**SUPPLEMENTARY MATERIAL**

**Selection of stimuli**

All items and distracters had an age of acquisition (AoA) of ≤3.1 on the rating scale of 1 to 7 used by Gilhooly and Logie (1980), which is equivalent to an AoA of 5.2 years. This criterion was set to ensure that there was a sufficient item pool to draw from and is in line with the finding that AoA ratings collected from adult samples tend to overestimate AOA by around 16 months relative to ratings made by parents of children of that age (Morrison, Chappell, & Ellis, 1997). In the tasks involving pictures, words were selected to be highly imageable. The images used were all in color, in a similar clip art style, and approximately equal in size. Imageability and AoA scores were taken from the MRC Psycholinguistic Database (Coltheart, 1981). Where a word could not be found within this database, other norms were referred to (Cortese & Khanna, 2008; Stadthagen-Gonzalez & Davis, 2006). Some words did not appear in any of the databases. For these words,

(a) the principal author used their professional judgment as to whether they were likely to be known by a child in nursery, based on several years’ experience of working with young children.

(b) The words were also presented to a group of teachers and parents of young children to judge whether they would expect a nursery age child to know them.

Post hoc analysis of ratings found a mean agreement of 86%.

**Further details on task instructions and difficulty coding**

*Initial sound task*

Children were told that a puppet would say a sound, and they had to guess, from that sound, which picture (out of a row of four) the puppet wanted. The task consisted of 24 items that included a range of initial phonemes. Half of the trials were coded as “easy” and half as “hard” with the level of difficulty being determined by the articulatory distance between the initial phonemes of the target and distracter items. For hard trials, the initial phonemes of the target word and the closest distracter differed by only one feature of voice, manner, or place (e.g., child hears /f/ and the closest distracter is “van”). For easy trials, all distracters differed in the voice, manner, and place of the initial phoneme relative to the target word (e.g., child hears /z/ and the closest distracter is “pen”). For target words beginning with a vowel, hard trials were defined as those where the closest distracter also began with a vowel, whereas all distractors in easy trials began with consonants.

*Mispronunciation reconstruction and detection tasks*

The mispronunciation reconstruction task and mispronunciation detection task were combined for ease of administration. Children were introduced to an on-screen alien who “sometimes says words properly and sometimes says them a bit wrong.” They heard the alien produce a word (correctly or incorrectly) and were asked to choose which of four pictures he was trying to say. It was explained to children that it would be easy when the alien said the word properly, but when he said it wrong they would need to listen carefully and think, “What does it sound the most like?” (the reconstruction component of the task). After the child pointed to one of the pictures, the correct item then appeared on the screen, the child heard the word again and was asked whether the alien said it properly (the mispronunciation detection component of the task).

Each target word was presented correctly and incorrectly with the correct and incorrect presentations occurring in different testing sessions. The task consisted of six of each of the following classes of mispronunciation: initial consonant substitution, final consonant substitution, deletion of a consonant from a consonant cluster, and vowel substitution. For mispronunciations involving substitutions, stimuli were selected so that there were three easy and three hard items within each category. For the mispronunciation reconstruction task, “easy” consonant substitutions involved a change in only one feature (voice, manner, or place). Easy vowel substitutions were those where the substitution was acoustically close, for example, net 🡪 *nairt* and “hard” vowel substitutions were acoustically distant, for example, hat 🡪 *hute.* For the mispronunciation detection task the difficulty coding was reversed, because although acoustic similarity between the target word and the mispronunciation makes reconstruction easier, it makes discrimination harder.

*Mispronunciation decision task*

Children were presented with a target picture on screen and heard two aliens say the word, one correctly and one incorrectly. The child was told that “both aliens will try and say the word. Each time one of them will say the word properly and one of them will say it a bit wrong.” The child was asked to point to the alien who said the word properly. This task involved the same 24 target words and corresponding mispronunciations as the mispronunciation reconstruction and detection tasks above.

*Word repetition task*

Children were told that an on-screen alien would say lots of words and he wanted them to copy each one. The 3 practice items and 20 test items were prerecorded and presented through a speaker, and children’s responses were recorded. Stimuli consisted of 40 CVC words.

*Nonword repetition*

This task had the same format as the word repetition task, but children were told that this time the alien “won’t say real words. He’ll say silly words like *lig*.” The 40 nonword stimuli were generated by vowel substitution, for example, book 🡪 [baʊk] to create an item that was either a true nonword or a very obscure word that was likely to be perceived as a nonword by the child.

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Table S.1. *Initial sound task stimuli*

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Initial sound | | Target word | Distracters |  | | |  | Initial sound difficulty type | | | |
| Training item | | |  |  |  |  | | |  | |
| /s/ | /sɒk/ | | /æpl/ | /bɹʌʃ/ | /maʊs/ | | | fricative | | easy | | |
|  | | |  |  |  | | |  | |  | | |
| Test items | | |  |  |  | | |  | |  | | |
| /ɛ/ | /ɛg/ | | /mæn/ | /dʌk/ | /tɹi:/ | | | vowel | | easy | | |
| /tʃ/ | /tʃi:z/ | | /mæn/ | /gʌn/ | /zɪp/ | | | affricate | | easy | | |
| /v/ | /væn/ | | /fɛ: ɹi/ | /kæt/ | /zɛbɹə/ | | | fricative | | hard | | |
| /l/ | /laɪn/ | | /dɒg/ | /naɪf/ | /kɪŋ/ | | | liquid | | hard | | |
| /ɒ/ | /ɒktəpəs/ | | /kɑ/ | /bənɑnə/ | /tɹeɪn/ | | | vowel | | easy | | |
| /l/ | /læmp/ | | /kɹæb/ | /pɛn/ | /fɔk/ | | | liquid | | easy | | |
| /p/ | /pəteɪtəʊ/ | | /naɪf/ | /lɒg/ | /dʒɛli/ | | | voiceless plosive | | easy | | |
| /ɛ/ | /ɛləfənt/ | | /bɔl/ | / ɒɹɪndʒ/ | /eɪpɹən/ | | | vowel | | hard | | |
| /n/ | /nɛt/ | | /hɛlɪkɒptə/ | /kæp/ | /fəʊn/ | | | nasal | | easy | | |
| /f/ | /fɪʃ/ | | /væn/ | /bæg/ | /sɒsɪdʒ/ | | | fricative | | hard | | |
| /p/ | /peɪnt/ | | /tɔɪlət/ | /bɛd/ | /ɹʌg/ | | | voiceless plosive | | hard | | |
| /n/ | /neɪl/ | | /mɑsk/ | /dɒl/ | /hɛn/ | | | nasal | | hard | | |
| /aɪ/ | /aɪyn/ | | /ɑm/ | /hæt/ | /ʌmbɹɛlə/ | | | vowel | | hard | | |
| /k/ | /kəʊm/ | | /ti:θ/ | /gɜl/ | /li:f/ | | | voiceless plosive | | hard | | |
| /æ/ | /ænt/ | | /kʌp/ | /teɪbl/ | /dɒg/ | | | vowel | | easy | | |
| /ʃ/ | /ʃi:p/ | | /nɛt/ | /gʌn/ | /bɑθ/ | | | fricative | | easy | | |
| /t/ | /tæp/ | | /maʊs/ | /dʒɑ/ | /ɹɪŋ/ | | | voiceless plosive | | easy | | |
| /k/ | /ki:/ | | /ɹʌg/ | /mu:n/ | /dʒɛli/ | | | voiceless plosive | | easy | | |
| /aʊ/ | /aʊl/ | | /æpl/ | /sɒk/ | /ɪglu:/ | | | vowel | | hard | | |
| /m/ | /mʌg/ | | /tʃɛə/ | /keɪk/ | /swi:t/ | | | nasal | | easy | | |
| /s/ | /stɑ/ | | /tɛdi/ | /bəʊt/ | /haʊs/ | | | fricative | | hard | | |
| z | /zɛbɹə/ | | /pɛn/ | /tʃi:z/ | /kɑ/ | | | fricative | | easy | | |
| m | /mɪɹə/ | | /sɪŋk/ | /nəʊz/ | /wɪtʃ/ | | | nasal | | hard | | |
| t | /ti:pɒt/ | | /pɛnsl/ | /dɒg/ | /væn/ | | | voiceless plosive | | hard | | |

Table S.2. *Mispronunciation reconstruction and detection task stimuli*

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mispron-unciation | Target word | | Distracters | |  | |  | Mispronunciation  type | | | Articulatory distancea |
| Training items | | | | | | | | | | | |
| N/A\* | /taɪgə/ | | /bʊk/ | | /pɛnsl/ | | /kæt/ | N/Ab | | | N/Ab |
| /hændwɪtʃ/ | /sænwɪdʒ/ | | /kætəpɪlə/ | | /bʌs/ | | /hɛlɪkɒptə/ | initial consonant substitution | | | minimal |
| N/A\* | /maʊs/ | | /pi:tsə/ | | /mæn/ | | /kʌp/ | N/Ab | | | N/Ab |
| /ʃəʊp/ | /səʊp/ | | /kəʊm/ | | /swi:t/ | | /ki:z/ | initial consonant substitution | | | minimal |
| Test items | |  | |  | |  | | |  |  | |
| /pɛf/ | /pɛn/ | | /mɛn/ | | /pɪn/ | | /kæt/ | final consonant substitution | | | maximal |
| /fəʊt/ | /bəʊt/ | | /hɑt/ | | /fɔk/ | | /sʌn/ | initial consonant substitution | | | maximal |
| /nɛərt/ | /nɛt/ | | /kəʊt/ | | /nəʊz/ | | /maʊs/ | vowel substitution | | | minimal |
| /gʌp/ | /gʌn/ | | /kæp/ | | /gɜl/ | | /kəʊt/ | final consonant substitution | | | maximal |
| /nɒg/ | /dɒg/ | | /lɛg/ | | /nɛt/ | | /bʊk/ | initial consonant substitution | | | minimal |
| /keɪg/ | /keɪk/ | | /rʌg/ | | /kɒt/ | | /dɒl/ | final consonant substitution | | | minimal |
| /teɪn/ | /reɪn/ | | /gʌn/ | | /tæp/ | | /hɑt/ | initial consonant substitution | | | maximal |
| /hju:t/ | /hæt/ | | /kɒt/ | | /hɛn/ | | /væn/ | vowel substitution | | | maximal |
| /drɪk/ | /drɪŋk/ | | /drʌm/ | | /bʊk/ | | /tɛnt/ | deletion of a consonant from a consonant cluster | | | N/A |
| /pɒn/ | /pɒnd/ | | /hɛn/ | | /pɪg/ | | /kæt/ | deletion of a consonant from a consonant cluster | | | N/A |
| /pæp/ | /tæp/ | | /kʌp/ | | /pɪn/ | | /dʌk/ | initial consonant substitution | | | minimal |
| /pæg/ | /bæg/ | | /dɒg/ | | /pɛn/ | | /hɔs/ | initial consonant substitution | | | minimal |
| /fɔɪk/ | /fɔk/ | | /bʊk/ | | /fi:t/ | | /væn/ | vowel substitution | | | minimal |
| /pɑg/ | /pɪg/ | | /dɒg/ | | /pɛn/ | | /bəʊl/ | vowel substitution | | | maximal |
| /su:l/ | /stu:l/ | | /bɔl/ | | /mun/ | | /reɪn/ | deletion of a consonant from a consonant cluster | | | N/A |
| /fɒt/ | /fi:t/ | | /but/ | | /fɪʃ/ | | /reɪn/ | vowel substitution | | | maximal |
| /wi:n/ | /kwi:n/ | | /bɪn/ | | /ki:z/ | | /fɪʃ/ | deletion of a consonant from a consonant cluster | | | N/A |
| /sɒt/ | /sɒk/ | | /sʌn/ | | /nɛt/ | | /pɪg/ | final consonant substitution | | | minimal |
| /sɛp/ | /stɛp/ | | /kæp/ | | /nɛt/ | | /wɪtʃ/ | deletion of a consonant from a consonant cluster | | | N/A |
| /tɛt/ | /tɛnt/ | | /tæp/ | | /kæt/ | | /sɪŋk/ | deletion of a consonant from a consonant cluster | | | N/A |
| /heɪn/ | /hɛn/ | | /bɪn/ | | /hæt/ | | /maʊs/ | vowel substitution | | | minimal |
| /dɒd/ | /dɒl/ | | /bɛd/ | | /dʌk/ | | /bæg/ | final consonant substitution | | | minimal |
| /bɔf/ | /bɔl/ | | /fɔk/ | | /but/ | | /kəʊt/ | final consonant substitution | | | maximal |
| /hɪn/ | /bɪn/ | | /mæn/ | | /haʊs/ | | /bʊk/ | initial consonant substitution | | | maximal |

a Articulatory distance between the mispronunciation and the target word.

b Two of the training items involved correct pronunciations of the target word

Table S.3. *Mispronunciation decision stimuli*

|  |  |  |  |
| --- | --- | --- | --- |
| Mispron-unciation | Target word | Mispronunciation  type | Acoustic distancea |
| Training item | |  |  |
| /læt/ | /kæt/ | initial consonant substitution | maximal |
|  | |  |  |
| Test items | |  |  |
| /pɛf/ | /pɛn/ | final consonant substitution | maximal |
| /fəʊt/ | /bəʊt/ | initial consonant substitution | maximal |
| /nɛ:ət/ | /nɛt/ | vowel substitution | minimal |
| /gʌp/ | /gʌn/ | final consonant substitution | maximal |
| /nɒg/ | /dɒg/ | initial consonant substitution | minimal |
| /keɪg/ | /keɪk/ | final consonant substitution | minimal |
| /teɪn/ | /reɪn/ | initial consonant substitution | maximal |
| /hju:t/ | /hæt/ | vowel substitution | maximal |
| /drɪk/ | /drɪŋk/ | deletion of a consonant from a consonant cluster | N/Ab |
| /pɒn/ | /pɒnd/ | deletion of a consonant from a consonant cluster | N/Ab |
| /pæp/ | /tæp/ | initial consonant substitution | minimal |
| /pæg/ | /bæg/ | initial consonant substitution | minimal |
| /fɔɪk/ | /fɔk/ | vowel substitution | minimal |
| /pɑg/ | /pɪg/ | vowel substitution | maximal |
| /sul/ | /stul/ | deletion of a consonant from a consonant cluster | N/Ab |
| /fɒt/ | /fi:t/ | vowel substitution | maximal |
| /wi:n/ | /kwi:n/ | deletion of a consonant from a consonant cluster | N/Ab |
| /sɒt/ | /sɒk/ | final consonant substitution | minimal |
| /sɛp/ | /stɛp/ | deletion of a consonant from a consonant cluster | N/Ab |
| /tɛt/ | /tɛnt/ | deletion of a consonant from a consonant cluster | N/Ab |
| heɪn | hɛn | vowel substitution | minimal |
| dɒd | dɒl | final consonant substitution | minimal |
| bɔf | bɔl | final consonant substitution | maximal |
| hɪn | bɪn | initial consonant substitution | maximal |

a Articulatory distance between the mispronunciation and the target word.

Table S.4. *Word and nonword repetition stimuli*

|  |  |
| --- | --- |
| Word | Nonword |
| Training items |  |  |
| boat | */lɪg/* |
| car | */vɑ/* |
| dig | */dɒf/* |
| Test items |  |
| bed | */bɔɪd/* |
| call | */kɛl/* |
| some | */sɛm/* |
| dot | */dæt/* |
| fat | */fɒt/* |
| tap | */tɛp/* |
| shed | */ʃid/* |
| cake | */ki:k/* |
| gun | */gæn/* |
| lap | */lʊp/* |
| sun | */sæn/* |
| men | */mʊn/* |
| ball | */bɜrl/* |
| tool | */tʊl/* |
| net | */nɛət/* |
| kick | */kaʊk/* |
| hall | */hɒl/* |
| half | */hɪf/* |
| nose | */nɑz/* |
| pool | */pɑl/* |
| hide | */hɒd/* |
| hurt | */hɔɪt/* |
| back | */baʊk/* |
| night | */nɜt/* |
| shop | */ʃup/* |
| fight | */fɛt/* |
| pet | */pɜt/* |
| hate | */haʊt//* |
| wool | */wæl/* |
| note | */nɔɪt/* |
| bowl | */bæl/* |
| road | */rʊd/* |
| bag | */bju:g/* |
| wash | */wɔɪʃ/* |
| burn | */bɒn/* |
| win | */waʊn/* |
| line | */lʊn/* |
| howl | */hæl/* |
| book | */bɒk/* |
| pot | */pju:t/* |