Methods

The typically developing (TD) children and children with word finding difficulty (WFD) were assessed on four core tasks: 1) picture naming as a measure of children’s ability to retrieve and produce words in response to a picture, 2) word-picture verification as a measure of the children’s knowledge of the word (to score correct they needed to both accept the target name and on a separate occasion reject the name of a close semantic co-ordinate), 3) picture judgement using a sub set of the naming items designed as a measure of associative semantics, 4) nonword repetition to explore the children’s phonological abilities when lexical processing is not required. The use of the picture judgement task and the non-word repetition task enabled examination of the children’s ability to deal with meaning in the absence of form and the reverse, i.e. form in the absence of meaning. Children were also assessed on background tasks of simple and choice reaction time, nonverbal ability and receptive vocabulary. Nonverbal ability was assessed with the British Ability Scales Pattern Construction subtest (Elliot, Smith, & McCullouch, 1996), and receptive vocabulary was assessed with the British Picture Vocabulary Scales (Dunn, Dunn, & Styles, 1997).

Details of core tasks and simple and choice reaction time tasks

Picture naming: The stimuli were 72 black and white line drawings of objects from Funnell, Hughes and Woodcock (2006). The objects were from four categories, with 18 items in each. Two categories represent living things and two represent artefacts. The task was programmed using the experimental software DMDX (Forster & Forster, 2003) running on a laptop computer with 15.4” screen. Naming responses were recorded using an external microphone connected to the laptop. Items were presented in one session divided into three blocks of 24 items each. Children were asked to provide a single word for each picture. The tester moved to the next item as soon as the name was produced. Responses were recorded at the time of testing and checked later from the recording. Four fixed randomized orders were rotated across children during testing. No more than two objects from the same category appeared in succession. Each trial began with the presentation of a fixation cross in the centre of the screen for 500 msecs. Then the picture appeared and stayed on the screen for a maximum of 5000 msecs in the case of the TD children and 10000 msecs in the case of children with word finding difficulty. Three items, not used in the main testing session, were presented for practice. Feedback on accuracy was given during the practice trials but not during the main task.

Naming responses were recorded using an external microphone connected to the laptop. CheckVocal software (Protopapas, 2007) was used to obtain naming latencies. Accuracy of the naming responses was also recorded. The classification scheme shown in the appendix was used for qualitative analysis of naming errors.

Word-Picture Verification Task (WPVT): A word-picture verification task was developed using the pictures from the naming task. It involved presenting one picture at a time on the computer together with a pre-recorded spoken word. On one occasion the picture was presented with the matching word and on another the picture was presented with a semantically related word. The child was asked to decide if the spoken word corresponded to the picture or not. Seventy-two object names were selected that were semantically related to the objects depicted in the Funnell et al. pictures. Related object names that were phonologically close to the target picture name or that started with the same phoneme (e.g., picture of a butterfly, semantically related word “bee”) were replaced.

The names of the pictures and the semantically related words were recorded by an adult English speaker. The audio files were edited to add 500 msecs of silence at the beginning and end of each file. The task was run on a laptop computer with a 15.4” screen and was programmed using the software DMDX (Forster & Forster, 2003). There were two testing sessions with individual target pictures appearing once in each session. In one session the picture appeared with its name, and in the other with the semantically related word. The 72 items in each testing session were split into three blocks of 24 items each with a rest pause between blocks. Children were asked to press designated response buttons on the keyboard. Responses were scored correct only if the child accepted the correct name and rejected the semantically related word. Three practice trials were presented with stimuli that were not included in the main testing session. Feedback was given after practice trials only. Four fixed random orders of stimuli were rotated across participants. Each trial began with the presentation of a fixation cross in the centre of the screen for 500 msec. The picture preceded the audio file by 16.62 msecs.

Picture judgement task of associative semantics (PJs): In this task three pictures depicting objects were presented - a target together with two pictures underneath. One of the two pictures presented in the lower part of the screen had an associative semantic relationship to the target, the second came from the same semantic category as the first. Sixty-nine pictures depicting items from the Funnell et al. (2006) and Druks and Masterson (2000) picture sets were selected from the Shutterstock website. The task was administered using a laptop computer with screen size 15.4” and it was programmed using Visual Basic software. There were three practice trials using items that did not appear in the main session and twenty trials in the main task. A fixation point appeared at the start of each trial. Children were asked to choose which of the two items in the lower part of the screen fitted best with the item at the top using designated response keys covered with stickers. Feedback on accuracy was only given during practice trials.

Nonword Repetition: The Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996) was used to explore the children’s phonological abilities when lexical processing is not required. The nonwords were administered singly for repetition according to manual instructions. Responses were scored at the time of testing and audio-recorded for later checking.

Simple and Choice Reaction Time: Computerized tasks of simple and choice reaction time were adapted from Powell, Stainthorp, Stuart, Garwood and Quinlan (2007) and programmed on a laptop computer with a 15.4 inch screen using the DMDX software (Forster & Forster, 2003). The simple reaction time task measured the time taken to make a key press response following the appearance of a target on the screen. Six different coloured drawings of monster characters were the target stimuli. The six pictures and instructions appeared on the welcome screen. The instructions were read aloud to ensure that the child understood the task. There were six items for practice followed by two blocks of 18 trials each. Each trial started with the presentation of a fixation point (a black cross) in the centre of a white screen, followed by a lag and then the appearance of the target stimulus. The duration of the lag varied, to discourage anticipatory responses, and was either, 300, 600 or 900 msecs. The lag times were randomised across trials and presentation of the six target stimuli was also randomised across trials. The target stimuli remained on the screen for 1500 msecs.

In the choice reaction time task the child was asked to decide which of two stimuli appeared on the computer screen, and to press the appropriate response key as quickly as possible. The targets were two dinosaur pictures (one green and one orange) from the Shutterstock pictures. Children were asked to press the left Ctrl button as soon as the green dinosaur appeared, or the right Ctrl button if the orange dinosaur appeared. Green and orange stickers were placed on the two buttons. As for the simple reaction time task, instructions that appeared on the welcome screen were read aloud by the tester. A mouse press initiated the practice block of six items, with half containing the orange and half the green dinosaur. A black fixation cross appeared in the middle of the white screen for 500 msecs followed by the target stimuli. Lag times varied in randomised order, as did appearance of either the orange or green dinosaur. The lag times were 300, 600 or 900 msecs. The target stimulus remained on the screen for 1500 msecs. There were two blocks of 18 trials each in the main test session.

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Appendix

Error categorisation for qualitative analysis of picture naming errors

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| --- | --- | --- | --- |
| Error type | Error subtype | Description | Examples |
| Semantic | coordinate | within same semantic category  | donkey named *horse* |
|  | superordinate | semantic category to which target belongs  | ostrich named *bird* |
|  | functional | functional attributes/use of target  | trowel named *digger* |
|  | circumlocution | multiword descriptive response | grater named *something that you grate cheese on* |
|  | visual attributes | similar physical features | scorpion named *crab* |
| Phonological | nonwords | nonword that shares at least 50% phonemes with target | caravan named *carara* |
|  | formal | real word that shares at least 50% phonemes with target, but not semantically related  |  |
| Mixed | semantic and phonological | semantically and phonologically-related  | tractor named *truck* |
| Perceptual |  | misperception of target | nest named *hedgehog* |
| Other |  | No response, unspecified noun, unrelated  | *don’t know, stuff, I know it*  |