

Supplementary Online Materials**Experiment 1***Inverse Efficiency Score (IES) Analysis*

In order to ensure that the effects of interest are not driven by speed-accuracy trade-offs, parallel analyses were carried out over the Inverse Efficiency Score (IES) as a dependent measure. The IES is calculated as: response time / 1 – percent error (Townsend & Ashby, 1978; see also Bruyer & Brysbaert, 2011). For simplicity, even though IES is a compound measure that combines both RT and accuracy, we refer to the patterns as ‘faster than’ or ‘slower than’.

IES Response Time Analysis. A 2X2 ANOVA **treating subject as the random effect** was performed contrasting the factors Decision Type and Presentation Format. Decision Type was significant ($F(1, 31) = 29.53$, $MSE = 453.75$, $p < .001$, $\eta p^2 = .49$): function decisions were significantly faster than manipulation decisions. There was a main effect of Presentation Format ($F(1, 31) = 17.92$, $MSE = 241.72$, $p < .001$, $\eta p^2 = .36$): the mean IES scores for picture stimuli were faster than the mean IES scores for word stimuli. The two-way interaction between Presentation Format and Decision Type was significant ($F(1, 31) = 35.55$, $MSE = 219.61$, $p < .001$, $\eta p^2 = .53$). Planned contrasts (paired t-test, two-tailed) were carried out following the same protocol as in the response time analysis in Experiment 1. Manipulation judgments with words were slower than manipulation judgments with pictures ($t(31) = 6.27$, $p < .001$); in addition, manipulation judgments with words were slower than function judgments with words ($t(31) = 7.00$, $p < .001$). Manipulation judgments with pictures were not slower than function judgments with pictures ($t(31) = 1.23$, $p < .22$). Function judgments with pictures were not slower than function judgments with words ($t(31) = 1.26$, $p < .21$; see Table S1 for IES scores in Experiment 1).

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Analysis Including Orthographic Similarities

Analysis of all materials (including trials with orthographic similarities): Only correct responses were included within the analysis (91.4% of trials). Response times (RT) were cleaned by excluding responses faster than 200 ms and greater than 2 standard deviations above and below the mean for each participant, calculated across all conditions (4.9% of correct trials were excluded according to those criteria). Response times, standard deviations, and error rates for each cell of the design are shown in Supplemental Table 2.

Accuracy Analysis: A 2X2 ANOVA **treating subject as the random effect** was performed over proportion correct data with the factors Decision Type and Presentation Format. There was a main effect of Decision Type ($F(1, 31) = 5.90$, $MSE = .01$, $p < .05$, $\eta p^2 = .16$); manipulation judgments led to more errors than function judgments. There was no main effect of Presentation Format ($F(1, 31) = .45$, $MSE = .004$, $p < .49$, $\eta p^2 = .01$), however the interaction between the two factors was significant ($F(1, 31) = 17.61$, $MSE = .01$, $p < .001$, $\eta p^2 = .36$). Planned contrasts (paired t-tests, two-tailed) showed that manipulation decisions with word stimuli were less accurate than manipulation decisions with picture stimuli ($t(31) = 2.58$, $p < .05$). The opposite pattern was the case for function decisions: function decisions with words were more accurate than function decisions with pictures ($t(31) = 3.56$, $p < .05$). Additionally, while there was no difference between manipulation and function decisions with pictures ($t(31) = .38$, $p > .69$), manipulation decisions with words were less accurate than function decisions with words ($t(31) = 4.12$, $p < .001$).

Response Time Analysis: A 2X2 ANOVA **treating subject as the random effect** was performed contrasting the factors Decision Type and Presentation Format. There was a main effect of the factor Decision Type ($F(1, 31) = 37.38$, $MSE = 256.63$, $p < .001$, $\eta p^2 = .55$); the

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mean RTs for manipulation decisions, collapsing over presentation format, were slower than the mean RTs for function decisions. There was also a main effect of Presentation Format ($F(1, 31) = 36.91$, $MSE = 103.05$, $p < .001$, $\eta p^2 = .54$); the mean RTs for picture stimuli were faster than the mean RTs for word stimuli. The interaction between the two factors was significant ($F(1, 31) = 41.54$, $MSE = 724.25$, $p < .001$, $\eta p^2 = .57$). Planned contrasts (paired t-tests, two-tailed) showed that manipulation judgments for words were slower than manipulation judgments for pictures ($t(31) = 7.55$, $p < .001$), and that manipulation judgments for words were slower than function judgments for words ($t(31) = 7.66$, $p < .001$). While manipulation judgments with pictures were slower than function judgments with pictures ($t(31) = 2.67$, $p < .05$), there was no difference between function judgments with words and function judgments with pictures ($t(31) = .64$, $p > .51$). These RT and accuracy analyses rule out any speed-accuracy tradeoffs for orthographically similar trials (see Supplemental Table 2 for all RT and accuracy effects of orthographically similar trials).

Analysis Removing Orthographic Similarities

In a further analysis, orthographic similarities between targets and answer choices were removed; in the main text all triads for which there was an orthographic similarity for either function or manipulation judgments were removed so that all analyses were within items. Here, we carried out an analysis in which only those triads were removed for each decision type for which there was an orthographic similarity between the target and comparison items. For function judgments, 3 of the 12 triads share orthographic similarity; for manipulation judgments, 1 of the 12 triads shares orthographic similarity.

Orthographic Accuracy Analysis. A 2X2 ANOVA treating subject as the random effect was performed contrasting the factors Decision Type and Presentation Format over proportion

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correct orthographically dissimilar trials. There was no main effect of Decision Type ($F(1, 31) = .162$, $MSE = .07$, $p > .68$, $\eta p^2 = .01$). There was a trend toward higher accuracy for word-form trials ($F(1, 31) = 3.45$, $MSE = .01$, $p > .06$, $\eta p^2 = .10$), while the two-way interaction was significant ($F(1, 31) = 10.04$, $MSE = .01$, $p > .01$, $\eta p^2 = .25$). Planned contrasts (t-tests, two-tailed) found no difference between manipulation judgments in picture- and word-form ($t(31) = 1.51$, $p > .13$), while the opposite was the case for function decisions, as function word judgments were more accurate than function picture judgments ($t(31) = 3.30$, $p < .01$). There was a trend toward higher accuracy for function judgments over words compared to manipulation judgments over words ($t(31) = 2.00$, $p = .054$); this trend was also present for function judgments over pictures, as they were slightly more accurate than manipulation judgments over pictures ($t(31) = 1.69$, $p > .09$).

Orthographic Response Time Analysis. A 2X2 ANOVA **treating subject as the random effect** was performed contrasting the factors Decision Type (function, manipulation) and Presentation Format (picture, words) over orthographically dissimilar trials. There was a main effect of Decision Type ($F(1, 31) = 25.68$, $MSE = 317.47$, $p < .001$, $\eta p^2 = .45$); manipulation decisions were slower than function decisions. There was a main effect of Presentation Format ($F(1, 31) = 37.99$, $MSE = 110.65$, $p < .001$, $\eta p^2 = .55$): decisions in word-form were slower than decisions in picture-form. The interaction between the two factors was significant ($F(1, 31) = 21.61$, $MSE = 986.63$, $p < .001$, $\eta p^2 = .41$). Planned comparisons (t-test, two-tailed) from the first analysis were carried out over the orthographically dissimilar triad RTs; all contrasts mirrored the above findings. Manipulation judgments with pictures were faster than manipulation judgments with words ($t(31) = 6.69$, $p < .001$). Function judgments with words were also faster than manipulation judgments with words ($t(31) = 5.81$, $p < .001$). Manipulation

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judgments with pictures were slower than function judgments with pictures ($t(31) = 2.63, p < .05$); however, there was no difference between function decisions in word-form and picture-form ($t(31) = 1.56, p > .11$). For all RT and accuracy effects of orthographically dissimilar trials in Experiment 1 see Supplemental Table 2.

Experiment 2

Inverse Efficiency Score (IES) Analysis

IES Score Analysis. A 2X2 ANOVA **treating subject as the random effect** was performed contrasting the factors Decision Type and Presentation Format. Decision Type was significant ($F(1, 31) = 15.85, \text{MSE} = 367.41, p < .001, \eta p^2 = .34$): function decisions were significantly faster than manipulation decisions. Response times were not differentially affected by presentation format ($F(1, 31) = 1.88, \text{MSE} = 121.04, p < .18, \eta p^2 = .06$): the mean IES scores for picture stimuli were not faster than the mean IES scores for word stimuli. The two-way interaction between Presentation Format and Decision Type was significant ($F(1, 31) = 33.21, \text{MSE} = 916.39, p < .001, \eta p^2 = .52$). Planned contrasts (paired t-test, two-tailed) were carried out following the same protocol as in the response time analysis in Experiment 2. Manipulation judgments with words were slower than manipulation judgments with pictures ($t(31) = 3.95, p < .001$); in addition, manipulation judgments with words were slower than function judgments with words ($t(31) = 5.17, p < .001$). Manipulation judgments with pictures were not slower than function judgments with pictures ($t(31) = 1.29, p < .22$). Function judgments with pictures were slower than function judgments with words ($t(31) = 3.85, p < .001$; see Table S3 for IES scores in Experiment 2).

Analysis Including Orthographic Similarities

Analysis of all materials (including trials with orthographic similarities): Only correct

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responses were included within the analysis (92.3% of trials), and the data were cleaned following the same criteria as in Experiment 1 (4.8% of correct trials were excluded as outliers). Response times, standard deviations, and error rates for each cell of the design are shown in Supplemental Table 4.

Accuracy Analysis. A 2X2 ANOVA **treating subject as the random effect** was performed contrasting the factors Decision Type and Presentation Format over the proportion correct data. There was no effect of Decision Type ($F(1, 31) = 1.85$, $MSE = 0.01$, $p > .17$, $\eta p^2 = .06$); Presentation Format marginally affected accuracy ($F(1, 31) = 3.87$, $MSE = 0.01$, $p = .058$, $\eta p^2 = .11$), as word stimuli were more accurate than picture stimuli. The interaction between decision type and presentation format was significant ($F(1, 31) = 9.95$, $MSE = 0.01$, $p < .01$, $\eta p^2 = .24$). While the accuracy of manipulation decisions was not modulated by the presentation as pictures or words ($t(31) = .29$, $p > .76$), function decisions with words were more accurate than function decisions with pictures ($t(31) = 4.00$, $p < .001$). Function decisions with words were also more accurate than manipulation decisions with words ($t(31) = 3.13$, $p < .01$). There was no difference between manipulation and function judgments in picture-form ($t(31) = .72$, $p > .46$).

Response Time Analysis. A 2X2 ANOVA **treating subject as the random effect** was performed contrasting the factors Decision Type and Presentation Format. Function decisions were significantly faster than manipulation decisions ($F(1, 31) = 33.98$, $MSE = 132.00$, $p < .001$, $\eta p^2 = .52$). There was no effect of Presentation Format ($F(1, 31) = 1.19$, $MSE = 378.34$, $p > .27$, $\eta p^2 = .04$). The two-way interaction between presentation format and decision type was significant ($F(1, 31) = 28.14$, $MSE = 369.24$, $p < .001$, $\eta p^2 = .48$). Manipulation decisions over words were significantly slower than manipulation decisions over pictures ($t(31) = 3.50$, $p < .001$), and manipulation decisions over words were significantly slower than function decisions

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over words ($t(31) = 6.51, p < .001$). Function decisions over words were faster than function decisions over pictures ($t(31) = 5.03, p < .001$), and function decisions over pictures were faster than manipulation decisions over pictures ($t(31) = 3.38, p < .01$). Thus, these RT and accuracy analyses rule out any speed-accuracy tradeoffs over orthographically similar trials (see Supplemental Table 4 for RT and accuracy effects of orthographically similar trials).

Analysis Removing Orthographic Similarities

Orthographic Accuracy Analysis. A 2X2 ANOVA treating subject as the random effect contrasting Decision Type and Presentation Format was carried out over proportion correct for orthographically dissimilar trials. There was no main effect of Decision Type ($F(1, 31) = .95$, $MSE = .01, p > .32, \eta p^2 = .03$), and a main effect of Presentation Format ($F(1, 31) = 4.31$, $MSE = .01, p < .05, \eta p^2 = .12$): word stimuli were more accurate than picture stimuli. The interaction between decision type and presentation format was significant ($F(1, 31) = 6.04$, $MSE = .01, p < .05, \eta p^2 = .16$). While there was no accuracy difference between manipulation decisions with words and pictures ($t(31) = .27, p > .77$), function decisions with words were more accurate than function decisions with pictures ($t(31) = 3.41, p < .01$). Function decisions with words were more accurate than manipulation judgments with words ($t(31) = 2.44, p < .05$); however function judgments with pictures were not different than manipulation judgments with pictures ($t(31) = .68, p > .49$).

Orthographic Response Time Analysis. A 2X2 ANOVA treating subject as the random effect was performed contrasting the factors Decision type and Presentation Format. There was a main effect of the factor Decision Type ($F(1, 31) = 35.76$, $MSE = 1251.20, p < .001, \eta p^2 = .54$): function decisions were faster than manipulation decisions. There was no main effect of the factor Presentation Format ($F(1, 31) = 2.67$, $MSE = 417.42, p > .10, \eta p^2 = .08$); the interaction

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between the two factors was significant ($F(1, 31) = 28.53$, $MSE = 358.94$, $p < .001$, $\eta p^2 = .48$). Manipulation judgments followed the same pattern as Experiment 1: picture judgments were faster than word judgments ($t(31) = 3.83$, $p < .01$). Function decisions doubly dissociated from manipulation decisions: function judgments in word-form were significantly faster than function judgments in picture-form ($t(31) = 3.82$, $p < .01$). Function judgments with words were faster than manipulation judgments with words ($t(31) = 6.42$, $p < .001$), and function judgments with pictures were faster than manipulation judgments with pictures ($t(31) = 3.80$, $p < .01$). These RT and accuracy effects rule out any speed-accuracy tradeoffs when orthographic similarities are removed in Experiment 2 (see Supplemental table 4 for all RT and accuracy effects when orthographic similarities are removed).

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Table Legend

Table S1. Mean response time (RT, in milliseconds), and standard deviations (SD, in milliseconds) for IES corrected response times in Experiment 1.

Table S2. Mean response time (RT, in milliseconds), response time standard deviation (RT SD, in milliseconds), proportion of error (PE), and proportion of error standard deviation (PE SD) by decision type and presentation format for orthographically similar, and dissimilar trials in Experiment 1.

Table S3. Mean response time (RT, in milliseconds), and standard deviations (SD, in milliseconds) for IES corrected response times in Experiment 2.

Table S4. Mean response time (RT, in milliseconds), response time standard deviation (RT SD, in milliseconds), proportion of error (PE), and proportion of error standard deviation (PE SD) by decision type and presentation format for orthographically similar, and dissimilar trials in Experiment 2.

Appendix A. Objects used in the function condition.

Appendix B. Objects used in the manipulation condition.

Appendix C. Word length and frequency for items in Experiments 1 and 2. Frequency values are from the Celex psycholinguistic database. * frequency data are not available.

Appendix D. Experimental instructions for manipulation trials

Appendix E. Experimental instructions for manipulation trials

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Table S1

	Manipulation		Function		Mean Format RT
	RT	SD	RT	SD	
Word	3131	1032	1990	397	2561
Picture	2269	533	2116	589	2193
Mean RT for Decision Type	2700		2053		

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Table S2

		Manipulation				Function				Mean Format RT
		RT	RT SD	PE	PE SD	RT	RT SD	PE	PE SD	
Orthographic Similarities Included	Word	2812	816	.13	.12	1958	429	.03	.06	2385
	Picture	2161	546	.09	.09	1919	392	.09	.09	2040
	Mean RT and PE for Decision Type	2486		.11		1939		.06		
Orthographic Similarities Removed	Word	2757	841	.11	.13	1994	503	.05	.07	2376
	Picture	2137	571	.08	.09	1890	409	.12	.11	2014
	Mean RT and PE for Decision Type	2447		.10		1942		.09		

Table S3

	Manipulation		Function		
	RT	SD	RT	SD	Mean Format RT
Word	2131	859	1578	449	1946
Picture	1921	518	1802	469	1861
Mean RT for Decision Type	2117		1690		

Table S4

		Manipulation				Function				Mean Format RT
		RT	RT SD	PE	PE SD	RT	RT SD	PE	PE SD	
Orthographic Similarities Included	Word	2039	574	0.09	.09	1485	323	0.04	.05	1699
	Picture	1822	445	0.08	.08	1627	375	0.10	.10	1788
	Mean RT and PE for Decision Type	1931		0.09		1556		0.07		
Orthographic Similarities Removed	Word	2040	581	0.10	.11	1487	334	0.04	.07	1764
	Picture	1802	426	0.09	.11	1607	335	0.11	.11	1705
	Mean RT and PE for Decision Type	1921		0.10		1547		0.08		

Appendix A.**Objects used in function condition.**

Target	Shares Function	Foil	Removed due to Orthographic Similarities
mop	<i>sponge</i>	sand paper	No
pizza cutter	<i>knife</i>	paint roller	No
pen	<i>typewriter</i>	piano	No
nail clipper	<i>nail file</i>	clothespin	Yes
candy bar	<i>lollypop</i>	pacifier	No

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towel	<i>blow drier</i>	spray bottle	No
door knocker	<i>doorbell</i>	thumb tack	Yes
turkey baster	<i>basting brush</i>	bicycle horn	Yes
butcher knife	<i>saw</i>	hammer	No
corkscrew	<i>bottle opener</i>	screwdriver	No
stapler	<i>paperclip</i>	hole puncher	No
axe	<i>saw</i>	bat	No

Appendix B.

Objects used in manipulation condition.

Target	Shares Manipulation	Foil	Removed due to Orthographic Similarities
sponge	<i>sand paper</i>	mop	No
pizza cutter	<i>paint roller</i>	knife	No
typewriter	<i>piano</i>	pen	No
nail clipper	<i>clothespin</i>	nail file	No

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lollipop	<i>pacifier</i>	candy bar	No
blow drier	<i>spray bottle</i>	towel	No
door bell	<i>thumb tack</i>	door knocker	No
turkey baster	<i>bicycle horn</i>	basting brush	No
hammer	<i>butcher knife</i>	saw	No
screwdriver	<i>corkscrew</i>	bottle opener	Yes
hole puncher	<i>stapler</i>	paper clip	No
bat	<i>axe</i>	saw	No

Appendix C.

Word length and frequency for items in Experiments 1 and 2. Frequency values are from the Celex psycholinguistic database.

Word	frequency	length
mop	3	3
pizza cutter	2	5

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	cutter	3	6
pen		26	3
nail clipper	nail	25	4
	clipper	0	7
candy bar	candy	7	5
	bar	0	3
towel		22	5
door	door	386	4
knocker	knocke	1	7
	r		
turkey	turkey	5	6
baster	baster	*	6
butcher	butcher	6	7
knife	knife	44	5
corkscrew		1	9
stapler		0	7
axe		9	3
sponge		8	6
knife		44	5
typewriter		11	10
nail file	nail	25	4
	file	38	4
lollypop		1	8
blow drier	blow	27	4
	drier	3	5
doorbell		3	8
basting	basting	*	7
brush	brush	17	5
bottle	bottle	116	3
opener	opener	3	6
paperclip		*	9
saw		1	3
sand paper	sand	58	4
	paper	225	5
paint roller	paint	26	5
	roller	5	6
piano		0	5
	clothespin	0	10
	pacifier	0	8
spray bottle	spray	11	5
	bottle	116	6
thumb tack	thumb	27	5
	tack	3	4
bicycle horn	bicycle	23	7

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	horn	18	4
	hammer	11	6
	screwdriver	3	11
hole	hole	92	4
puncher	puncher	0	6
bat		14	3

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Appendix D.

Function Instructions

You will be seeing three objects in a triangle shape.

TARGET Object

LEFT Object RIGHT Object

Your task is to choose which object is more related to the target object based on function.

By function, is meant the purpose of use of the object (e.g., a car is used for driving, a bed is used for sleeping, a razor is used for shaving).

If the LEFT Object is more related to the TARGET Object, hit the left arrow.

If the RIGHT Object is more related to the TARGET Object, hit the right arrow. You want to perform this task as quickly and accurately as possible.

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Appendix E.

Manipulation Instructions

You will be seeing three words in a triangle shape.

TARGET Object

LEFT Object RIGHT Object

Your task is to choose which object is more related to the target object based on the manner of manipulation.

By manner of manipulation, is meant the pattern of motor movements associated with the use of the object (e.g., a rake is manipulated in a similar way as a broom).

If the LEFT Object is more related to the Target Object, hit the left arrow.

If the RIGHT Object is more related to the Target Object, hit the right arrow.

You want to perform this task as quickly and accurately as possible.