Holm-Bonferroni correction to keep the family-wise error rate at $\alpha = .05$.

Supplementary Table S4

Test of the estimated proportion of object responses against chance across SOAs in Experiment 2.

SOA	Proportion of object responses	SE	<i>z</i>	<i>p</i>
33 ms	.489	0.065	-0.67	.502
67 ms	.465	0.076	-1.83	.067
100 ms	.455	0.076	-2.35	.019
133 ms	.472	0.092	-1.23	.220

Note. The theoretical chance level was 50%.

Supplementary Table S5

Models assessing the effect of SOA and the covariates object size and eccentricity on the proportion of object responses in Experiment 2.

Predictors	M1					M2					M3			
	Logit	CI	z	p		Logit	CI	z	p		Logit	CI	z	p
(Intercept)	-0.12	-0.22 – -0.01	-2.14	.032		-0.11	-0.20 – -0.01	-2.15	.031		-0.06	-0.17 – -0.04	-1.18	.238
SOA	-0.03	-0.10 – 0.03	-1.02	.308		-0.04	-0.10 – 0.02	-1.27	.203		-0.02	-0.09 – 0.05	-0.67	.504
Object size						0.38	0.26 – 0.50	6.13	<.001		0.48	0.34 – 0.62	6.67	<.001
Eccentricity						-0.14	-0.23 – -0.05	-3.09	.002		-0.26	-0.37 – -0.15	-4.70	<.001
Object size * Eccentricity											-0.22	-0.41 – -0.03	-2.27	.023
Object size * SOA											0.14	0.04 – 0.24	2.74	.006
Eccentricity * SOA											-0.16	-0.24 – -0.09	-4.20	<.001
Object size * Eccentricity * SOA											-0.13	-0.29 – 0.02	-1.72	.085

Note. All predictors in these analyses were standardized. The nonsignificant effect of SOA in these models is therefore estimated for an object with average size and eccentricity. As can be seen in Figure 4c and the interactions between object size or eccentricity with SOA, the effect of SOA varied significantly for objects of different sizes and eccentricities (for the distribution of these properties see Figure 4b).

Supplementary Table S6

Models assessing the effect of SOA and the covariates object size and eccentricity on the proportion of object responses only for trials with confidence ratings > 1 in Experiment 2.

Predictors	M1					M2				M3			
	Logit	CI	<i>z</i>	<i>p</i>		Logit	CI	<i>z</i>	<i>p</i>	Logit	CI	<i>z</i>	<i>p</i>
(Intercept)	-0.15	-0.29 – -0.01	-2.17	.030		-0.12	-0.24 – 0.00	-1.96	.050	-0.06	-0.20 – 0.07	-0.89	.374
SOA	-0.05	-0.13 – 0.03	-1.19	.234		-0.05	-0.13 – 0.03	-1.21	.227	-0.06	-0.15 – 0.04	-1.15	.249
Object size						0.60	0.43 – 0.76	7.18	<.001	0.68	0.49 – 0.86	7.01	<.001
Eccentricity						-0.23	-0.33 – -0.13	-4.57	<.001	-0.40	-0.53 – -0.26	-5.83	<.001
Object size * Eccentricity										-0.33	-0.59 – -0.08	-2.55	.011
Object size * SOA										0.09	-0.05 – 0.23	1.29	.196
Eccentricity * SOA										-0.16	-0.28 – -0.05	-2.74	.006
Object size * Eccentricity * SOA										-0.05	-0.28 – 0.17	-0.47	.641

Note. Trials in which participants rated their confidence as “not confident at all” made up 29.9% of data. All predictors in these analyses were standardized.

Supplementary Table S7

Model assessing confidence rating differences between object and texture responses at each SOA in Experiment 2.

SOA	Logit	CI	<i>z</i>	<i>p</i>
33	-0.10	-0.35 – 0.16	-0.74	.459
67	-0.12	-0.30 – 0.07	-1.21	.228
100	0.24	0.02 – 0.45	2.14	.032
133	0.02	-0.21 – 0.25	0.14	.890

Supplementary Table S8

Models assessing the effect of consistency ratings, SOA, object size and eccentricity on the proportion of object responses in Experiment 2.

Predictors	M1				M2				M3			
	Logit	CI	<i>z</i>	<i>p</i>	Logit	CI	<i>z</i>	<i>p</i>	Logit	CI	<i>z</i>	<i>p</i>
(Intercept)	-0.12	-0.22 – -0.01	-2.15	.032	-0.10	-0.20 – -0.00	-1.97	.049	-0.08	-0.18 – 0.03	-1.46	.143
SOA	-0.03	-0.10 – 0.03	-1.04	.297	-0.04	-0.10 – 0.02	-1.42	.154	-0.04	-0.10 – 0.01	-1.46	.144
Consistency	0.11	0.05 – 0.16	3.69	<.001	0.10	0.04 – 0.16	3.27	.001	0.10	0.05 – 0.16	3.46	.001
Object size					0.38	0.27 – 0.50	6.55	<.001	0.40	0.27 – 0.52	6.32	<.001
Eccentricity					-0.18	-0.26 – -0.09	-3.87	<.001	-0.25	-0.35 – -0.15	-4.88	<.001
Object size * Eccentricity									-0.19	-0.34 – -0.04	-2.54	.011
Object size * SOA									0.09	0.02 – 0.16	2.52	.012
Eccentricity * SOA									-0.14	-0.20 – -0.07	-4.18	<.001
Object size * Consistency									0.03	-0.05 – 0.11	0.78	.438
Eccentricity * Consistency									-0.01	-0.09 – 0.06	-0.32	.751
SOA * Consistency									0.04	-0.02 – 0.10	1.33	.183
Object size * Eccentricity * SOA									-0.09	-0.19 – 0.02	-1.62	.105
Object size * Eccentricity * Con.									-0.02	-0.10 – 0.07	-0.36	.719
Object size * SOA * Consistency									-0.00	-0.07 – 0.06	-0.05	.961
Eccentricity * SOA * Consistency									0.01	-0.05 – 0.06	0.20	.843
Object size * Ecc. * SOA * Con.									0.03	-0.06 – 0.11	0.63	.528

Note. All predictors in these analyses were standardized. Con. = Consistency, Ecc. = Eccentricity.

Supplementary Table S9

Models assessing the effect of the presentation sequence condition and the covariates object size and eccentricity on log response times in Experiment 3.

Predictors	M1			M2			M3		
	log(RT)	CI	<i>t</i>	log(RT)	CI	<i>t</i>	log(RT)	CI	<i>t</i>
(Intercept)	7.39	7.33 – 7.45	230.32	7.38	7.33 – 7.44	251.69	7.38	7.32 – 7.44	251.46
Condition [T-O]	0.02	0.01 – 0.04	3.04	0.02	0.01 – 0.04	3.11	0.02	0.01 – 0.04	2.89
Object size				-0.05	-0.07 – -0.04	-5.90	-0.06	-0.08 – -0.04	-5.50
Eccentricity				0.01	-0.00 – 0.03	1.61	0.02	-0.00 – 0.04	1.62
Object size * Eccentricity							0.01	-0.02 – 0.04	0.72
Object size * Condition							0.01	-0.01 – 0.02	0.78
Eccentricity * Condition							-0.00	-0.02 – 0.01	-0.59
Object size * Eccentricity * Condition							-0.01	-0.02 – 0.01	-0.72

Note. The covariates object size and eccentricity were standardized. The condition predictor was dummy coded with the object-texture sequence as the baseline. T-O = texture-object sequence.

Supplementary Table S10

Models assessing the effect of the presentation sequence condition and the covariates object size and eccentricity on basic-level categorization accuracy in Experiment 3.

Predictors	M1				M2				M3			
	Logit	CI	<i>z</i>	<i>p</i>	Logit	CI	<i>z</i>	<i>p</i>	Logit	CI	<i>z</i>	<i>p</i>
(Intercept)	1.47	1.10 – 1.84	7.73	<.001	1.58	1.27 – 1.88	10.07	<.001	1.58	1.27 – 1.90	9.75	<.001
Condition [T-O]	-0.16	-0.26 – -0.06	-3.12	.002	-0.16	-0.26 – -0.06	-3.01	.003	-0.13	-0.26 – 0.00	-1.89	.058
Object size					0.72	0.55 – 0.90	8.04	<.001	0.73	0.55 – 0.92	7.73	<.001
Eccentricity					-0.17	-0.28 – -0.07	-3.28	.001	-0.18	-0.33 – -0.03	-2.36	.018
Object size * Eccentricity									-0.17	-0.39 – 0.05	-1.48	.140
Object size * Condition									0.01	-0.17 – 0.20	0.13	.897
Eccentricity * Condition									-0.07	-0.21 – 0.06	-1.08	.280
Object size * Eccentricity * Condition									0.01	-0.20 – 0.23	0.14	.892

Note. The covariates object size and eccentricity were standardized. The condition predictor was dummy coded with the object-texture sequence as the baseline. T-O = texture-object sequence.

Supplementary Table S11

Models assessing the effect of the presentation sequence condition and the covariates object size and eccentricity on confidence ratings in Experiment 3.

Predictors	M1					M2				
	Logit	CI	z	p		Logit	CI	z	p	
Condition [T-O]	-0.18	-0.27 – -0.08	-3.68	<.001		-0.18	-0.28 – -0.09	-3.72	<.001	
Object size						0.84	0.60 – 1.08	6.79	<.001	
Eccentricity						-0.29	-0.45 – -0.13	-3.58	<.001	

Note. The covariates object size and eccentricity were standardized. The Condition predictor was dummy coded with the object-texture sequence as the baseline. We attempted to fit a model containing interactions between condition, object size and eccentricity (i.e., M3) for the confidence ratings, but the model structure was not supported by the data and the model failed to converge. T-O = texture-object sequence.