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Gabriella Vigliocco
Experimental Psychology, UCL

Courtenay Norbury
Language and Cognition, UCL

Marta Ponari
School of Psychology, University of Kent

About the Authors

Gabriella Vigliocco is Professor of the Psychology of Language at University College London**.** Her research concerns language development and processing and she is especially interested how language helps learning and sharing about the world. If you want to know more about Gabriella's work, visit: http://www.language-cognition-lab.org/

Courtenay Norbury is Professor of Developmental Disorders of Language and Communication at University College London. Her research focuses on language disorders in a range of neurodevelopmental conditions and how language interacts with other aspects of development. If you want to know more about Courtenay's research, visit: http://www.ucl.ac.uk/pals/people/profiles/academic-staff/courtenay-norbury

Marta Ponari is Lecturer in Cognitive Psychology at the University of Kent. Her research focuses on social cognition, and she is particularly interested in the role of a range of individual differences in processing emotion in language and in recognising emotions in others. If you want to know more about Marta's research, visit: https://www.kent.ac.uk/psychology/people/ponarim/

EXECUTIVE SUMMARY

Learning and using abstract concepts like *idea* or *freedom* is essential to academic achievement as all high-level societal, cultural and scientific endeavors are heavily based on the ability to grasp and manipulate abstract ideas. Despite this, there is not much research investigating how abstract concepts are learned during childhood. We know very little about when children learn abstract words and concepts, and what factors support their acquisition. Moreover, we do not know whether abstract concepts are especially hard to learn for atypically developing children, like children with Developmental Language Disorders (DLD), or Autistic Spectrum Disorders (ASD).

In this project we provide first evidence concerning the questions above. In particular:

- **When do children learn abstract words and concepts? What are the words and concepts learnt at different ages?** Our work shows that, for typically developing children, the majority of abstract words are learnt between the ages of six and ten. Children learn some abstract words earlier, typically these refer to emotions (*happy*, *sad*) or have emotional content (*good*, *bad*). In general, up to the age of nine, children learn more abstract words that have emotional associations, especially positive associations (e.g., *hope*) than words without such associations (e.g., *plain*), which are learnt later. *These findings provide a benchmark against which to evaluate the developmental trajectory of abstract vocabulary learning.*
- **What are the factors supporting learning of abstract words and concepts?** We found that typically developing children learn better at first words with emotional (especially positive) associations. More precisely, we found that children both <u>know</u> more abstract words as well as more easily <u>learn</u> new abstract words with emotional associations up until about the age of 9. Thus, emotional processing appears to be an important factor underscoring learning abstract vocabulary. Later on, from the age of 10, as linguistic abilities develop, this is not the case anymore. *Thus, formal teaching of abstract concepts and words should take into account that up to age 9, concepts with emotional association may be easier to learn than those without.*
- **Are abstract concepts especially hard to learn for atypically developing children?** We studied for the first time learning of abstract concepts in children with DLD and ASD. In both groups we found that while children with a language deficit (both DLD and those ASD children with associated poor language) show poorer knowledge of words, this is the case for <u>both</u> concrete and abstract words, contra to common wisdom according to which abstract words (because overall more difficult) should be especially hard for these children. Importantly, children with ASD, without associated language impairment, did not differ from their typically developing peers. *Thus, speech and language therapy should equally focus on concrete and abstract words and concepts in order to allow children with language impairments to access abstract ideas.*
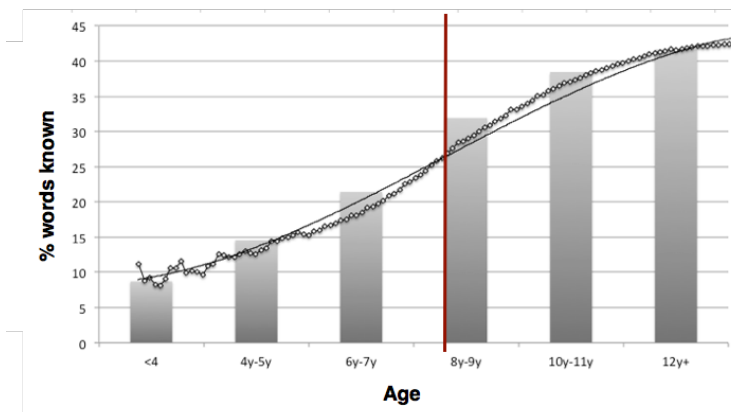
1. KEY FINDINGS

Figure 1: Percent of known abstract words (over total vocabulary) at different ages computed on age-of-acquisition norms (from Ponari, Norbury & Vigliocco, 2017)

1.1 When do children learn abstract words and concepts?

First, we looked at when children learn abstract words and concepts by carrying out analyses of an existing large database on "age-of-acquisition" (AoA) norms for more than 10,000 English words. These are ratings provided by adults asked to indicate when themselves had learnt all sorts of words. **Figure 1** shows the percentage of abstract words (over total vocabulary) being known from 4 to 14 years. The curve in the figure indicates that the rate of learning changes at about 9 years of age from a steep increase in the number of abstract words being learnt to a slower rate and therefore it highlights how the majority of abstract vocabulary is learnt _between the age of 6 and 9_, coinciding with primary school education.

1.2 What are the words and concepts learnt at different ages?

According to the AoA data, among the first abstract words being learnt up to the age of 4 are emotion words such as "happy" and "sad" and other words with emotional associations such as "good", "bad", "cute" and "naughty". Importantly, up to about the age of 9, children tend to know more abstract words with emotional associations than neutral words (e.g., it is more likely they know words such as "hope" than "plain", even if all these words do not differ on other dimensions such as their frequency in the language and their length, see **Figure 2**). As the AoA data are ratings from adults, we then also carried out studies with children (aged 6-11). In particular, we engaged them in a game in which they had to help an alien recognizing real words among fake words. Here, we found that up to the age of 9, children were better able to recognize abstract words with emotional (especially positive) associations. No difference between words with or without emotional associations was found after this age (Ponari et al., 2017).
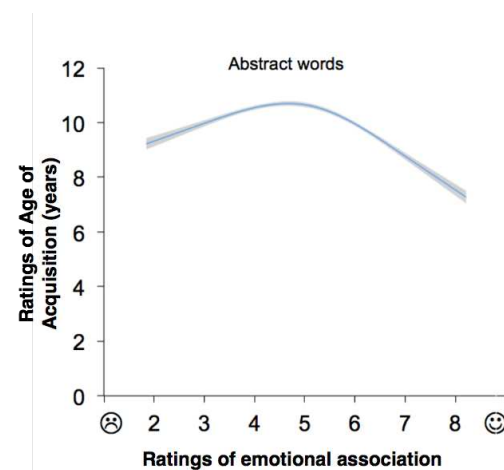

Figure 2: Relation between age-of-acquisition and Emotional Association ratings for 14,000 words (from Ponari, Norbury & Vigliocco, 2017)

These results converge with our analyses of the AoA data.

1.3 What are the factors supporting learning of abstract words and concepts?

The studies above only looked at the words that children _know_ at the different ages, and therefore we cannot conclude that words with emotional associations are easier to _learn_. In a learning study, we taught children (aged 7-10) 24 abstract words they did not know (i.e., words that are typically learnt

from age 14 onward) engaging them in fun small group activities (e.g., short stories, word tombola,

Figure 3: Definition scores (max = 4) for valences and neutral words according to school year in the word learning experiment. The bars represent confidence intervals in a statistical model including length of words and vocabulary scores of children. (from Ponari, Norbury & Vigliocco, in prep)

creating mind-maps) for 20 mins for 4 consecutive days. We tested the children on the 5th day. Some of the words they learnt had emotional associations (e.g., "karma"), some were neutral (e.g., "analogy"). Moreover, sometimes the words were taught in the context of other emotional words, and sometimes only in the context of neutral words. This latter helps us understand if the teaching strategy matters. At test, we asked children to define the new words, and also to recognize them among fillers. Because we fou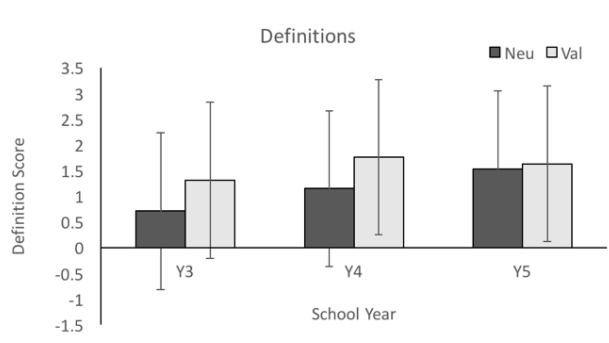nd that children were nearly 100% correct in recognizing the words, we focused on their ability to define them. First of all, we found that children were overall very good at learning these new words, suggesting that our short, but focused training was successful in teaching new vocabulary. Most relevant here, we found that children in school years 3 and 4 could provide better definitions for words with emotional associations than for neutral words. Such a difference was not present anymore in school year 5 (see **Figure 3**). This finding converges again with what we found analyzing adults' ratings, and children's knowledge of words. Interestingly, however, whether the new word was embedded in an emotional context or not did not have a significant effect. Thus, we can conclude that whether the word has emotional associations *affects* learning, whereas it does not matter whether the teaching context is emotional or not (Ponari, Norbury & Vigliocco, in preparation).

1.4 Are abstract words and concepts especially hard to learn for atypically developing children?

Our work investigated both children with Developmental Language Disorders (DLD) and children with Autism Spectrum Disorder (ASD). For children with DLD, it is a commonly held view (both among researchers and practitioners such as Speech-Language Therapists) that they have special problems in learning abstract vocabulary. This view is based on the assumption that language development is a crucial precursor of learning the more difficult abstract concepts and words, while concrete words are easier because learning and processing can also take advantage of their sensory and motor qualities. However, such a view has never been tested before. We asked children with DLD (mean age 10.4) and TD children (one group matched

Figure 4: Comparison between children with DLD and typically developing children of the same age. a) Proportions of correct recognitions; b) definition scores (max = 4) (from Vigliocco, Ponari & Norbury, 2017)

to the DLD children for age, and another group matched for vocabulary) to (a) recognise real words among fake words; (b) provide definitions for abstract and concrete words. The results were clear-cut: children with DLD were less accurate in recognising words and less able to provide definitions that their typically developing peers of the same age, but there was no indication of a greater impairment for abstract than concrete words (illustrated in **Figure 4a** and **4b**, respectively). This finding indicates that while language development is critical for learning vocabulary (both abstract and concrete), it is not the case that learning of abstract words can only occur based on language (as
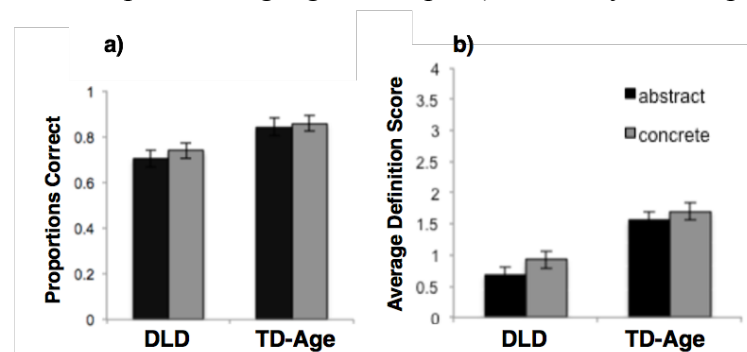
otherwise we would have found that DLD children had a greater impairment for abstract words). DLD children were also compared with younger TD children matched on vocabulary. This comparison suggests that DLD children use the same strategies as TD children in learning abstract words as here, again, we did not find any difference between concrete and abstract words.

Difficulties in social/emotional interactions are considered to be a core feature of Autism Spectrum Disorder. Moreover, a number of previous studies have further documented deficits in understanding of affective language and language referring to ment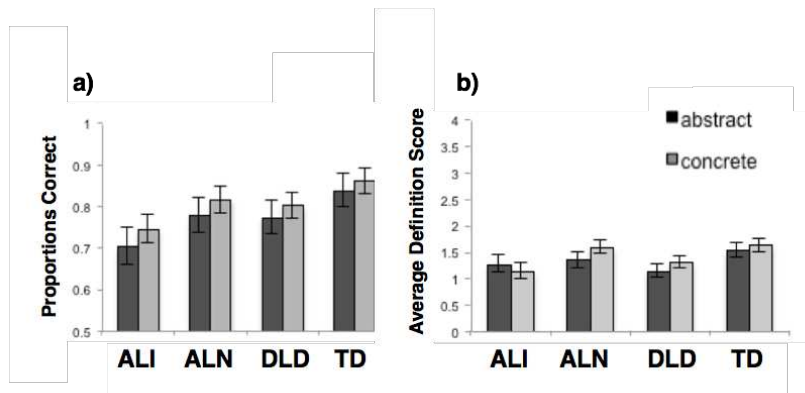al states, although results are somewhat mixed. However, we know very little about whether children with ASD have problems more generally with abstract words, which is especially interesting because, as we have seen, abstract words with emotional associations are easier to learn for TD children up to the age of 9. We asked a group of children with a diagnosis of ASD (and a control group of TD children) to (a) carry out spoken recognition of abstract and concrete words; (b) define these words. Crucially, we divided the

Figure 5: Comparison of children with ASD and language defects (ALI), with ASD and no language deficits (ALN), DLD and TD children matched on age. a) Proportions of correct recognitions; b) definition scores (max = 4) (from Norbury, Ponari & Vigliocco, in prep)

children with ASD in two subgroups: children with ASD and language impairment (ALI) and children with ASD but no language impairment (ALN). Language impairments often co-occur with ASD. The main findings are summarised in **Figure 5**. We found no evidence that children with ASD have general problems with abstract words and concepts, despite their putative difficulties with abstract words referring to "theory of mind". Importantly, we also found that children with ASD do not have general problems with words with emotional associations. This finding indicates that children with ASD may not have core emotion processing deficits but rather deficits with social cognition. However, those children with ASD and co-occurring language impairments (ALI) show an impairment in their vocabulary (both concrete and abstract words) similar to DLD children. In contrast, children with ASD but no language impairment (ALN), performed just as well their TD peers. This finding strongly underscores the importance of distinguishing children with ASD who have additional LI and those with language abilities within the normal range, as they behave as clearly distinct groups.

2 IMPLICATIONS FOR PRACTICE

To our knowledge, despite the importance of abstract vocabulary for academic achievement, no previous research has assessed how either typically or atypically developing children learn them, therefore, our study provides some critical initial evidence on which practice might be based. The main implications we can derive from the work are:

2.1 Primary school practices to teaching abstract words and concepts to TD children in Years 1-4 should take advantage of the fact that children show greater knowledge and learn more easily abstract words that have emotional associations until about the age of 9. After this age, children seem to be equally good at learning abstract words with and without emotional associations. Thus, in early years, vocabulary teaching could prioritize the many abstract words that have emotional associations over those without. When teaching words belonging to this latter class, a recognition of their greater difficulty may lead to more effective teaching strategies. For older children, emphasis on linguistic explanation of abstract word meanings should be sufficient and effective.

2.2 Speech-language therapy interventions for children with language impairments should explicitly encompass both concrete and abstract vocabulary and highlight different sources of meaning (linguistic, emotional, tangible). It is likely that vocabulary will need to be explicitly taught, as deriving meaning from linguistic context appears to be challenging for these children.

2.3 ASD children with language impairment, and ASD children without language impairments should be considered as two qualitatively distinct groups and, therefore benefitting from different support. In particular, speech-language therapy interventions, as described in (2) should be especially helpful for children with ASD and language impairment, while potentially unnecessary for children with ASD and no language impairment. For this latter group, vocabulary achievement across semantic domains (concrete and abstract) is not lagging behind.

3. TO WHAT EXTENT WERE THE PROJECT OBJECTIVES MET?

Our first objective was *to provide the first existing assessment of how abstract knowledge develops in: Typically Developing (TD) children; children with Developmental Language Disorders (DLD); children with Autism Spectrum Disorder (ASD, with or without associated language impairments)*. This objective was fully met. To our knowledge, this project is the first to document knowledge of abstract concepts and words in childhood and for both typically and atypically developing children.

Our second objective was *to establish the precursors of learning abstract concepts. In particular, to provide a critical assessment of the role of linguistic and emotional factors*. This objective was fully met. Our work with TD children indicates that emotional associations of words support learning of abstract words at earlier age. Our work with DLD children indicates that language development is clearly not a <u>specific</u> precursor in learning abstract vocabulary, while it clearly affects vocabulary learning in general (of both concrete and abstract words). We are currently undertaking follow-up computational work designed to better understand if and when lesions to different mechanisms during learning (in the form of simulated lesions to parameters of a neural net) can give rise to specific impairments for abstract words (Rotaru, Ponari, Norbury, Lenci & Vigliocco, in prep). Our work with ASD children suggests that the type of impairment in understanding social and theory of mind concepts characteristic of this group also does not lead to generalised problems in learning and processing abstract words and concepts.

Our final objective was: *on the basis of (1) and (2), develop criteria to inform teaching and learning strategies as well as policies*. This objective has also been met. As described above in "Implications for Practice", our results have direct implications for education and speech and language therapy.

4. PROJECT METHODOLOGY

The project was divided into two main Strands.

5.1 Strand 1 provided initial evidence on performance of TD children at different ages (to potentially guide development of assessment tools) and it provided specific information about whether and to what extent children with LI and ASD can master abstract concepts.

Participants
Typically Developing Children: Sixty children aged 6-12 years were recruited from mainstream classrooms in Southeast England. Children were divided in three age groups: 6-7 years; 8-9 years; 10-11 years. All participants were native English speakers.

Children with developmental language disorder: Eighteen children with an existing diagnosis of DLD (14 males; mean age = 10.03, SD = 1.76) were recruited from schools in Southeast England. All children had a clinical diagnosis from a speech-language therapist external to the research team. Children in the TD groups were selected from a pool of 73 children who completed both tasks and were matched to the DLD children on gender and age (n = 18, 14 males; mean age = 10.34, SD = 1.44) or on gender and raw scores on the *British Picture Vocabulary Scale* (BPVS; Dunn, Dunn, Whetton, & Burley, 1997) (n = 18, 14 males; mean age = 8.16, SD = 2.12). TD children were recruited from local schools and did not have any reported special educational needs, or history of language delay. Non-verbal cognitive abilities were assessed using the Matrix Reasoning test of the Wechsler Abbreviated Scale of Intelligence (WASI, Wechsler, 1999). DLD children were also administered the Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals: Core Language Scales (CELF; Semel, Wiig, & Secord, 2006).

Children with autism spectrum disorder: Thirty-four boys with an existing diagnosis of Autism Spectrum Disorder (ASD; mean age = 10.97; SD = 1.59) were recruited from schools in Southeast England. All children had a clinical diagnosis of ASD from clinical services external to the research team and were receiving additional educational support for their difficulties. To address the variation in language ability within the ASD group, the comparison group included 17 typically developing children (TD; 13 boys) recruited from mainstream schools in South East England, and 17 children with specific language impairment (SLI; 13 boys), recruited from special education schools. Each participant with SLI had been identified by a certified speech and language therapist external to the research team and was receiving special educational support for language impairment at school.

Methods
This strand used standard methods from language acquisition/psycholinguistics, which have been previously used both with TD, LI and ASD children:
(a) *word definition*: children are presented with spoken words and asked to define them
(b) *synonym judgments*: children are presented with triplets of words and have to decide which two are most similar.
(c) *lexical decision*: children are presented with spoken words and non-words and they have to decide which ones are the real words.

We chose these tasks in order to have more explicit (as word definition; similarity judgments) and more implicit (as lexical decision) tasks that tap into knowledge of words; and expressive (definitions) as well as receptive (similarity judgments and lexical decision) tasks. We took great care in selecting words across concrete and abstract domains which were matched in all relevant lexical dimensions and that, however, span a range of "age-of-acquisition" ratings, in order to be able to develop testing materials with increasing difficulty (thus to be used with children of different ages).

Although these tasks have been previously used in studies with children of this age group, no previous study has used abstract words (in addition to concrete words). Because these words are inherently more difficult, this increased the difficulty of the tasks especially for the synonym judgment task, which imposes working memory demands, in addition to semantic decisions. For this reason we found that our younger children could not do the task and therefore results from this task are not reported here. For the definitions and lexical decision, further details of the methods and detailed results are reported in our publications (Ponari, Norbury & Vigliocco, 2017; Vigliocco, Ponari & Norbury, 2017; Norbury, Ponari, Thornton & Vigliocco, in prep). Materials are available upon request.

5.2 Strand 2 aimed to provide us with novel insight on what factors support learning of abstract words in children.

Participants
76 children aged 7-10 years (35 females, average age = 9.53, range = 7.88-10.82) were recruited from mainstream classrooms in Southeast England. All children were native English speakers, had normal or corrected to normal vision and no history of developmental disorders or reported special educational need. Testing took place during the last month of the school year; 24 children were at the end of Year 3, 27 children at the end of Year 4, and 25 at the end of Year 5.

Methods
We chose abstract words unknown to the children and designed a short training (20 mins per day for 4 days) to teach these words to children aged 8-10. Each child was trained on 12 new abstract words (such as *rogue, analogy, insight*). Children were trained in groups of four. They were provided with definitions of the words, they were asked to use them in sentences; they played bingo with the words,

they completed a mind-map using the words and finally produced pictures for the words. For half of the children the teaching emphasized emotions associated with the words: such as asking how the word "made them feel", and embedding the words in sentences and texts with emotional connotations. For the other half, instead, we focused on providing encyclopedic information. Further details of the teaching strategies are provided upon request. On the final day they were asked to carry out three tasks involving the words they learnt during the week:

(a) word definition: children are presented with written words and asked to write their definition

(b) *lexical   decision:*   children are presented with written words they just learnt, other abstract words they don't know and non-words and they have to decide which ones are the real words.

All studies (Strand 1 and 2) were approved by the University College London Research Ethics Committee. Informed, written consent was obtained from the parents, and verbal assent was obtained from the children prior to testing.

KEY REFERENCES

Norbury, C.F., Ponari, M. Thornton, A. & Vigliocco, G. (under review). Abstract words are not harder than concrete words for children with autism spectrum disorder.

Ponari, M., Norbury, C.F., Vigliocco, G. (2017). How do children process abstract concepts? Evidence from a lexical decision task. *Developmental Science,* DOI: 10.1111/desc.12549

Vigliocco, G., Ponari, M., Norbury, C.F. (2017). The Role of Linguistic Information in Learning Abstract Words: Evidence from Children with Specific Language Impairment (SLI). In Proceedings of the 39th Meeting of the Cognitive Science Society, London, July.

Vigliocco, G., Ponari, M., Norbury C.F. (in revision). Learning and Processing Abstract Words and Concepts: Insights from Typical and Atypical Development. *Topics in Cognitive Science*.

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