The impact of speech complexity on preschooler attention and learning

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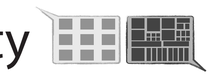
Complexity



- Children's language environments contain diverse sources of input, from simplified directed speech, to nearby adult conversations, phone calls, TV... [1]

Attention

- Infants' attention is responsive to stimulus complexity[2,3]
- Rational learners may implicitly monitor information absorption rate, disattending when it is too low[4]

Learning

- Previous studies have assumed --- but not directly tested --- that differential attention based on stimulus complexity is related to learning[2-4]

PARTICIPANTS: 46[5] 4--6-year-olds (M=4.6, SD=0.47)

SIMPLE

Once, a boy and his dog were good friends. They liked to play all day. This night, they were looking at the frog they caught. The boy looked at him from his chair while the dog put his nose in the frog's jar. The frog smiled up at them.

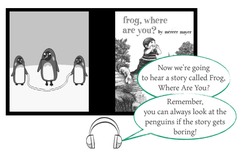
*all words appear on M-CDI[6]

COMPLEX

Once there lived two companions. They frolicked together. This night, they were ogling the frog they caught. The boy ogled him from his chair while the dog put his nose in the frog's jar. Their attention amused him.

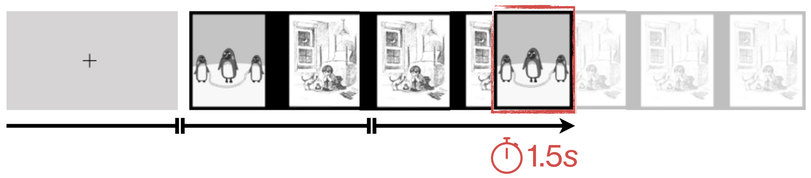
*6 later acquired words
1 unfamiliar target / page

Familiarization



Children introduced to textless picture book & distractor GIF on eyetracker

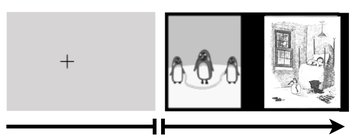
Page 1



Children hear either SIMPLE or COMPLEX story narration

All children hear page narration once, after which audio loops for up to 5 further repetitions, or until children fixate continuously on GIF for 1.5s

Pages 2--6



...triggering the next page.

Children hear 6 total pages.

...

Listening Comprehension

Where did the boy and the dog first look for the frog?

Word Generalization

Can you point to the one who is *ogling* something?

Children's learning is tested.

Is preschoolers' attention responsive to spoken language complexity?

Voluntary Trial Duration

= Per-page listening times above & beyond obligatory first page repetition & GIF trigger

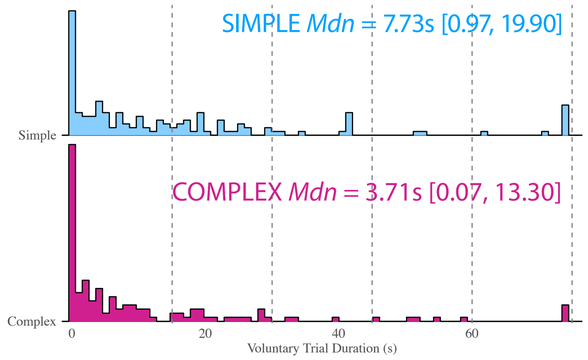
Net Dwell Time

= Fixation duration to Areas of Interest (AOIs):

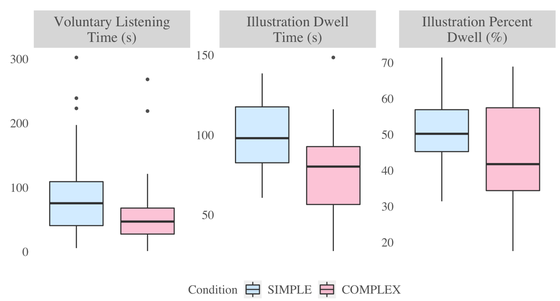
Illustration:
SIMPLE *Mdn* = 14.76s [11.97, 20.83]
COMPLEX *Mdn* = 12.66s [7.84, 17.72]
...or *GIF:*
SIMPLE *Mdn* = 5.42s [3.74, 8.28]
COMPLEX *Mdn* = 5.64 [3.19, 8.80]

Percent Net Dwell Time

= AOI Fixation as % of total duration
Illustration:
SIMPLE *M* = 50.5% [40.8, 64.2]
COMPLEX *M* = 44.4% [26.9, 61.1]



^ *Listening times were highly variable*



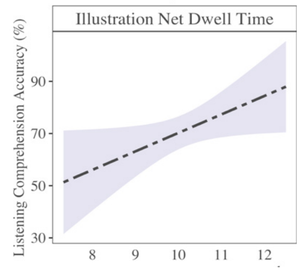
Does attention predict learning?

- Linear mixed effects models:

TEST-ACCURACY ~ ATTENTION-METRIC + AGE + CONDITION + TRIAL-NUMBER + (1|ID) + (1|TRIAL)

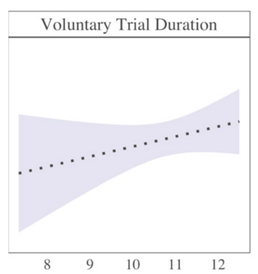
Listening Comprehension (% correct)

	(1)	(2)	(3)	(4)	(5)
Intercept	−111.00*	−305.00**	89.20	−62.70	−27.20
	(−203.00, −18.40)	(−518.00, −92.10)	(−109.00, 287.00)	(−130.00, 4.32)	(−86.50, 32.00)
Condition (COMPLEX)	−3.36	−0.62	−6.26	−2.62	−2.01
	(−16.10, 9.37)	(−13.50, 12.30)	(−19.10, 6.62)	(−15.50, 10.30)	(−14.20, 10.20)
Age	25.00***	23.70***	21.70**	23.10**	25.90***
	(11.60, 38.40)	(10.70, 36.70)	(7.89, 35.50)	(9.80, 36.40)	(13.10, 38.80)
Attention Metric:	*Listening Time*†	*Illustration*‡	*GIF*‡	*Illustration %*¶	*GIF %*¶
	6.00*	23.20*	−11.30	0.53*	−0.67**
	(0.58, 11.40)	(5.67, 40.70)	(−28.40, 5.76)	(0.04, 1.01)	(−1.11, −0.24)



Word Learning (% correct)

	(1)	(2)	(3)	(4)	(5)
Intercept	5.05	−60.60	256.00	37.80	79.40
	[−134.00, 144.00]	[−194.00, 72.50]	[−19.50, 532.00]	[−55.00, 130.00]	[−36.50, 195.00]
Condition (COMPLEX)	−3.36	−0.62	−6.26	−2.62	−2.01
	[−16.10, 9.37]	[−13.50, 12.30]	[−19.10, 6.62]	[−15.50, 10.30]	[−14.20, 10.20]
Age	−0.90	−2.46	−6.88	−6.99	−4.04
	[−24.80, 23.00]	[−23.90, 19.00]	[−30.80, 17.00]	[−27.40, 13.40]	[−27.40, 19.40]
Attention Metric:	*Listening Time*†	*Illustration*‡	*GIF*‡	*Illustration %*¶	*GIF %*¶
	3.80	26.20*	−17.50	0.81**	−0.51
	[−4.21, 11.80]	[4.22, 48.20]	[−38.70, 3.62)	[0.28, 1.34]	[−1.18, 0.16]



^ *Illustration dwell time and % predicted word learning, listening comprehension*

...Is attention driven by learning?

- Likelihood of CONTINUING LISTENING vs. MOVING ON:
- *Children significantly less likely to MOVE ON in the Complex condition with greater age (& language development)*

Endnotes

1 Foushee, Griffiths, & Srinivasan (2016)
2 Kidd, Piantadosi, & Aslin (2012)
3 Kidd, Piantadosi, & Aslin (2014)
4 Gerken, Balcomb, & Minton (2011)
5 Target sample size: 64
6 Fenson et al. (2007)
7 foushee@berkeley.edu