

Normative multitrial recall performance, metacognitive judgments, and retrieval latencies for Lithuanian–English paired associates

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Memory researchers using paired associates have benefited greatly from the Swahili–English norms reported by Nelson and Dunlosky (1994). Given recent increases in the amount and kinds of research using paired associates, however, researchers would now benefit from an expanded set of normative measures for foreign language vocabulary words. We report data for 120 Lithuanian–English word pairs collected from 236 undergraduates. Participants completed three study–test trials and were asked to make metacognitive judgments for each item. We report normative recall performance, recall latencies, and error types for each item across trials, as well as the perceived difficulty of each item on the basis of metacognitive judgments.

Paired associates have long been a favorite tool of researchers in the field of human memory. The most common example of paired associates is concrete English noun pairs. In a typical experiment, participants study a list of paired associates and later take a memory test in which they are asked to recall the second word of a paired associate (i.e., the target) when they are prompted with the first word (i.e., the cue). These noun paired associates are often used under the assumption that results found with this type of paired associate (i.e., concrete nouns) will generalize to other types of paired associates, such as foreign language paired associates (i.e., translation equivalents from two different languages). One reason results should generalize in such a case is that both types contain a cue and an associated target word. However, with many foreign languages, such as French or Spanish, it is not uncommon for participants to have exposure to the language (and potentially some paired associates that would be used from that language) prior to the experiment. The issue of prior exposure can be avoided by choosing arbitrary noun paired associates. However, subjects learn foreign language words differently than they do English word pairs, because foreign language pairs rely heavily on phonological encoding, whereas English pairs rely more on semantic encoding (Papagno, Valentine, & Baddeley, 1991). Nelson and Dunlosky (1994) argued that because of this finding, arbitrary noun paired associates do not necessarily generalize to foreign language vocabulary. At the time, no normative data existed for a foreign language vocabulary set suitable to serve as a substitute for arbitrary noun paired associates. To fill this gap, Nelson and Dunlosky provided normative data on Swahili–English translations.

These Swahili–English paired associates have been used frequently by memory researchers (e.g., Dunlosky &

Thiede, 1998; Jang & Nelson, 2005; Kelemen & Creeley, 2001; Kelemen, Frost, & Weaver, 2000; Kelemen, Winingham, & Weaver, 2007; Richards & Nelson, 2004; Scheck, Meeter, & Nelson, 2004; Scheck & Nelson, 2005; Thiede, 1999; Toppino & Cohen, 2009; Van Overschelde & Nelson, 2006) and have become increasingly popular in certain areas of research, such as research on testing effects (e.g., Bahrick & Hall, 2005; Carpenter, Pashler, Wixted, & Vul, 2008; Karpicke, 2009; Karpicke & Roediger, 2008; Kornell & Bjork, 2008; Kornell & Metcalfe, 2006; Pyc & Rawson, 2007, 2009, in press). However, the normative measures reported by Nelson and Dunlosky (1994) focus almost exclusively on retrieval accuracy. Although the Swahili–English norms have served memory researchers well, the field would benefit from an additional set of foreign language paired associates, not only to facilitate establishing the generalizability of key findings but also to provide measures beyond those originally reported by Nelson and Dunlosky. For example, given recent interest in the impact of retrieval difficulty on learning (see, e.g., Karpicke & Roediger, 2007; Pyc & Rawson, 2009), a researcher might want to consider the retrieval latency of a particular item. Metamemory researchers would be interested in the perceived difficulty of a particular item from ease-of-learning judgments (EOLs) and judgments of learning (JOLs). Both memory and metamemory researchers alike may be interested in the types of errors common to a particular item (e.g., commission vs. omission errors).

Of practical concern, it is also reasonable to assume that researchers frequently use Swahili–English paired associates across multiple experiments. Utilizing these items across multiple experiments has the unfortunate consequence of automatically excluding individuals from participating in more than one experiment that includes Swahili–English

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paired associates. Researchers can increase the functional size of their available subject pool by having an additional language set available for paired-associate learning studies. Additionally, utilizing multiple language sets has the added benefit of establishing the generalizability of results across foreign language paired-associate studies.

Accordingly, the purpose of the present study was to provide an expanded set of normative measures for a different foreign language vocabulary set, which will provide researchers with more options when choosing paired associates for experiments. Specifically, we examined retrieval accuracy, recall latency, perceived item difficulty, and error patterns for a set of Lithuanian words and their English translations. Lithuanian was chosen primarily on the basis of Nelson and Dunlosky's (1994) rationale for the use of Swahili. Like Swahili, Lithuanian is a relatively uncommon language, ensuring low rates of prior exposure among participants. Because Lithuanian is a Baltic language, it is dissimilar to Romance languages familiar to most people through schooling, which also minimizes the occurrence of cognates. Additionally, Lithuanian uses the standard English alphabet, avoiding issues of transliteration that would necessarily occur with languages that use other alphabets. For practical purposes, Nelson and Dunlosky avoided the use of letter modifiers such as accents. A portion of the Lithuanian items in our material set contains modifiers (42 of 120 items) permitting researchers to vary the orthographic variability of their item set as they see fit.

METHOD

Participants

Participants included 240 Kent State University undergraduates who volunteered to participate in exchange for \$10 compensation. Data from 4 participants were not included because of a programming error that rendered their data unusable. As a motivator for performance, each participant was entered into a drawing for a \$100 prize; prior to beginning the task, participants were informed that the top third of performers would be entered into the drawing three times, and that the middle third of performers would be entered two times.

Materials

The item list included 125 Lithuanian–English paired associates. Each paired associate consisted of a Lithuanian word and its English translation. All English words were concrete nouns with concreteness ratings in the range of 500–700 (Coltheart, 1981). Additionally, each word was greater than three characters in length, each word was not a hyphenated or compound word, and the two words of any given paired associate were not cognates. Five items were used as primacy buffer items at the beginning of each study trial, and they were not presented during test trials.

Procedure

Each participant was presented with 40 target Lithuanian–English items via computer. Participants learned a subset of 40 items to manage total task time, minimize boredom and fatigue, and keep the to-be-learned item list at a reasonable length. We used a random yoking procedure to ensure that each item was presented an equal number of times across participants. The yoking procedure was as follows: The list of 120 items was first randomized and split into thirds. The first 40 items were assigned to the first participant, the second 40 items were assigned to the second participant, and the third 40 items were assigned to the third participant. The list of 120

items was then randomized anew, split into thirds, and assigned to the next 3 participants. This procedure continued until each item was assigned to 80 participants.

Each participant completed three alternating study–test trials for each of his or her assigned items. During the study phase of each trial, participants were first presented with the 5 primacy buffer items in random order, followed by the 40 target items in random order. Items were presented for study at a rate of 10 sec per item. Participants then completed the test phase. The first 20 items presented in the study phase were randomized anew and presented one at a time for a test trial. The remaining 20 items from the study phase were then randomized anew and presented for a test trial. This method ensured at least a 20-item lag between studying a given item and being tested on that item. During test trials, the Lithuanian cue word of a paired associate was presented (e.g., “*bulvė* = ?”), and the participant had 12 sec to type the corresponding English target translation into a response field before being moved on to the next item. Items were computer scored by comparing the first three letters of the target answer and the cue.¹ Recall latencies were recorded for each response as the time (in seconds) between the onset of a Lithuanian word and the first keypress of the participant's response.

Following the third test phase, the 40 target items were randomized anew and were presented for judgment trials. During judgment trials, items were serially presented on the screen, and participants made two judgments for each item using a slider on a continuous scale. Participants were first prompted to make an EOL, in which they were asked to rate how difficult it was for them to learn the given item. The left side of the scale was labeled “very hard,” and the right side was labeled “very easy.” For the JOL, participants were asked to rate the likelihood of being able to recall the English word of a given item were they to be tested on that item in 1 week. The left side of the scale was presented as “0% likely to recall,” and the right side was presented as “100% likely to recall.” Each judgment was recorded as a number between 0 and 100 depending on the position of the slider on the scale.

RESULTS

Recall Performance

Mean recall performance for each item is reported in Table A1 in the Appendix. Mean recall performance was .22 for Trial 1 ($SD = .13$), .50 for Trial 2 ($SD = .16$), and .66 for Trial 3 ($SD = .13$). These data indicate performance off the floor in the initial trial, substantial positive gains in recall performance with each additional trial, and performance off the ceiling after the third trial. Additionally, these data indicate a wide range of recall performance throughout the item set on each trial, giving researchers an ample range of performance to consider across practice trials when selecting items for experiments.

Similar to the Nelson and Dunlosky (1994) norms, performance for an individual item on any given trial was highly predictive of performance on subsequent trials. Recall performance on Trial 1 was highly correlated with performance on Trial 2 ($r = .88, p < .001$). Likewise, recall performance on Trial 2 was highly correlated with performance on Trial 3 ($r = .93, p < .001$). These results indicate that items retained their relative difficulty across trials.

Metacognitive Judgments

Mean EOL and JOL for each item are reported in Table A1. The two judgments were highly correlated ($r = .99, p < .001$), suggesting that both judgments were relatively equivalent for gauging the perceived difficulty of a given item. Both judgments were also highly correlated

with recall performance for each of the three trials. The correlations between EOL judgments and recall performance were $r = .91, .97, \text{ and } .93$ for Trials 1, 2, and 3, respectively. The correlations between JOLs and recall performance were $r = .89, .95, \text{ and } .93$ for Trials 1, 2, and 3, respectively (all $ps < .001$). EOL judgments ranged from 19.6 to 88.6 (median = 45.8, $SD = 13.2$), and JOLs ranged from 20.6 to 83.8 (median = 45.69, $SD = 12.14$).

Frequency of Occurrence

To parallel statistics reported by Nelson and Dunlosky (1994), the Thorndike and Lorge (1944) frequency-of-occurrence norms for the English words are presented in Table A1. To examine any possible effects that familiarity of an English word might have had for establishing an association with the Lithuanian translation, we computed Pearson correlations between word frequency and the proportion correct on Trial 1. The correlation was significant ($r = .25, p = .006$) and consistent with the magnitude of the correlation reported by Nelson and Dunlosky with Swahili–English pairs ($r = .25$). Although the size of the correlation was only moderate, this repeated finding indicates that preexperimental familiarity was a predictive factor for successful recall. The extent to which this effect was due to improved target memory and/or a stronger associative link between the cue and target is a question for future research.

Recall Latency

Mean recall latencies for each item are reported in Table A2 in the Appendix. Recall latency was computed as the time in seconds between the onset of a Lithuanian word and the first keypress of the participant's response. Only latency data from trials on which the response was scored as correct are included in Table A2. The data are ordered from shortest to longest recall latency on Trial 1. Table A2 is partitioned vertically by the first occurrence of a correct response. The first partition reports the latency data across trials for items that were correctly recalled in Trial 1 first, the second partition reports the latency data across trials for items correctly recalled in Trial 2 first, and the third partition reports the latency data across trials for items correctly recalled in Trial 3 first. Within any given partition, a participant's response to an item was included only if that item was also correctly recalled in the preceding trials. For example, a participant who correctly responded to an item in Trial 1 and Trial 3 but not in Trial 2 would have latency data included in the Trial 1 means but not the Trial 2 or Trial 3 means. By arranging the data in this manner, a researcher can assess the expected retrieval latency of an item at any given trial of recall on the basis of the number of times the item has been correctly recalled.

Types of Error

The error frequencies across trials for each item are reported in Table A3 in the Appendix, as are the rates of commission. The rates of commission are reported as the ratio of commission errors to total errors for an item. To conserve space, errors of omission are not reported; however, these can be calculated easily from the reported data.

Although the majority of errors for items are represented by errors of omission, researchers are still left with a good range of commission rates to choose from. Commission rates ranged from .12 to .63 (median = .28, $SD = .11$).

SUMMARY

Swahili–English word pairs have seen an upsurge in popularity, especially in testing-effect research. The present set of norms provides a number of measures not reported in the Nelson and Dunlosky (1994) Swahili–English set, and this provides greater utility to researchers. In addition to recall accuracy, we provide recall latency, error patterns, and metacognitive measures. Each of these measures will be useful for a variety of interests in memory research. For example, the recall latency data are useful for research examining the effects of retrieval fluency on memory, and the error analysis is useful for research examining the perseverance of errors across learning trials. It should be noted that use of these measures should be limited to experimental designs using the Lithuanian word to cue retrieval of the English word. Caution should be exercised when using the English word to cue the Lithuanian word, since the measures reported here do not necessarily generalize to this reversed procedure. Overall, the present data provide a good range across all measures, in which values are off the floor and ceiling, thereby providing a large set of new foreign language paired associates for researchers.

AUTHOR NOTE

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NOTE

1. Two items, *priest* and *scissors*, were particularly prone to spelling errors in the first three letters (e.g., *preist* and *sissors*), which caused them to be scored as incorrect. The scoring program was modified to account for these common errors.

APPENDIX

Table A1
Proportions of Correct Recall Across Trials, Ease-of-Learning Judgments (EOLs), Judgments of Learning (JOLs), and Frequency of Occurrence of English Words

Word Pair		Proportion Correct			EOL	JOL	Frequency
Lithuanian	English	Trial 1	Trial 2	Trial 3			
lova	bed	.76	.90	.95	89	84	1,236
mėsa	meat	.56	.87	.91	76	76	489
upė	river	.50	.70	.84	70	67	455
sesuo	sister	.49	.86	.94	76	72	590
namas	house	.49	.75	.87	67	64	4,231
daina	song	.48	.81	.88	70	72	394
želė	jelly	.46	.63	.73	63	63	169
pupa	bean	.46	.82	.91	74	71	265
akis	eye	.45	.73	.85	68	66	5,786
nafta	oil	.45	.72	.78	65	65	536
karalius	king	.43	.59	.73	56	53	393
pomidoras	tomato	.43	.65	.80	60	59	166
burna	mouth	.42	.80	.90	76	74	699
gėlė	flower	.38	.62	.75	60	58	902
mokykla	school	.36	.74	.85	59	53	1,585
tiltas	bridge	.35	.75	.83	65	64	467
smegenys	brain	.34	.65	.78	58	57	401
sausainis	cookie	.34	.65	.81	58	59	72
purvas	dirt	.34	.63	.71	58	54	136
palaidinė	shirt	.33	.70	.80	59	54	264
pliažas	beach	.33	.66	.76	60	59	31
batas	shoe	.33	.63	.70	56	51	536
vėjas	wind	.32	.59	.72	50	50	657
medis	tree	.32	.57	.80	58	57	942
tinklas	net	.32	.62	.81	56	53	168
pastatas	building	.31	.70	.86	61	59	1,014
stogas	roof	.30	.59	.76	53	51	417
ugnis	fire	.29	.58	.72	54	54	1,319

Table A1 (Continued)

Word Pair		Proportion Correct			EOL	JOL	Frequency
Lithuanian	English	Trial 1	Trial 2	Trial 3			
pyragas	cake	.29	.54	.75	47	47	531
durys	door	.29	.64	.76	63	60	2,511
žirklys	scissors	.29	.54	.71	50	50	29
rūsys	basement	.28	.76	.88	64	64	89
traukinys	train	.27	.71	.84	63	63	1,019
dūmai	smoke	.27	.63	.73	58	58	545
pienas	milk	.27	.59	.78	60	59	663
krautuvė	store	.26	.39	.58	41	38	897
kelnės	pants	.26	.43	.59	43	43	43
obuolys	apple	.26	.58	.77	52	51	220
knyga	book	.25	.55	.79	52	51	684
langas	window	.24	.49	.71	49	47	1,564
auksas	gold	.24	.61	.73	55	51	712
mėnulis	moon	.24	.60	.76	55	54	285
vanduo	water	.23	.55	.74	52	50	2,067
vinis	nail	.23	.53	.64	49	45	171
vilkas	wolf	.23	.56	.70	51	53	121
koja	leg	.23	.61	.71	56	57	642
duona	bread	.23	.51	.77	52	48	423
urvas	cave	.23	.47	.67	45	45	40
augalas	plant	.22	.58	.69	50	50	944
žolė	grass	.21	.51	.67	44	42	253
kėdė	chair	.20	.43	.63	47	48	1,298
riteris	knight	.20	.51	.71	47	47	47
miestas	city	.20	.56	.79	54	49	1,258
medus	honey	.20	.43	.63	49	47	274
lietus	rain	.20	.46	.74	47	48	372
skėtis	umbrella	.19	.43	.56	43	46	41
paukštis	bird	.19	.46	.60	39	41	386
žiedas	ring	.19	.51	.65	42	43	622
padanga	tire	.19	.57	.70	46	45	865
puodelis	cup	.19	.50	.66	42	42	1,336
adata	needle	.19	.53	.70	49	47	88
bulvė	potato	.18	.52	.69	47	47	384
šokis	dance	.18	.49	.64	43	45	1,167
piniginė	wallet	.18	.60	.74	51	48	36
kilimėlis	rug	.17	.47	.60	38	40	262
palėpštis	broom	.17	.47	.56	40	37	34
vaistas	drug	.17	.40	.45	36	36	123
žuvis	fish	.16	.35	.52	36	34	597
lazda	baton	.16	.33	.56	34	32	13
kumpis	ham	.16	.54	.74	50	49	143
laiptelis	stair	.15	.37	.50	32	35	446
būgnas	drum	.15	.56	.73	53	55	70
kunigas	priest	.15	.51	.67	45	48	78
plaukas	hair	.15	.35	.62	42	42	1,183
tvora	fence	.15	.47	.63	41	41	256
kambarys	room	.15	.49	.66	43	40	3,789
arbata	tea	.15	.50	.73	47	45	484
mygtukas	button	.15	.40	.53	39	39	196
šakutė	fork	.15	.31	.61	37	39	137
mašina	car	.14	.50	.67	48	49	2,218
kreida	chalk	.14	.39	.53	38	37	31
krosnis	stove	.14	.36	.47	29	31	199
laidas	wire	.14	.31	.50	37	41	449
šalmas	helmet	.14	.32	.54	34	36	48
smaragdas	emerald	.14	.44	.67	39	39	61
ledas	ice	.14	.39	.58	38	42	428
kardas	sword	.14	.31	.53	34	33	91
kepuraitė	hat	.14	.41	.58	33	34	976
kraujas	blood	.13	.31	.55	32	36	504
strėlė	arrow	.13	.45	.58	42	38	39
perukas	wig	.13	.38	.57	37	39	23
plyta	brick	.13	.53	.78	53	51	201
tvartas	barn	.13	.40	.59	36	37	176
kablelis	hook	.13	.28	.46	28	29	198
turgus	market	.13	.50	.54	42	42	726
stalas	table	.12	.36	.53	41	38	1,325
sriuba	soup	.12	.47	.62	43	45	246
raktas	key	.12	.41	.60	39	37	268
kareivis	soldier	.11	.54	.70	45	47	259
vėžys	lobster	.10	.39	.58	35	36	45
voras	spider	.10	.36	.59	35	39	42

Table A1 (Continued)

Word Pair		Proportion Correct					EOL	JOL	Frequency
Lithuanian	English	Trial 1	Trial 2	Trial 3					
kirvis	axe	.10	.31	.51	37	37	53		
šepetys	brush	.10	.31	.55	33	35	404		
svogūnas	onion	.09	.36	.61	37	42	268		
vonias	bath	.09	.32	.61	36	40	315		
dažai	paint	.09	.32	.62	34	36	1,102		
maišas	bag	.09	.34	.53	38	36	500		
smuikas	violin	.08	.39	.42	31	32	49		
padažas	gravy	.08	.27	.38	27	26	84		
diržas	belt	.08	.30	.51	31	36	146		
kriauklė	sink	.08	.25	.42	25	25	202		
gatvė	street	.07	.43	.65	41	44	1,197		
geležis	iron	.06	.35	.61	32	30	454		
vėliava	flag	.06	.31	.47	32	33	135		
laikrodis	clock	.05	.29	.53	31	33	235		
varpas	bell	.04	.12	.25	20	21	109		
muilas	soap	.04	.18	.42	25	24	192		
laiškas	letter	.04	.29	.46	27	29	1,748		
kamuolys	ball	.04	.24	.53	23	26	503		
krantas	shore	.03	.18	.41	20	24	240		

Note—Frequency is reported as the English word’s number of occurrences per million words from Thorndike and Lorge (1944).

Table A2
Mean Recall Latencies in Seconds for Each Item Across Practice Trials

Word Pair		First Correct Recall in Trial 1						First Correct Recall in Trial 2				First Correct Recall in Trial 3	
		Trial 1		Trial 2		Trial 3		Trial 2		Trial 3		Trial 3	
		<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>
laiškas	letter	3	2.172	2	1.742	1	1.650	21	4.673	21	2.317	14	3.693
lova	bed	61	2.212	61	1.301	61	1.242	11	2.020	10	1.363	5	2.167
burna	mouth	33	2.245	33	1.296	33	1.118	30	1.699	30	1.514	8	2.513
nafta	oil	35	2.259	35	1.423	35	1.122	21	2.034	21	1.513	5	1.920
stalas	table	9	2.287	8	1.773	8	1.388	20	4.098	18	1.924	14	2.762
muilas	soap	3	2.322	2	1.558	2	1.417	12	4.597	11	2.032	19	3.212
mėsa	meat	44	2.342	44	1.538	44	1.287	25	2.343	24	1.654	4	1.371
sesuo	sister	40	2.372	40	1.372	40	1.169	30	1.957	29	1.153	7	2.117
dūmai	smoke	20	2.460	20	1.639	19	1.375	27	2.764	26	1.649	10	3.078
pupa	bean	36	2.494	36	1.398	36	1.305	29	1.965	29	1.400	7	1.905
vėliava	flag	5	2.550	5	4.623	4	2.213	20	3.242	20	1.970	14	3.932
pomidoras	tomato	34	2.554	30	1.831	30	1.822	22	2.252	21	2.231	10	2.497
stogas	roof	24	2.563	23	1.746	23	1.770	24	2.828	23	1.814	14	2.496
smegenys	brain	26	2.582	26	1.647	26	1.476	24	2.546	23	1.501	11	2.550
tiltas	bridge	28	2.585	28	1.490	28	1.204	32	2.330	30	1.531	8	2.194
rūšys	basement	22	2.598	22	1.616	22	1.323	37	2.707	37	1.671	10	2.127
namas	house	39	2.603	39	1.561	39	1.244	20	2.409	20	1.627	10	2.403
urvas	cave	18	2.649	17	1.639	17	1.445	20	3.335	20	1.645	16	3.060
daina	song	37	2.659	37	1.378	37	1.281	25	1.845	25	1.788	6	3.939
vonias	bath	7	2.671	5	2.147	5	1.993	19	2.847	18	1.893	21	3.285
pienas	milk	21	2.674	21	1.745	20	1.393	26	3.078	26	2.144	16	3.140
skėtis	umbrella	15	2.690	15	2.000	15	1.656	18	3.533	16	2.601	12	3.593
medis	tree	25	2.717	24	1.985	23	1.454	21	3.307	21	1.729	18	2.598
akis	eye	35	2.755	34	1.886	33	1.331	23	2.741	22	1.914	10	2.543
sausainis	cookie	27	2.757	27	1.654	25	1.291	25	2.581	25	1.767	15	2.208
raktas	key	9	2.807	7	1.674	7	1.164	25	3.397	22	1.900	16	2.773
kėdė	chair	16	2.868	15	1.680	15	1.340	19	2.123	19	1.689	15	2.387
adata	needle	15	2.868	15	1.899	15	1.323	28	2.867	27	1.854	15	2.426
želė	jelly	36	2.918	32	2.236	30	2.102	17	2.977	15	1.949	9	3.522
knyga	book	20	2.922	19	1.918	19	1.332	25	2.249	25	2.036	18	2.706
gėlė	flower	30	2.922	26	1.947	25	1.253	23	2.632	20	2.118	10	2.263
arbata	tea	12	2.928	12	1.982	12	1.574	28	2.839	27	1.749	19	2.756
koja	leg	18	2.942	17	1.387	17	1.374	31	2.533	31	1.362	8	2.781
duona	bread	18	2.959	16	2.070	15	1.569	24	2.456	23	1.839	21	3.201
šokis	dance	14	2.969	13	2.181	12	1.625	25	3.294	24	1.861	12	2.935
palaidinė	shirt	27	2.973	27	2.178	27	1.885	30	3.021	26	1.984	12	2.950
kareivis	soldier	9	3.002	9	2.933	9	1.572	34	3.049	34	2.240	12	2.192
kreida	chalk	11	3.050	10	1.713	10	1.577	20	3.064	20	2.643	11	2.462
maišas	bag	7	3.055	7	2.260	6	1.711	20	3.577	20	2.453	16	2.375
upė	river	40	3.058	40	1.442	40	1.322	16	2.603	16	1.436	11	2.536

Table A2 (Continued)

Word Pair		First Correct Recall in Trial 1						First Correct Recall in Trial 2				First Correct Recall in Trial 3	
		Trial 1		Trial 2		Trial 3		Trial 2		Trial 3		Trial 3	
Lithuanian	English	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>
tinklas	net	25	3.065	24	1.478	24	1.228	25	3.336	25	1.848	14	2.629
geležis	iron	5	3.070	4	2.967	4	2.071	24	3.613	24	1.691	21	3.908
batas	show	26	3.072	26	1.883	24	1.803	24	3.322	24	1.803	8	3.785
kumpis	ham	13	3.077	12	1.906	12	1.779	32	3.675	31	1.941	17	2.778
būgnas	drum	12	3.078	12	2.333	12	1.693	32	3.226	31	2.241	15	2.583
ledas	ice	11	3.080	11	1.714	11	1.589	20	3.238	20	1.873	15	4.249
kelnės	pants	21	3.081	17	1.699	17	1.904	18	2.605	15	1.860	14	1.961
strėlė	arrow	10	3.098	10	1.677	10	1.510	25	2.884	25	1.990	10	2.518
purvas	dirt	27	3.101	26	2.033	26	1.709	24	3.119	20	3.213	10	3.395
lietus	rain	15	3.152	15	1.896	15	1.710	20	3.483	19	2.542	22	2.700
šalmas	helmet	11	3.189	11	1.994	11	2.452	14	2.526	14	1.664	17	3.520
augalas	plant	17	3.191	17	2.042	15	1.648	28	2.835	27	2.040	12	3.153
pliažas	beach	26	3.198	26	1.910	26	1.580	26	3.108	25	1.916	9	2.939
dažai	paint	7	3.207	6	2.075	6	1.550	19	3.133	19	2.260	23	3.409
tvora	fence	12	3.210	12	2.825	12	1.942	25	2.777	24	2.105	14	2.635
puodelis	cup	15	3.220	14	2.085	14	1.715	26	3.146	25	2.035	14	2.950
bulvė	potato	14	3.227	14	1.919	14	1.565	26	2.571	25	1.795	14	2.412
auksas	gold	19	3.239	19	1.905	19	1.889	29	2.875	27	1.774	12	2.851
obuolys	apple	20	3.242	20	1.745	20	1.380	25	2.355	25	1.613	15	2.153
riteris	knight	16	3.263	15	1.457	15	1.601	25	2.445	24	1.687	16	2.230
kambarys	room	12	3.283	12	1.922	12	1.881	27	3.188	24	2.376	16	3.492
plyta	brick	10	3.325	10	2.255	10	1.825	31	3.136	30	1.815	21	3.711
medus	honey	15	3.344	13	1.786	12	1.499	20	2.554	19	1.958	16	3.363
žolė	grass	16	3.395	14	1.940	13	1.719	26	3.008	25	2.188	13	1.699
krautuvė	store	21	3.399	19	2.076	19	1.884	12	3.651	9	1.928	17	4.121
diržas	belt	6	3.408	5	2.027	5	1.780	19	4.537	16	2.219	18	3.626
kardas	sword	11	3.438	9	2.320	9	1.930	16	3.697	14	2.163	18	3.587
traukinys	train	21	3.444	21	1.702	21	1.375	34	2.531	31	1.677	13	2.610
miestas	city	16	3.455	16	1.961	16	1.726	29	3.093	28	2.379	19	3.182
durys	door	22	3.468	21	2.009	21	1.928	28	2.004	27	1.682	10	1.743
sriuba	soup	9	3.469	8	1.771	8	1.481	28	3.019	27	1.907	13	2.805
mokykla	school	28	3.473	28	1.902	28	1.494	30	3.092	30	1.693	8	2.388
smaragdas	emerald	11	3.480	11	2.488	11	1.870	23	2.943	20	1.714	21	2.617
mėnulis	moon	19	3.482	17	2.055	16	1.357	31	2.892	31	1.906	12	2.556
vaistas	drug	13	3.508	12	2.311	11	2.103	19	2.878	18	2.336	5	4.913
krosnis	stove	11	3.508	10	2.017	10	1.827	18	4.094	14	2.202	13	3.421
žiedas	ring	15	3.511	15	1.971	13	1.865	25	2.907	24	1.992	14	2.407
gatvė	street	6	3.517	6	1.553	6	1.908	29	3.155	28	2.172	19	2.711
karalius	king	34	3.560	31	2.284	31	2.035	16	3.139	15	3.048	11	3.291
vilkas	wolf	18	3.573	17	2.131	15	1.964	27	3.314	25	2.233	14	2.849
šakutė	fork	12	3.590	12	2.389	12	1.629	13	3.271	12	2.040	25	3.080
ugnis	fire	23	3.654	22	1.657	22	1.633	23	2.709	22	1.607	11	2.145
turgus	market	10	3.662	10	1.858	10	1.502	30	2.287	29	1.695	4	2.817
vėjas	wind	25	3.665	25	1.741	24	1.458	21	3.651	21	2.140	11	3.095
pastatas	building	25	3.727	23	1.770	22	1.780	33	2.754	31	2.105	14	3.805
žuvis	fish	13	3.746	10	2.448	9	2.935	18	3.044	13	1.650	18	3.624
plaukas	hair	12	3.751	9	2.054	9	2.311	19	4.186	18	2.144	20	2.778
lazda	baton	13	3.771	12	2.363	12	1.694	15	3.017	14	1.658	19	3.161
mygtukas	button	12	3.800	11	1.682	11	1.414	21	3.613	20	2.016	10	2.957
smuikas	violin	6	3.825	5	2.133	5	2.347	25	4.362	19	2.355	8	3.552
laidas	wire	11	3.842	8	2.206	6	1.889	16	3.465	16	3.082	14	2.554
pyragas	cake	23	3.842	22	2.436	22	2.392	21	3.278	21	2.363	15	3.207
mašina	car	11	3.876	10	1.550	10	1.522	28	3.021	27	2.173	13	2.947
langas	window	19	3.892	19	2.696	18	1.609	19	3.106	18	1.637	19	2.618
tvartas	barn	10	3.893	10	1.647	10	1.605	21	3.032	19	1.924	17	2.784
vanduo	water	18	3.899	17	2.576	17	1.840	25	2.725	24	2.083	15	2.640
laiptelis	stair	12	3.940	11	1.742	11	1.448	18	3.740	18	3.027	9	3.989
varpas	bell	3	3.972	3	2.200	3	1.894	6	2.522	5	2.120	11	2.776
vėžys	lobster	8	4.054	6	1.900	6	2.453	25	3.155	24	2.290	15	3.551
kriauklė	sink	6	4.067	5	2.263	5	1.687	15	3.299	14	1.921	13	3.287
žirklės	scissors	23	4.080	22	2.225	22	1.448	21	3.198	20	2.928	15	2.807
padažas	gravy	6	4.161	3	2.428	3	2.061	18	4.676	15	2.747	10	4.005
kirvis	axe	8	4.167	8	2.873	8	1.852	17	2.741	16	2.002	17	3.344
kraujas	blood	10	4.213	8	1.815	7	1.795	15	3.496	15	2.103	17	2.889
kablelis	hook	10	4.255	10	2.347	10	1.718	12	3.904	11	2.818	15	3.643
vinis	nail	18	4.281	18	2.221	18	1.423	23	3.189	22	1.711	10	3.352
piniginė	wallet	14	4.292	14	1.692	14	1.617	34	3.442	33	1.815	12	2.304
padanga	tire	15	4.313	15	2.148	15	2.071	30	2.729	29	1.640	11	3.094
kepuraitė	hat	11	4.482	9	2.246	9	2.152	24	3.638	21	2.766	16	4.208
kilimėlis	rug	14	4.501	14	2.089	14	1.873	24	3.231	23	2.025	12	3.014

Table A2 (Continued)

Word Pair		First Correct Recall in Trial 1						First Correct Recall in Trial 2				First Correct Recall in Trial 3	
		Trial 1		Trial 2		Trial 3		Trial 2		Trial 3		Trial 3	
Lithuanian	English	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>	<i>n</i>	<i>M</i>
kunigas	priest	12	4.540	11	2.570	11	2.076	29	3.428	26	2.575	15	3.030
kamuolys	ball	3	4.572	2	2.867	2	2.150	17	4.110	17	2.492	22	3.813
palėpštis	broom	13	4.715	12	2.082	11	1.770	24	3.015	24	1.591	7	2.610
laikrodis	clock	4	4.721	3	1.756	3	1.639	20	3.833	20	1.823	18	2.953
perukas	wig	10	4.958	8	1.948	8	1.898	21	3.516	21	2.616	14	3.706
šepetys	brush	8	4.983	8	2.385	8	1.473	17	4.296	16	2.235	20	4.206
voras	spider	8	4.988	7	2.169	7	2.529	22	3.645	20	1.984	19	3.489
paukštis	bird	15	5.058	14	3.460	14	2.012	22	3.443	21	2.383	11	4.005
svogūnas	onion	7	5.319	6	2.928	6	1.547	21	3.498	21	1.712	18	3.037
krantas	shore	2	6.633	2	3.408	2	6.617	12	3.243	9	2.104	21	4.721

Table A3
Error Frequencies and Rates of Commission Errors for Each Item Across Practice Trials

Word Pair		<i>n</i>	Number of Errors			Rate of Commission Errors		
Lithuanian	English		Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
lova	bed	80	19	8	4	.63	.63	1.00
pomidoras	tomato	80	46	28	16	.48	.43	.63
burna	mouth	79	46	16	8	.48	.56	.50
gėlė	flower	79	49	30	20	.47	.57	.55
sesuo	sister	81	41	11	5	.44	.82	.40
pastatas	building	80	55	24	11	.44	.63	.82
mėsa	meat	79	35	10	7	.43	.30	.71
daina	song	77	40	15	9	.43	.33	.67
tiltas	bridge	80	52	20	14	.40	.50	.36
namas	house	79	40	20	10	.40	.45	.40
pyragas	cake	79	56	36	20	.39	.44	.50
šalmas	helmet	78	67	53	36	.39	.34	.39
pienas	milk	79	58	32	17	.38	.31	.35
diržas	belt	79	73	55	39	.37	.40	.49
miestas	city	80	64	35	17	.36	.34	.41
rūsys	basement	78	56	19	9	.36	.42	.33
želė	jelly	78	42	29	21	.36	.41	.29
žirklys	scissors	80	57	37	23	.35	.41	.30
paukštis	bird	78	63	42	31	.35	.52	.42
nafta	oil	78	43	22	17	.35	.36	.35
strėlė	arrow	77	67	42	32	.34	.40	.47
pliažas	beach	79	53	27	19	.34	.41	.58
žolė	grass	78	62	38	26	.34	.29	.35
žuvis	fish	81	68	53	39	.34	.26	.33
laiptelis	stair	78	66	49	39	.33	.31	.36
maišas	bag	80	73	53	38	.33	.30	.50
smuikas	violin	76	70	46	44	.33	.33	.23
kunigas	priest	79	67	39	26	.33	.28	.38
lazda	baton	81	68	54	36	.32	.30	.36
arbata	tea	80	68	40	22	.32	.45	.50
langas	window	78	59	40	23	.32	.30	.35
kirvis	axe	80	72	55	39	.32	.22	.36
adata	needle	81	66	38	24	.32	.37	.54
mėnulis	moon	80	61	32	19	.31	.34	.26
vilkas	wolf	79	61	35	24	.31	.34	.50
duona	bread	79	61	39	18	.31	.36	.61
dūmai	smoke	75	55	28	20	.31	.43	.50
šakutė	fork	80	68	55	31	.31	.31	.48
stalas	table	77	68	49	36	.31	.29	.36
pupa	bean	79	43	14	7	.30	.43	.57
vėjas	wind	78	53	32	22	.30	.38	.32
kėdė	chair	79	63	45	29	.30	.44	.38
dažai	paint	77	70	52	29	.30	.33	.45
smaragdas	emerald	78	67	44	26	.30	.23	.50
palėpštis	broom	77	64	41	34	.30	.44	.47
palaidinė	shirt	81	54	24	16	.30	.29	.50
batas	shoe	80	54	30	24	.30	.23	.29
plyta	brick	78	68	37	17	.29	.30	.24
mašina	car	76	65	38	25	.29	.39	.48
riteris	knight	79	63	39	23	.29	.28	.39
šokis	dance	77	63	39	28	.29	.26	.54

Table A3 (Continued)

Word Pair		<i>n</i>	Number of Errors			Rate of Commission Errors		
Lithuanian	English		Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
būgnas	drum	79	67	35	21	.28	.43	.33
tvora	fence	79	67	42	29	.28	.29	.31
perukas	wig	77	67	48	33	.28	.21	.39
žiedas	ring	79	64	39	28	.28	.23	.39
ledas	ice	79	68	48	33	.28	.31	.39
sriuba	soup	77	68	41	29	.28	.17	.31
svogūnas	onion	75	68	48	29	.28	.31	.41
augalas	plant	78	61	33	24	.28	.30	.38
medus	honey	76	61	43	28	.28	.30	.29
šepetys	brush	80	72	55	36	.28	.22	.28
medis	tree	79	54	34	16	.28	.26	.38
piniginė	wallet	80	66	32	21	.27	.44	.38
turgus	market	80	70	40	37	.27	.28	.32
plaukas	hair	79	67	51	30	.27	.25	.37
kambarys	room	79	67	40	27	.27	.43	.70
traukinys	train	77	56	22	12	.27	.45	.67
vėžys	lobster	79	71	48	33	.27	.29	.45
vinis	nail	78	60	37	28	.27	.30	.46
krantas	shore	78	76	64	46	.26	.30	.41
kumpis	ham	82	69	38	21	.26	.21	.19
vonia	bath	76	69	52	30	.26	.27	.37
mokykla	school	78	50	20	12	.26	.60	.50
akis	eye	78	43	21	12	.26	.33	.50
ugnis	fire	78	55	33	22	.25	.18	.27
padažas	gravy	77	71	56	48	.25	.23	.31
gatvė	street	81	75	46	28	.25	.26	.32
geležis	iron	80	75	52	31	.25	.25	.35
padanga	tire	79	64	34	24	.25	.21	.33
stogas	roof	80	56	33	19	.25	.30	.37
upė	river	80	40	24	13	.25	.25	.46
kardas	sword	80	69	55	38	.25	.20	.37
vaistas	drug	78	65	47	43	.25	.32	.33
sausainis	cookie	80	53	28	15	.25	.36	.47
purvas	dirt	80	53	30	23	.25	.43	.39
varpas	bell	77	74	68	58	.24	.21	.28
muilas	soap	77	74	63	45	.24	.22	.24
kareivis	soldier	79	70	36	24	.24	.33	.38
skėtis	umbrella	77	62	44	34	.24	.34	.38
durys	door	76	54	27	18	.24	.41	.50
laiškas	letter	78	75	55	42	.24	.22	.31
karalius	king	80	46	33	22	.24	.24	.55
krautuvė	store	80	59	49	34	.24	.29	.47
vanduo	water	77	59	35	20	.24	.34	.30
knyga	book	80	60	36	17	.23	.31	.35
auksas	gold	79	60	31	21	.23	.19	.33
kriauklė	sink	79	73	59	46	.23	.37	.41
raktas	key	78	69	46	31	.23	.20	.32
kraujas	blood	75	65	52	34	.23	.40	.29
laikrodis	clock	78	74	55	37	.23	.29	.30
kreida	chalk	77	66	47	36	.23	.32	.44
kilimėlis	rug	81	67	43	32	.22	.28	.41
tinklas	net	79	54	30	15	.22	.43	.40
tvartas	barn	78	68	47	32	.22	.15	.22
kepuraitė	hat	81	70	48	34	.21	.27	.32
urvas	cave	79	61	42	26	.21	.38	.35
kamuolys	ball	79	76	60	37	.21	.27	.38
mygtukas	button	80	68	48	38	.21	.27	.24
kablelis	hook	78	68	56	42	.21	.21	.36
vėliava	flag	81	76	56	43	.20	.20	.21
lietus	rain	76	61	41	20	.20	.32	.35
smegenys	brain	77	51	27	17	.20	.33	.35
voras	spider	80	72	51	33	.19	.33	.30
laidas	wire	78	67	54	39	.19	.33	.36
kelnės	pants	81	60	46	33	.18	.26	.36
bulvė	potato	77	63	37	24	.17	.22	.29
obuolys	apple	78	58	33	18	.17	.24	.28
koja	leg	79	61	31	23	.16	.39	.48
krosnis	stove	78	67	50	41	.15	.26	.32
puodelis	cup	80	65	40	27	.12	.20	.26

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