## 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 | mova | 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 | stewand | ice axe | ice | bank |
| sturgeon | sturget | rake | farrot | clock |


| 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 | glutture | 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 |  |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Pre- } \\ & \text { test } \end{aligned}$ | Training: | 1. Familiarization | Training: | 1. Familiarization |
|  |  | 2. Multiple Choice - |  | 2. Multiple Choice - Pictures |
|  |  | Pictures - Oral repetition |  | - Oral repetition |
|  |  | 3. Multiple Choice - |  | 3. Multiple Choice - Words |
|  |  | Words - Written repetition |  | - Written repetition |
|  |  | 4. Word Completion - Oral |  | 4. Word Completion - Oral |
|  |  | 5. Multiple Choice - |  | 5. Multiple Choice - Pictures |
|  |  | Pictures - Written repetition |  | - Written repetition |
|  |  | 6. Multiple Choice - |  | 6. Multiple Choice - Words |
|  |  | Words - Oral repetition |  | - Oral repetition |
|  |  | 7. Picture Naming - Oral |  | 7. Picture Naming - Oral |
|  |  | 8. Multiple Choice - |  | 8. Multiple Choice - Pictures |
|  |  | Pictures - Oral repetition |  | - Oral repetition |
|  |  | 9. Picture Naming - |  | 9. Picture Naming - Written |
|  |  | Written |  |  |
|  |  | 10. Familiarization |  | 10. Familiarization |
|  | Test: | 1. Free recall | Test: | 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 Englishspeaking 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 wordpicture 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

[^0]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 pseudoword, 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 2 s . 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 <br> Num <br> trials | Day2 <br> Num <br> (rials |  |  |
| :--- | ---: | ---: | ---: | ---: |
| 2. Multiple Choice - Pictures - Oral repetition | 13.6 | $34 \%$ | 12.6 | $30 \%$ |
| 3. Multiple Choice - Words - Written <br> 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 | 7.4 | $18.5 \%$ | 1.1 | $3 \%$ |
| repetition | 1.7 | $4 \%$ | 1.4 | $3.5 \%$ |
| 6. Multiple Choice - Words - Oral repetition | 15 | $37.5 \%$ | 12.7 | $31.8 \%$ |
| 7. Picture Naming - Oral | 0.8 | $2 \%$ | 0.6 | $1.5 \%$ |
| 8. Multiple Choice - Pictures - Oral repetition | 15.8 | $39.4 \%$ | 14.9 | $37.1 \%$ |
| 9. Picture Naming - Writing |  |  |  |  |


[^0]:    ${ }^{1}$ Charge, N., \& Taylor, L. B. (1997). Recent developments in IELTS. ELT Journal, 51(4), 374-380.

