Supporting Online Material for

The Critical Importance of Retrieval for Learning

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Supporting Online Material

Materials and Methods

In the experiment, 40 Washington University undergraduates learned a list of 40 Swahili-English word pairs (e.g., *mashua – boat*) selected from previously published norms (*S1*). The list of word pairs is shown in Table S1. Students learned the list across a total of 8 alternating study (S) and test (T) periods. The first study period consisted of 40 study trials followed by 40 test trials. After that, the number of study and test trials varied according to the condition. During study trials, students saw each Swahili word and its English translation on a computer screen for 5 sec and were told to study the pair so they could recall the English word given the Swahili word. After every study period, subjects performed a 30 sec distracter task that involved verifying multiplication problems. Each test period consisted of 40 or fewer test trials (depending on the condition). During test trials, students saw each Swahili word and a cursor and their task was to type the correct English translation. Each test trial lasted 8 sec after which the computer program automatically advanced to the next item regardless of whether the student had entered a response. If subjects failed to recall an item during testing, they were not given feedback.

The students learned the vocabulary words in one of four conditions. In the standard condition, students studied and were tested over the entire list of 40 pairs in each study and test period (denoted ST). In a second condition, students studied the entire list in the first period, were tested over the entire list in the second period, but then they restudied only the pairs they had not recalled on the previous test (denoted S_NT, where S_N indicates that only non-recalled pairs were restudied). The entire list was tested in each

test period in the S_NT condition. In a third condition, students studied the entire list in each study period, but only items that they had not yet recalled were tested in test period (denoted ST_N, where T_N indicates that only non-recalled pairs were repeatedly tested). All 40 pairs were studied each time in this condition. Finally, in a fourth condition, students restudied only non-recalled pairs and were tested only over non-recalled pairs (S_NT_N). Therefore, both the number of pairs studied and tested diminished across periods in this condition. This S_NT_N condition is the adjusted learning or dropout technique used in prior research (*S2-S4*). The condition also represents what students are often told to do: Study something until it is learned (or recallable) and then drop it from further practice. In the ST_N and S_NT_N conditions, students recalled each pair one time in the learning phase, whereas in the S_NT and ST conditions, students repeatedly recalled the pairs in every test period.

At the end of the learning phase, we asked students to predict how many of the 40 pairs they would recall on a final test in 1 week (an aggregate judgment of learning). Students were then dismissed and returned for the final test a week later. On the final test, subjects were shown each Swahili word for 15 sec and were told to type the correct English translation. After completing the test, subjects were debriefed and thanked for their participation.

Table S1

Forty Swahili-English word pairs used in the experiment

Number	Swahili	English
1	adhama	honor
2	adui	enemy
3	bustani	garden
4	buu	maggot
5	chakula	food
6	dafina	treasure
7	elimu	science
8	embe	mango
9	fagio	broom
10	farasi	horse
11	fununu	rumour
12	godoro	mattress
13	goti	knee
14	hariri	silk
15	kaa	crab
16	kaburi	grave
17	kaputula	shorts
18	leso	scarf
19	maiti	corpse
20	malkia	queen
21	mashua	boat
22	ndoo	bucket
23	nyanya	tomato
24	pazia	curtain
25	pipa	barrel
26	pombe	beer
27	punda	donkey
28	rembo	ornament
29	roho	soul
30	sala	prayer
31	sumu	poison
32	tabibu	doctor
33	theluji	snow
34	tumbili	monkey
35	usingizi	sleep
36	vuke	steam
37	yai	egg
38	zeituni	olives
39	ziwa	lake
40	zulia	carpet

References

S1.   T. O. Nelson, J. Dunlosky, *Memory*, **2**, 325 (1994).

S2.   R. S. Woodworth, *Psychol. Bull.*, **11**, 58 (1914).

S3.   W. F. Battig, *Psychon. Sci. Monogr. Supp.*, **1**, 1 (1965).

S4.   A. L. Gillette, *Arch. Psychol.,* **28** (1936).