

Supplementary material

Tartaro, G., Takashima, A., & McQueen, J.M. (in press). Consolidation as a mechanism for word learning in sequential bilinguals. *Bilingualism: Language and Cognition*.

These supplementary materials include:

- 1. Materials:** Critical stimuli (Table S1).
- 2. Procedure:** Timeline of tasks (Table S2) and descriptions of each training-phase task.
- 3. Results:** Error rates during the training phase (Table S3).

1. Materials

Table S1. Critical words used in the experiment. Each base word (used in pause detection) was paired with a novel word (used in training, recognition memory and primed lexical decision) and with words that were related and unrelated to the meaning of the novel word (used in primed lexical decision).

Base word	Novel word	Novel word meaning	Related word	Unrelated word
apple	appet	plinth	column	tiger
artichoke	articham	muff	cardigan	bottle
baboon	babake	hilt guard	sword	magma
baggage	baggen	watering can	plant	whale
bottom	bottang	hang glider	air	telephone
brother	brothon	allen key	hammer	cloud
business	businet	stool	chair	radio
cabbage	cabber	circular saw	wood	cavern
carpet	carpoke	spinning top	ball	bush
chamber	chambin	crane	truck	cascade
cliff	cliffon	junk	sail	animal
cockroach	cockroate	bib	baby	belt
donkey	donkoon	infusion pack	doctor	beast
dungeon	dungess	pacifier	mouth	jeep
movie	movva	dugong	dolphin	cross
flamingo	flamingit	trowel	brick	desk

hornet	hornan	pottery clay	mud	glasses
insurance	insurat	tarpaulin	camping	car
jewelry	jewelret	stump	tree	bicycle
joker	jokege	lyre	singer	bone
kitchen	kitchure	tabla	drum	volcano
lollipop	lollipat	street lamp	night	string
lullaby	lullabin	gate	wall	jeans
mistake	mistain	gothic arch	church	gift
nephew	nephon	ink quill	pen	ski
nugget	nuggip	shower head	bath	card
nursery	nurseroot	dragon fruit	banana	wife
onion	oniat	snow plough	winter	vegetables
peanut	peanob	figure-eight knot	knot	heart
pineapple	pineappote	dessert mouse	snake	printer
sponge	spont	carnation	rose	train
steward	steward	ice axe	ice	bank
sturgeon	sturget	rake	garden	jacket
thousand	thousart	fishing reel	fish	cave
thunder	thundit	tea infuser	tea	rock
ticket	tickup	beach chair	sand	cello
tomato	tomatey	stick insect	bee	page
treason	treasak	clothes peg	clean	power
warrior	warriamp	decanter	wine	steam
woman	womart	hot-water bottle	fever	tunnel
balloon	ballood	tuning pegs	guitar	lighter
blanket	blankon	horseshoe crab	shore	phone
blister	blistid	drill	factory	clown
bundle	bundert	merlon	tower	thermos
charcoal	charcane	great hornbill	parrot	metro
chicken	chickit	astrolabe	clock	salt

cinnamon	cinnamit	soap bubbles tool	bubble	mint
currency	currendle	candle wick	light	square
dwarf	dwart	bergamasco sheepdog	sheep	cigarette
effort	effork	siphon	metal	peach
elbow	elban	hairpin turn	road	lemon
enemy	enebo	halter	horse	cream
grocery	grocerage	cocktail spoon	spoon	anchor
hundred	hundrim	alembic	alchemist	hill
husband	husbaid	spear	knight	duck
juggler	juggly	harpoon cannon	arrow	puppy
lobster	lobsted	tiara	princess	cement
luggage	luggart	monowheel	bike	pear
mermaid	mermerk	scaffolding	construction	bear
misfit	misfen	percussion brushes	percussion	shadow
oatmeal	oatmeer	whisk	egg	head
pumpkin	pumpkit	bag valve mask	oxygen	gold
rabbit	rabbort	cigar cutter	cigar	penguin
raccoon	raccoot	pan flute	piano	berry
screen	screet	thinning scissors	hair	cannon
scuba	scubof	peruvian hat	hat	eagle
sister	sisstuck	electric cart	wheel	book
slogan	slogart	mantelpiece	fire	foot
spider	spidoot	kilij	shield	television
bacon	bacap	skylight	roof	orange
storage	storal	eyelash curler	eye	table
striker	strikup	cape	cloak	toast
sugar	sugot	solitaire board game	chess	steak
twilight	twiline	truss bridge	river	mail
uncle	unsho	lectern	speaker	baseball
velvet	velvage	palette	colour	pig

waitress	waitrean	exotic tree	leaf	cow
queen	queep	paint roller	painter	moon
walnut	walwot	pinwheel	wind	ankle
whisker	whiskimp	curtain rail	curtain	mummy
almond	almote	jewelry headband	necklace	bomb
apricot	apricon	stapler	paper	bulb
bachelor	bachelow	correction tape	rubber	tractor
bishop	bishot	diving mask	sea	star
blossom	blossor	nailfile	nail	veil
children	childrake	compass rose	map	bag
cucumber	cucumbess	stretcher	hospital	duke
daughter	daughtet	type blocks	print	dream
employ	emplate	microphone stand	microphone	corn
essay	essend	jet engine	airplane	fork
fridge	fridgel	naval ship	submarine	forest
friend	friemp	cherub	heaven	market
gambler	gamblook	canteen bottle	water	job
garlic	garlit	machine gun	gun	torch
glutton	gluttire	decorative hat plume	soldier	floor
hamster	hamstan	paddle	canoe	olive
harbor	harbet	millstone	oil	wave
holiday	holidage	picklock	knife	soap
inheritance	inheritay	tower of Hanoi	toy	hamburger
iron	irat	chimney	smoke	boat
kidney	kidnoff	pencil sharpener	pencil	bread
laundry	laundrap	sound mixer	computer	statue
lizard	lizark	toilet brush	toilet	cat
month	monet	honey dipper	honey	pub
mushroom	mushrin	carabiner	rope	mirror
napkin	napker	revolver cylinder	bullet	painting

nuance	nuamp	basque pelota bat	racket	mine
trouble	troubom	carriage	wagon	blender
referee	refeno	figurehead	ship	school
shrimp	shrint	sickle	grass	dog
smuggler	smuggleen	flintlock pistol	pistol	programmer
spindle	spinlant	rugby goal posts	rugby	key
tenant	tenom	crampon	snow	band
texture	textort	stew	soup	rocket
tissue	tissen	buoy	ocean	money
trousers	trousept	easel	brush	mister
tuxedo	tuxedair	psaltery	xylophone	wardrobe
weapon	weapal	mancala	game	button
window	windot	cervical collar	neck	jam
wolf	wolfary	pizza cutter	pizza	bamboo

2. Procedure

Table S2. An overview of the whole procedure, including the two days of training and the testing phase with the tasks used in each phase.

Day 0	Day 1	Day 2
Pre-test	Training:	Training:
	<ol style="list-style-type: none"> 1. Familiarization 2. Multiple Choice – Pictures – Oral repetition 3. Multiple Choice – Words – Written repetition 4. Word Completion – Oral 5. Multiple Choice – Pictures – Written repetition 6. Multiple Choice – Words – Oral repetition 7. Picture Naming – Oral 8. Multiple Choice – Pictures – Oral repetition 9. Picture Naming – Written 10. Familiarization 	<ol style="list-style-type: none"> 1. Familiarization 2. Multiple Choice – Pictures – Oral repetition 3. Multiple Choice – Words – Written repetition 4. Word Completion – Oral 5. Multiple Choice – Pictures – Written repetition 6. Multiple Choice – Words – Oral repetition 7. Picture Naming – Oral 8. Multiple Choice – Pictures – Oral repetition 9. Picture Naming – Written 10. Familiarization
	Test:	Test:
	<ol style="list-style-type: none"> 1. Free recall 	<ol style="list-style-type: none"> 1. Free recall 2. Recognition-memory task (fMRI) 3. Pause-detection task 4. Primed lexical-decision task

Description of tasks

Pre-test

Participants conducted a preliminary screening in order to check that they were eligible for the experiment (right-handed Italian native speakers, with normal or corrected-to-normal sight and hearing, no history of neurological or language-related disorders, should not have metal parts in the body, and should not have suffered from claustrophobia in the past).

In addition, knowledge of all English words used in the experiment was asked in order to confirm which of the words were unknown to the participants. Furthermore, we asked the participant's proficiency in English using (when available) the IELTS score (when not available, other tests, such as TOEFL, TOEIC or Cambridge CELA were converted to the equivalent IELTS score). We choose the IELTS as measurement of proficiency since is widely

considered a reliable evaluation of the level of English (Charge & Taylor, 1997)¹. The length of stay in English speaking countries was noted. Given the generally high level of English proficiency in the sample, the fact that none of them spoke Dutch, and the international English-speaking environment they all lived in, the Netherlands was considered to be an English speaking country.

Training tasks

Familiarization

The training phase started and ended with a familiarization task. This was done at the beginning of the training phase, to give initial exposure to all the novel words and their associated pictures and, at the end, to expose participants again with the correct novel word–picture pairings. During this task, for every trial, a fixation-cross appeared in the middle of the screen for 1 second. Then the picture of an object with the associated novel word underneath the picture appeared. After 500 ms, the word was presented auditorily through loudspeakers. At the offset of the novel word, the word “Repeat!” appeared on the screen and the subjects were instructed to repeat the word out aloud within 3 seconds. In each round of this task, all 40 novel word-picture pairs were presented one time each in a random order.

Multiple Choice Pictures, oral repetition

This task was conducted as the second and again as the eighth task of the training phase. For every trial, a fixation-cross appeared at the center of the screen for 1 second. Then one of the trained novel words appeared in the center of the screen together with four different images displayed in the four corners of the screen. The images had been exposed to the participants during the familiarization phase. One of them was the correct image (i.e., it was paired with the novel word during familiarization). 100 ms after the onset of the picture-word screen, the sound of the word was presented through the speakers. Participants were instructed to wait for their response until they had heard the full word. All answers given before the end of the sound were not registered. At acoustic offset, the subjects had to correctly associate the word with its image by selecting one of the four buttons of the pad, each of them representing one of the four corners of the screen. If the participant did not answer within 3 s, the trained word on the screen disappeared and the four pictures were substituted with digits 1, 2, 3 and 4, indicating the corresponding button press. A colored bar under the picture or the digit of the given answer informed the participant if the association was correct (green bar) or incorrect (red bar). After the colored bar feedback, the correct picture appeared at the center of the screen again with the associated novel word under it. After 100 ms the sound of the word was presented. At the offset of the auditorily presented word, “Repeat!” appeared on the top of the image and the participants were instructed to repeat the word within 2 seconds. This was done for all 40 trained picture-word associations once, one time each in a random order, in each round of this task.

Multiple Choice Words, written repetition

The third task was again a multiple-choice task. At the beginning, a fixation-cross appeared in the middle of the screen for 1500 ms. Then a picture from the trained set appeared in the middle of the screen with four novel words from the trained list in the four corners with one

¹ Charge, N., & Taylor, L. B. (1997). Recent developments in IELTS. *ELT Journal*, 51(4), 374-380.

of them being the correct option. If the participant did not answer within 3 s, the trained word on the screen disappeared and the four words were substituted with digits 1, 2, 3 and 4, indicating the corresponding button press. A colored bar under the word or the digit of the given answer informed the participant if the association was correct (green bar) or incorrect (red bar). After the response, the correct picture and the novel word appeared at the center of the screen and after 100 ms the auditory form of the word was presented. At the acoustic offset of the word “Write!” appeared on the top of the image and the participants had to write the word they had heard. When the subject pressed ENTER after he or she wrote the pseudo-word, the program moved to the next trial. This was done for all 40 trained picture-word associations, one time each in a random order.

Word completion

In the fourth task, the participants were instructed to name the pictures from the training list out loud. At the beginning of the trial a fixation-cross appeared in the middle of the screen for 1 s, then one of the images of the set was presented in the middle of the screen together with the first letter of the corresponding word underneath it and the phrase “Name it!” above the picture. Participants had 4 s to correctly orally name the picture. After 4 s, the picture and the letter disappeared and the phrase “Press the space-bar to have feedback” and the picture and the correct novel word under it appeared on the screen, followed by the pronunciation of the word through the speakers after 100 ms. At the offset of the spoken novel word the word “Repeat!” was shown on top of the picture. The participants were instructed to repeat the name of the picture within 2 s. Then the program continued to the next trial. This was done for all 40 trained picture-word associations, one time each in a random order.

Multiple Choice Pictures, written repetition

The fifth task was very similar to the second and eighth tasks. A trained novel word was shown in the center of the screen together with four picture options in the four corners, and the participant’s task was to choose the correct picture. The timing of presentation was the same as in the second and eighth tasks. However, after the button-press response, instead of overtly repeating the word, participants were instructed to type the word. This was done for all 40 trained picture-word associations, one time each in a random order.

Multiple Choice Words, oral repetition

The sixth task was very similar to the third task. Participants had to choose the corresponding word when cued with the picture. The timing of presentation was the same as the third task. After the correct auditory word feedback, participants were cued to repeat the word overtly within 2 s. Then the program moved on to the next trial. This was done for all 40 trained picture-word associations, one time each in a random order.

Picture naming – oral

The seventh task was a picture naming task. A trial started with a fixation-cross appearing for 1 s at the center of the screen, followed by a picture with the text “Name it!” on top of it. The participant had 3 s to orally name the picture. After 3 s, the picture with the correct name appeared on the screen and 100 ms later, the correct word was also presented via the speakers. At the word offset, “Repeat!” appeared on the screen and the participant were instructed to repeat the word within 2s. This was done for all 40 trained picture-word associations, one time each in a random order.

Picture naming – written

The ninth task was similar to the seventh task, but instead of repeating the naming the picture orally, participants were instructed to type in the word that was associated with the cued picture on the screen. When participants pressed “ENTER” upon completion of the word typing, the correct written word – picture – auditory word feedback was given and the participants were prompted to repeat the word orally. After 2 s, the trial moved on to the next. This was done for all 40 trained picture-word associations, one time each in a random order

3. Results

Table S3. Error rates (number of trials out of 40 and percentage) in all tasks in the training phase.

Tasks	Day1		Day2	
	Num trials	%	Num trials	%
2. Multiple Choice – Pictures – Oral repetition	13.6	34%	12.6	30%
3. Multiple Choice – Words – Written repetition	7.4	18.5%	6.4	16%
4. Word Completion – Oral	23.2	58.1%	19.9	49.8%
5. Multiple Choice – Pictures – Written repetition	7.4	18.5%	1.1	3%
6. Multiple Choice – Words – Oral repetition	1.7	4%	1.4	3.5%
7. Picture Naming – Oral	15	37.5%	12.7	31.8%
8. Multiple Choice – Pictures – Oral repetition	0.8	2%	0.6	1.5%
9. Picture Naming – Writing	15.8	39.4%	14.9	37.1%