Do shared distributional contexts aid learning of Italian gender classes in 7-year-old children?

Helen Brown[1], Lydia Gunning[1], & Elizabeth Wonnacott[2]

[1]University of Warwick, [2]University College London

Background

- Language learning involves forming generalizations over word classes
- Artificial language learning experiments suggest that adults can generalize based on shared distributional contexts and that "frames" provide a particularly useful context (Mintz, Wang, & Li, 2014).
- Literature on distributional learning in children is more limited; few experiments have investigated their learning of gender-like noun classes
- There is some evidence that high type frequency aids generalization in children (Gomez 2002; Wonnacott, Boyd, Thomson, & Goldberg, 2012), however high type frequency may also create an additional burden on working memory, which may hinder learning (Brooks et al., 2006).

Research Questions

- Can 7-year-olds can acquire gender classes via distributional learning over frames using input from a real language (Italian: 2 gender classes)?
- Will type frequency promote (or hinder) generalization?

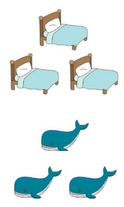
Method

Participants: 30 monolingual English speaking 7-8 year olds

Language input:

- Children were exposed to singular and plural Italian noun-phrases which have determiners and vowel suffixes marked for *gender* and number:

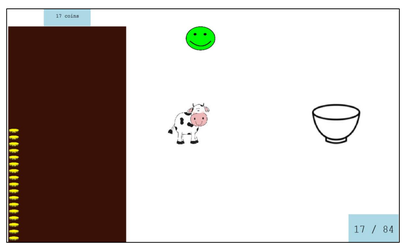
masculine singular:	il	$noun_{[masculine]}$ + o	**il** lett**o**
masculine plural:	i	$noun_{[masculine]}$ +i	**i** lett**i**
feminine singular:	la	$noun_{[feminine]}$ +a	**la** balen**a**
feminine plural:	le	$noun_{[feminine]}$ +e	**le** balen**e**



- **"Determiner + Noun Stem + Vowel"** forms a frame which can serve as a context for distributional learning
- Two between-subjects experimental conditions (total exposure matched)
  - High Type Frequency – 12 nouns, 6 per gender class
  - Low Type Frequency – 4 nouns, 2 per gender class

Procedure:

Exposure in 5 * 30 minute sessions over five consecutive days using a "word learning game": Hear a noun-phrase and choose between the correct picture and foil. Foils could differ in gender, number, or both.



Additional tests of comprehension and production were administered at the end of sessions 3 and 5 including:

(1) Noun-phrase identification: Speeded version of training task
(2) 2AFC test of knowledge of frames: See picture and choose between the correct noun-phrase and a foil in which the determiner was incorrect for gender, number, or both
(3) Production test : Hear singular NP and produce plural (or vice versa)

New nouns were included in the 2AFC & production tests to probe generalization

Results: Training Task

- High level of accuracy by Session 5 (89%)
  - ➢ Evidence of strong vocabulary (item-level) learning
- When pictures depicted the same noun, differing only in number, performance was above chance in the low (66%, z = 4.34, p < .001), but not the high (57%, z = 1.57, *ns*) type frequency condition
  - ➢ High type frequency may hinder learning of number marking
- When pictures depicted different nouns, performance was higher on trials in which the nouns were different genders. This effect was stronger in the low type-frequency condition (*type frequency * gender agreement*, z = -2.41, p = .02)
  - Low TF: same gender 85%, different gender 90%, z = -4.77, p < .001
  - High TF: same gender 79%, different gender 81%, z = -1.72, p = .09

Results: Test Tasks

(1) Noun-Phrase Identification

Accuracy

- Consistent with data from the training task, when pictures depicted different nouns, performance was higher on trials in which the nouns were different genders, but only in the low type-frequency condition (*type frequency * gender agreement*, z = -1.4, p = .08)
  - Low TF: same gender 82%, different gender 87%, z = -2.51, p < .01
  - High TF: same gender 81%, different gender 82%, z = 0.11, *ns*

Response times

- Faster when the foil is of a different gender (Session 5 only): same gender 1764 ms, different gender 1637 ms, t(29) = -2.03. p = .04.
  - ➢ Children may be predictively using gender of the determiner to identify the upcoming noun (Lew Williams, & Fernald, 2007)

(2) 2AFC Test of Knowledge of Frames

- Strong performance with trained nouns but at chance with new untrained nouns: trained 91%, untrained 53%, z = 9.51, p < .001
  - ➢ Strong item learning but no generalization of frames
- For trained nouns there was a significant main effect of foil-type: gender incorrect 89%, number incorrect 85%, both incorrect 92%, z = -3.25, p = .001
- Low type frequency benefit for trials in which foil was incorrect for number: low TF 90.8%, high TF 78.8%, z = 2.49, p = .01
  - ➢ Number marking learnt better under low type frequency conditions

(3) Production Test

- Usage of determiners and vowels scored separately

RESPONSE TYPE	DETERMINERS		VOWELS	
	Old nouns	New nouns	Old nouns	New nouns
Correct	35%	22%	50%	29%
Incorrect gender	1%	2%	5%	12%
Incorrect gender & number	1%	1%	5%	8%
No change (incorrect number)	57%	64%	36%	45%
Other	6%	10%	4%	6%

- Most common pattern was to repeat given vowel/determiner
- For both old and new nouns, when they did change number, they were more likely to produce a form with correct than incorrect gender
  - Determiners: old χ^2 = 89.3, p < .001; new χ^2 = 32.3, p < .001
  - Vowels: old χ^2 =79.2, p < .001; new χ^2 = 4.17, p = .04
  - ➢ The preference for using a gender-matched determiner with new nouns provides (tentative) evidence of generalization

Control Experiment

Question: Are children really generalizing (i.e. showing knowledge of word classes), or are results due to phonetic similarity between gender matched forms?

Method: Children only hear individual nouns as either singular or plural during training. Do they still show generalization in the production task?

Determiners: marginally more likely to produce correct than incorrect gender, χ^2 =3.13, p=.08, but effect is weaker than in main exp, χ^2 = 31.70, p <.001

RESPONSE TYPE	NEW NOUNS	
	Determiner	Vowels
Correct	17%	5%
Incorrect gender	5%	2%
Incorrect gender & number	4%	3%
No change (incorrect number)	64%	83%
Other	10%	8%

Vowels: equally likely to produce correct/incorrect gender (both 7%), marginally weaker effect than in main exp, χ^2 = 3.75, p = .052.

Summary and Discussion

- **Strong item level learning:** Children can identify errors in the vowel (2AFC test) and may also use the gender of the determiner to predict the upcoming noun (RT in noun-phrase identification)
- **Weak learning of number marking:** Only acquired in the smaller low type frequency condition
- **Generalization:** No evidence of generalized learning of frames in 2AFC test; some tentative evidence of generalization in production: if children produce a new noun with an unattested vowel/determiner, they are likely produce a form correctly marked for gender