
Comprehension Delay of Word Order in Preschoolers

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Production-Comprehension Asymmetries in Child Language

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Early and Accurate?!

- **Production** at the 2-word stage

- Earliest phrases conform to word order rules of the target language

(Brown, 1973; Braine, 1976; Clahsen 1982)

- Including when finiteness, negation, & scrambling play a role

(German and Dutch: Verrips & Weissenborn, 1992; Poeppel & Wexler 1993; Schaeffer, 2000; Neeleman & Weerman, 1997; French: Déprez & Pierce, 1993; Swedish: Platzack, 1996)

- **Comprehension** even earlier

- 1;2-1;6 yr olds can distinguish “Cookie Monster is washing Big Bird” from the reverse

(Hirsh-Pasek & Golinkoff, 1996)

Comprehension Delay in Preschoolers

Chapman & Miller (1975)

Tested 2-year-olds: same sentences in two tasks

- Could **correctly produce**
“The car is pushing the cow”
- Would **mis-interpret** the sentence
“The car is pushing the cow” as meaning
<the cow is pushing the car>

S	O
+an	+an
+an	-an
-an	+an
-an	-an

(Replicated in McClellan, Yewchuk, & Holdgrafer, 1986).

Optimality Theory

- Prince & Smolensky (1993/2004)
 - OT as framework modeling phonological phenomena
 - OT also models production (Syntax) & comprehension (Semantics)
 - Hearers/Speakers must select the best meaning/form by applying a set of ranked, potentially conflicting constraints to a set of possible candidates
 - Constraints can influence only production, only comprehension, or both
 - Smolensky (1996)
 - an incorrect ranking of constraints accounts for common asymmetries found in early child speech
-

Understanding Word Order

Effect on sentence meaning

- In English & Dutch
 - 1st NP usually the subject
 - Subjects are preferably animate; objects are preferably inanimate



Constraints

In terms of OT
(Lamers & de Hoop 2004)

PRECEDENCE

The subject precedes the object




PROMINENCE

The subject outranks the object in prominence
(animacy)




Mis-ranked Constraints

Children's **production**

Input = meaning	Output = form	PROMINENCE	PRECEDENCE
<the car is pushing the cow> 	"The car is pushing the cow"		
	"The cow is pushing the car "		*!

Children's **comprehension**

Input = form	Output = meaning	PROMINENCE	PRECEDENCE
"the car is pushing the cow" 	<The car is pushing the cow >	*!	
	<'The cow is pushing the car >		*

Predictions



Netherlands Organisation for Scientific Research

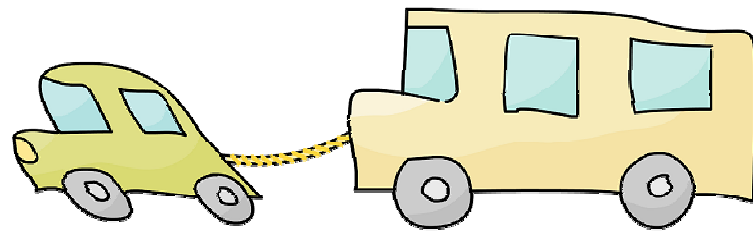
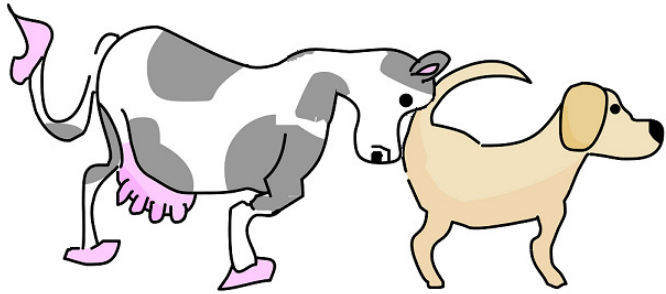
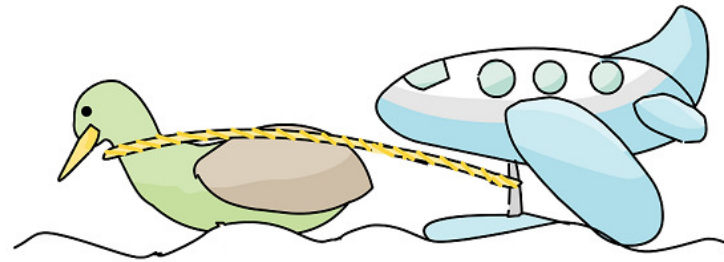
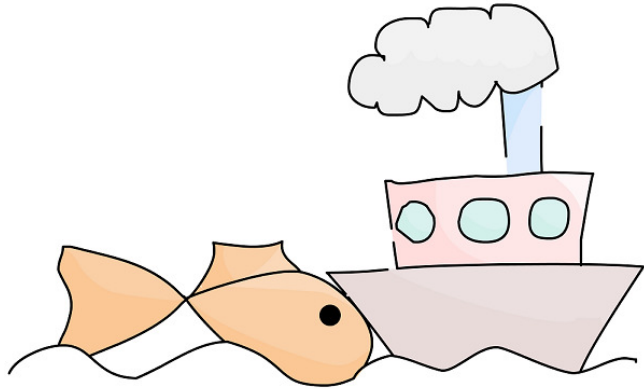
- Is there really an early comprehension delay in S-O word order?
- If so, [-an+an] is predicted to be problematic in comprehension only:
 - Accuracy
 - will reveal problems in [- +]
 - children of aprox. 4 yrs will show adult-like accuracy
 - Eye movements
 - preference for distractor in [-+], target otherwise
- Adult Controls
 - no differences between tasks or conditions

Experiment

- Participants
 - 11 healthy monolingual Dutch preschoolers (2;10-4;0)
- Materials
 - 16 items (no fillers, 5 practice)
 - 4 animals, 4 vehicles
 - Verbs: push & pull



Materials

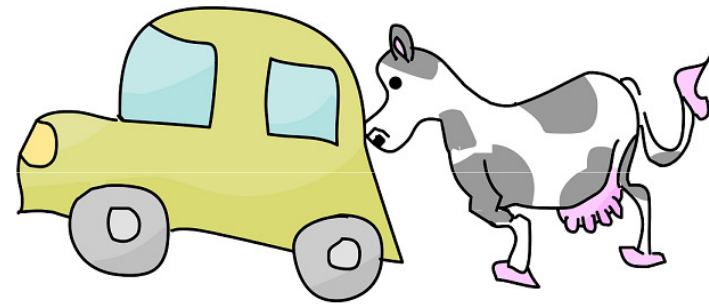
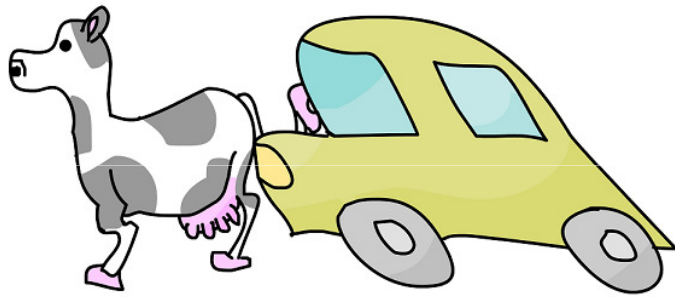


Procedure

- Elicited Production
- Picture Selection Task
- Pre-test
 - 16 Nouns (say & identify)
 - Pointing
 - Pushing & Pulling (with string)
- 2 Blocks
 - 1st verb 8 Comp 8 Prod (3 prac)
 - 2nd verb 8 Comp 8 Prod (2 prac)
 - (Calibration)



Parent wears dark glasses



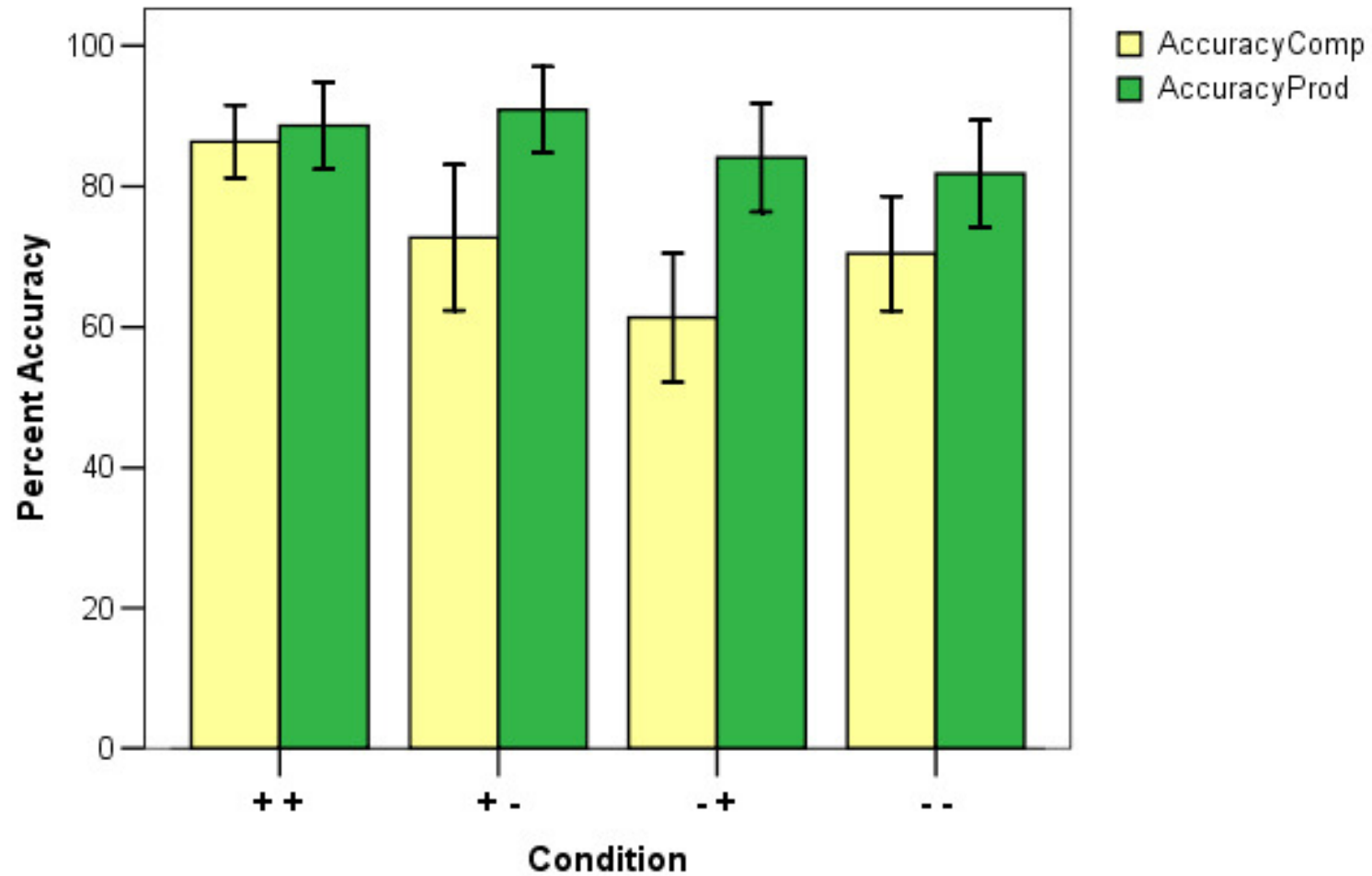
Results: Accuracy

Mean percent correct for tasks per condition

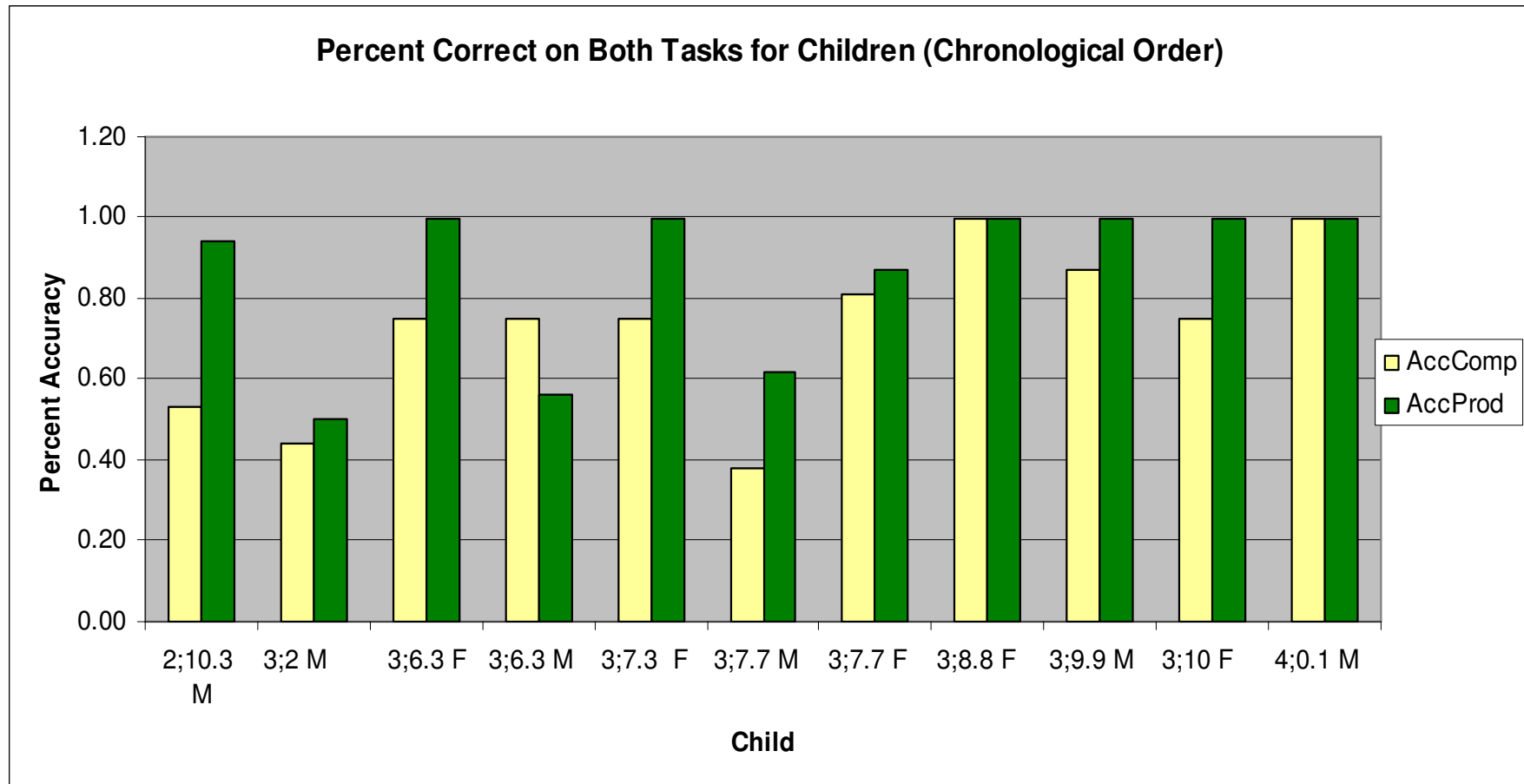
Dutch children		
Condition	Comp	Prod
+ an + an	86.36	88.64
+ an -an	72.73	90.91
-an +an	61.36	84.09
-an -an	70.45	81.82
Total	73.23	86.37

English children (C&M)		
Condition	Comp	Prod
+ an + an	66.5	83.7
+ an -an	93.8	86.3
-an +an	50.1	89.3
-an -an	65.2	82.4
Total	68.9	85.4

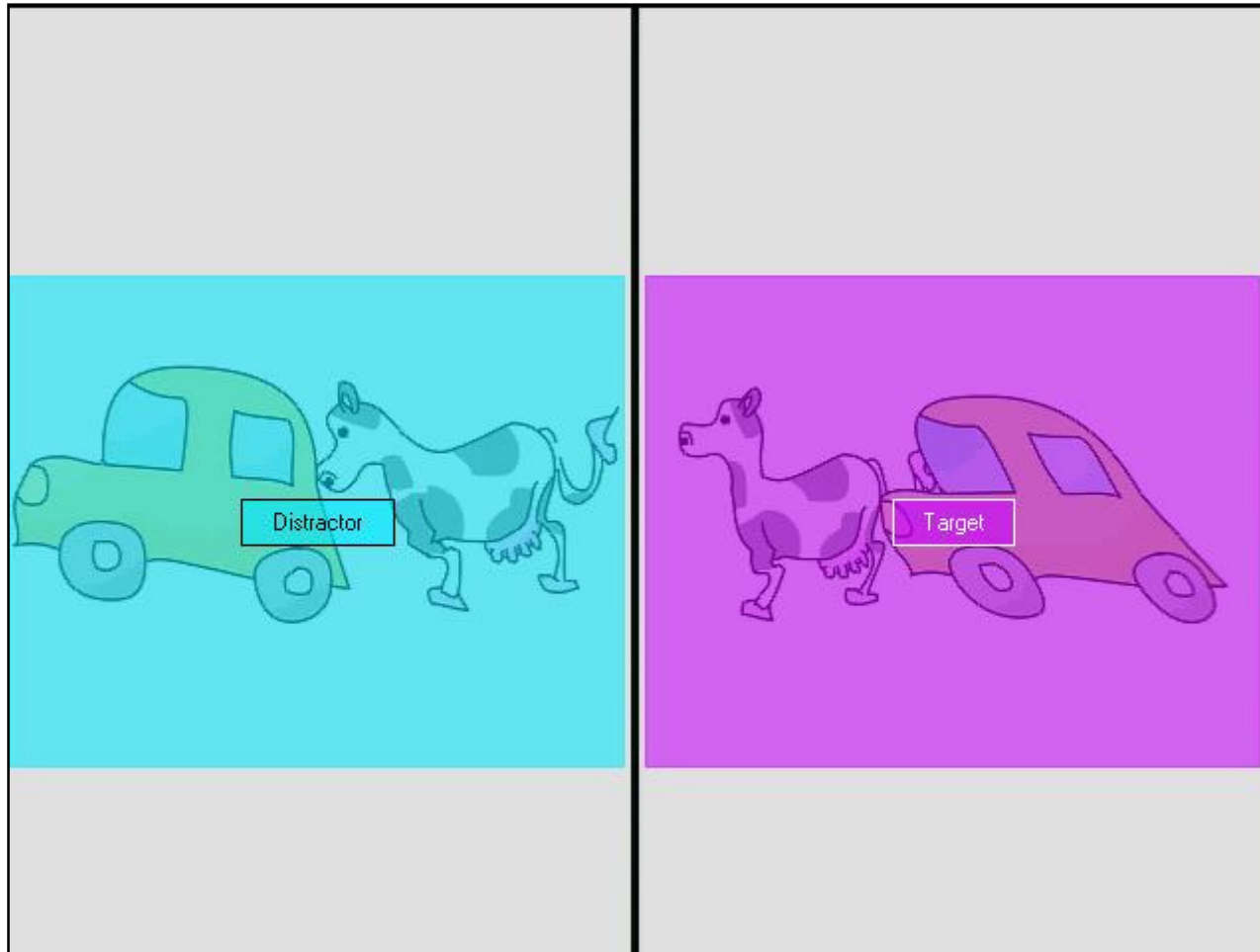
Accuracy Per Condition



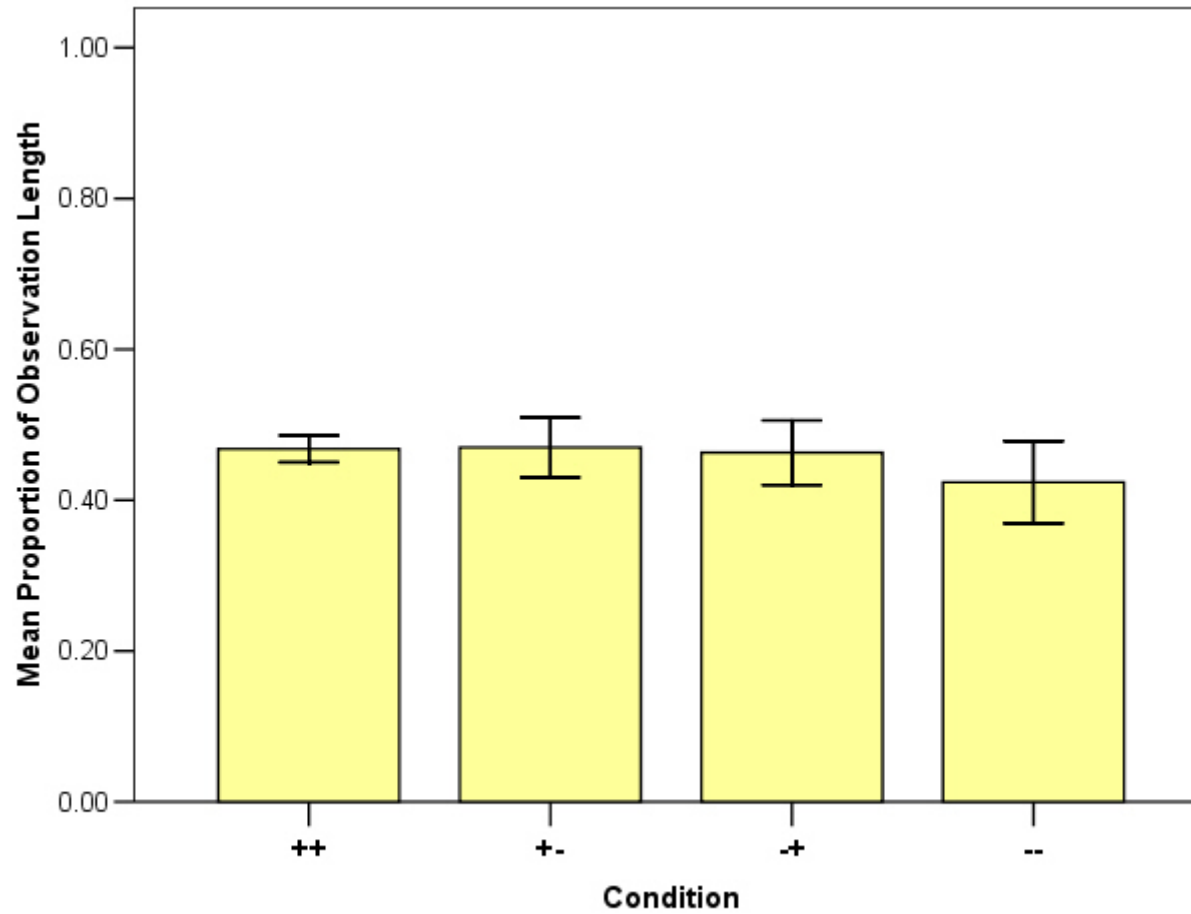
Accuracy Per Child



Areas of Interest

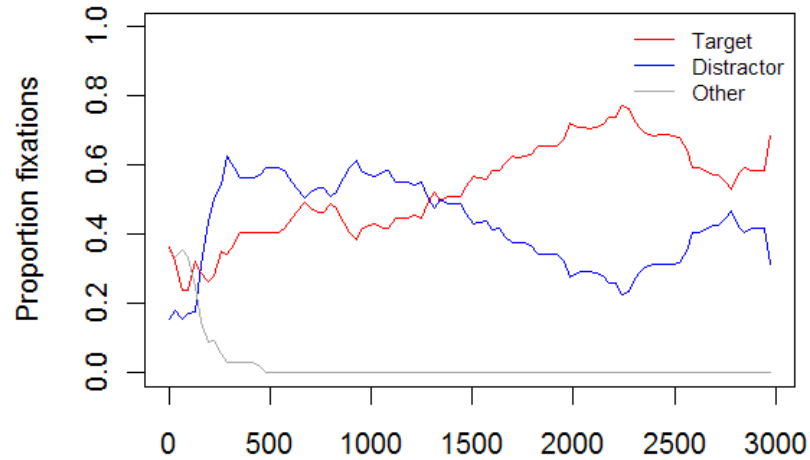


Observation Length to Target

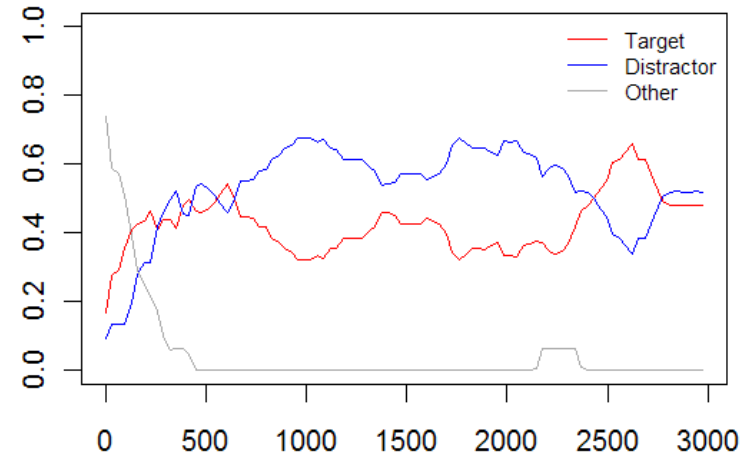


Children (3s)

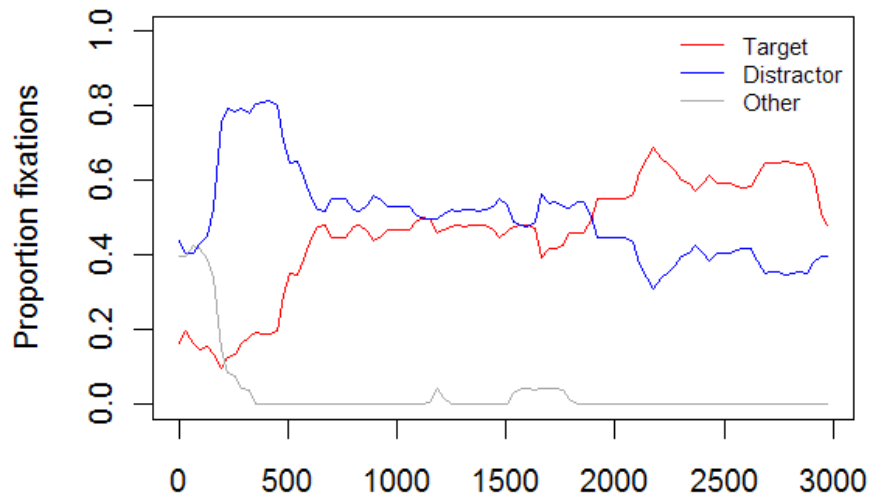
CONDITION +-



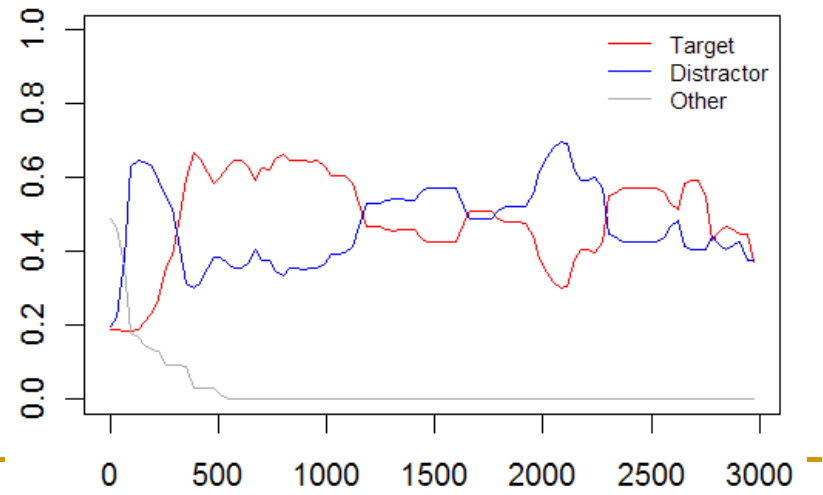
CONDITION -+



CONDITION ++



CONDITION --



Time (ms)

Time (ms)

Adult Controls

- 19 adults, 20-43yrs, (10F, 9M)
 - Differences
 - Sentence Stimuli → Recorded
 - 16 Fillers
 - Measure Reaction Time / Voice Onset Latency
 - 2 Lists
 - 2 ordering of task types (C first or P first)
-

Results - Adults

- Accuracy

- Comprehension = 97%
- Production = 100%

- Reaction Time

- Effect of S-O animacy

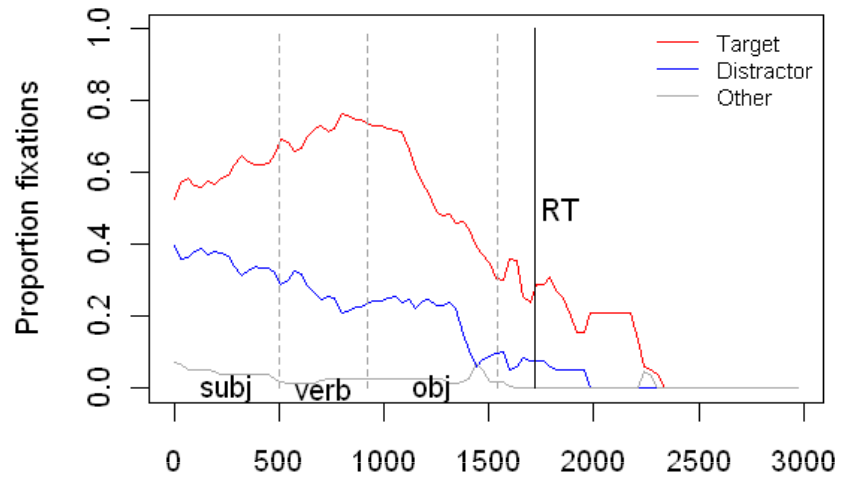
Condition	RT(ms)
[+an+an]	295
[+an-an]	185
[-an+an]	447
[-an -an]	388

- Observation Length to Target

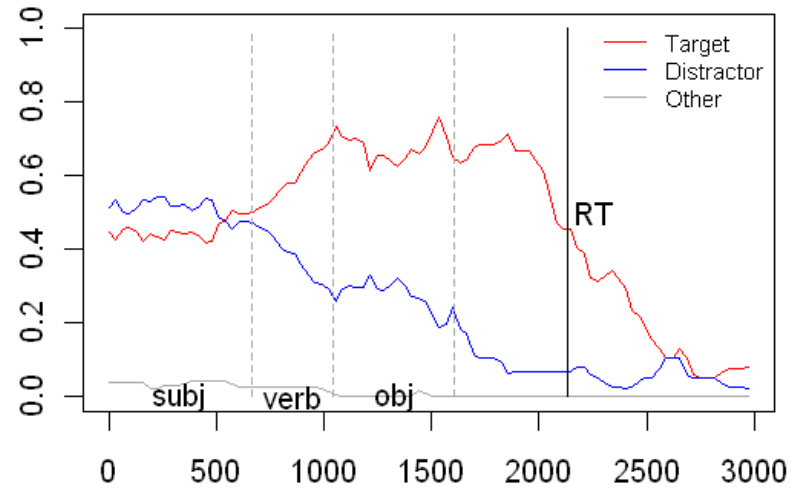
- No effect of S-O animacy
-

Adults

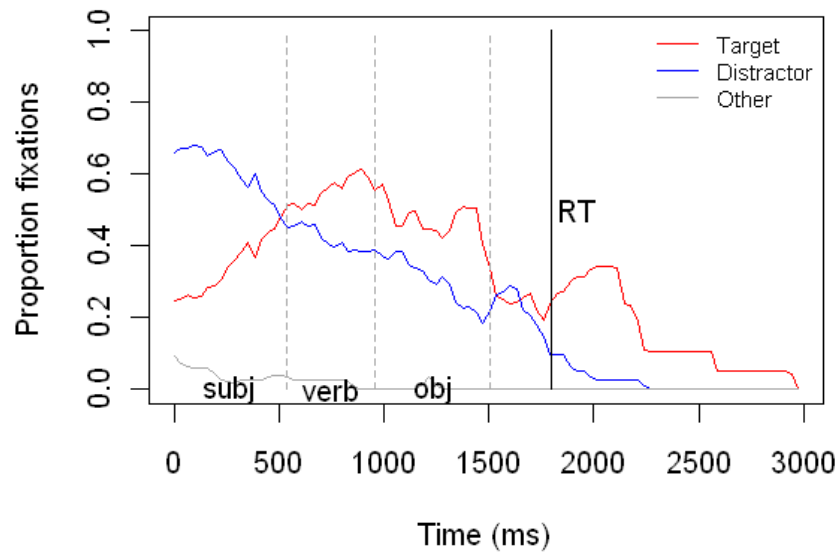
CONDITION +-



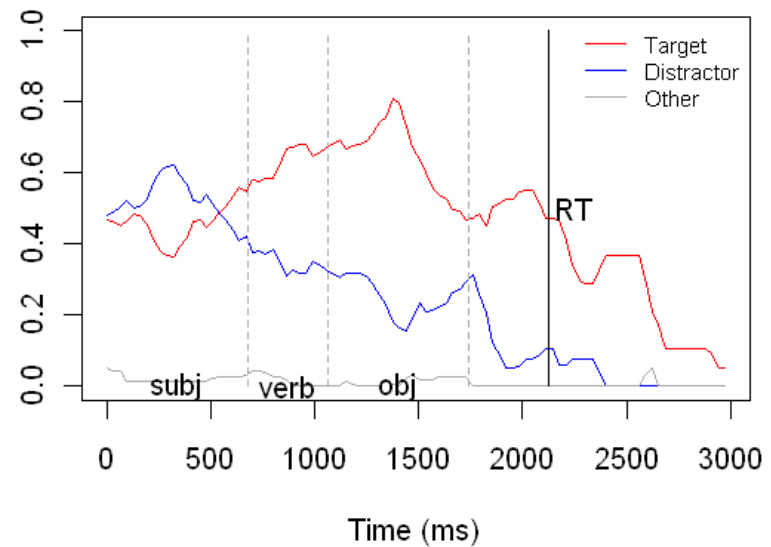
CONDITION -+



CONDITION ++



CONDITION --



Next steps

- Keep children still
 - monitor arm adjustment
 - More controls
 - two lists, to control for picture biases
 - fillers to control for side biases
 - pre-record sentences
 - An easier task
 - animated/moving stimuli
 - looking without decision-making
 - Exploit entire range of animacy hierachy
 - humans vs. animals
-

Conclusions

- The comprehension delay for S-O word order (English; C&M) can be modelled in OT with an incorrect constraint ranking of PROMINENCE and PRECEDENCE
 - The overall poorer performance in comprehension in comparison to production indicates a comprehension delay in S-O word order
 - Accuracy in comprehension was especially difficult in the [-an+an] condition
 - There were no differences in the conditions wrt looking time towards target so far . . .
-

Conclusions

- Accuracy and looking behavior of adult controls showed no animacy effects, but RT did
 - Children at about 4yrs showed adult-like accuracy on both tasks, supporting the hypothesis that constraints are correctly ranked by about this time
-

Extra Slides

- Participant Ages
 - Materials (Sentences)
 - Per Child Graph (Vocab Order)
 - Scoring
 - Incorrect Answers by Condition
 - Track Loss
 - Fixations Proportions over time (5s)
 - Practice – Children
 - Adult Fillers
 - Practice – Adults
 - Unscorable Adult responses
 - Adult Tableau
 - OT & Processing
-

Participants

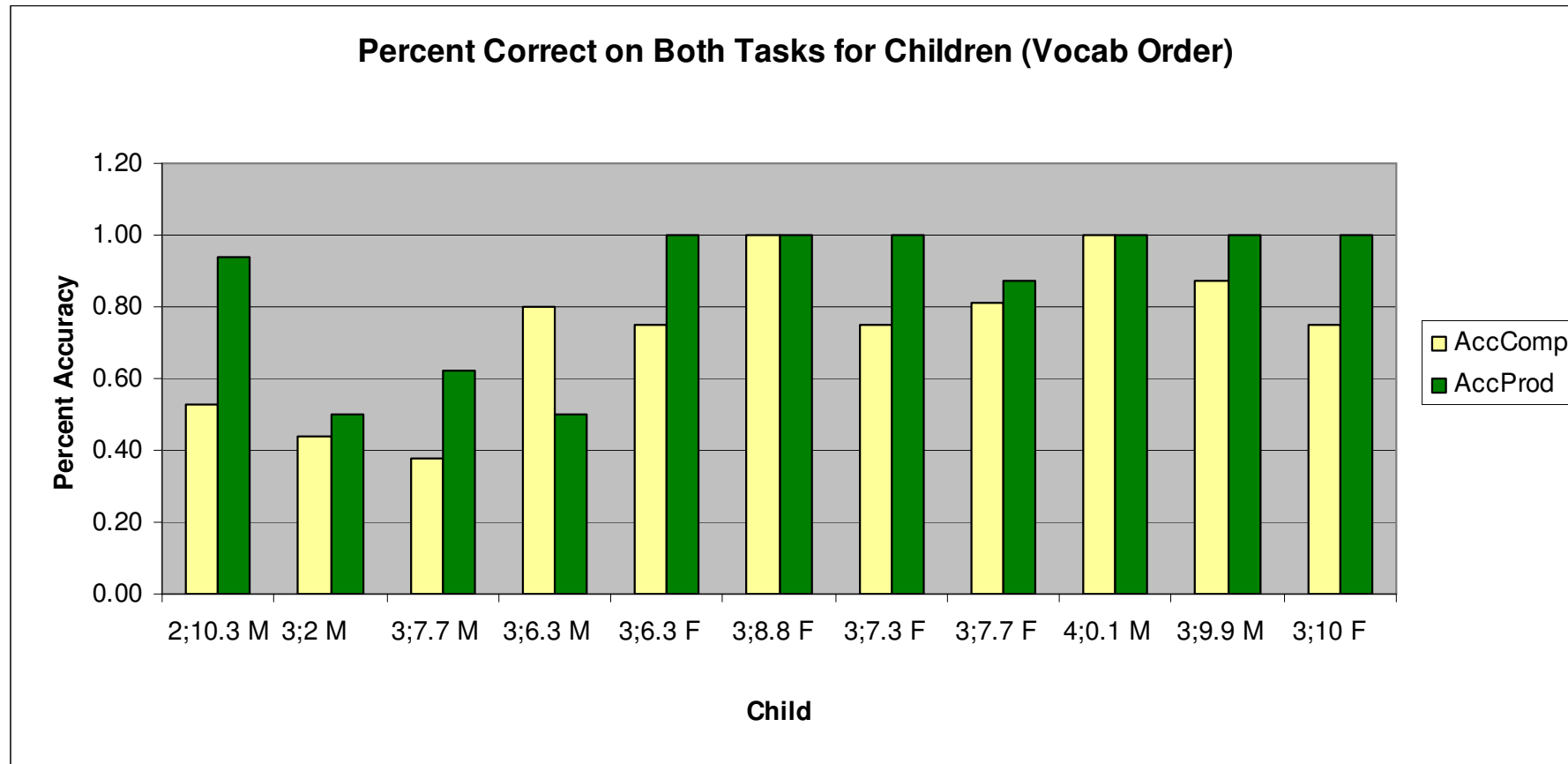
Name	Gender	Age(yr)
SN	M	2;10.3
JO	M	3;2
AL	F	3;6.3
TN	M	3;6.3
JE	F	3;7.3
LN	M	3;7.7
LE	F	3;7.7
KN	F	3;8.8
MS	M	3;9.9
NE	F	3;10
FS	M	4;0.1

Materials

- 16 sentences (with no fillers, 5 practice)
- duck, fish, cow, dog
- boat,(water)plane, car, bus
- push (*duwen*) & pull (*trekken*)

[+ +]	W	de eend duwt de vis	[- +]	W	de boot trekt de vis
[- +]	L	de auto duwt de koe	[+ -]	L	de koe trekt de auto
[+ -]	W	de vis duwt de boot	[- -]	W	het vliegtuig trekt de boot
[- -]	L	de bus duwt de auto	[+ +]	L	de hond trekt de koe
[+ +]	L	de koe duwt de hond	[- -]	L	de auto trekt de bus
[- -]	W	de boot duwt het vliegtuig	[+ -]	W	de eend trekt het vliegtuig
[+ -]	L	de hond duwt de bus	[- +]	L	de bus trekt de hond
[- +]	W	het vliegtuig duwt de eend	[+ +]	W	de vis trekt de eend

Per Child (Vocab Order)



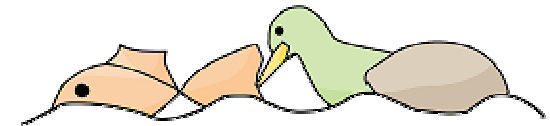
Scoring

- Comprehension

- Point to left
- Point to right
- Point to left, then **right**
- Point to right, then **left**
- Unclear
- Both
- No answer

- Production

- SVO
- OVS
- Anders (but good)
- Anders (but wrong)
- Other (uninterpretable)
- No Answer

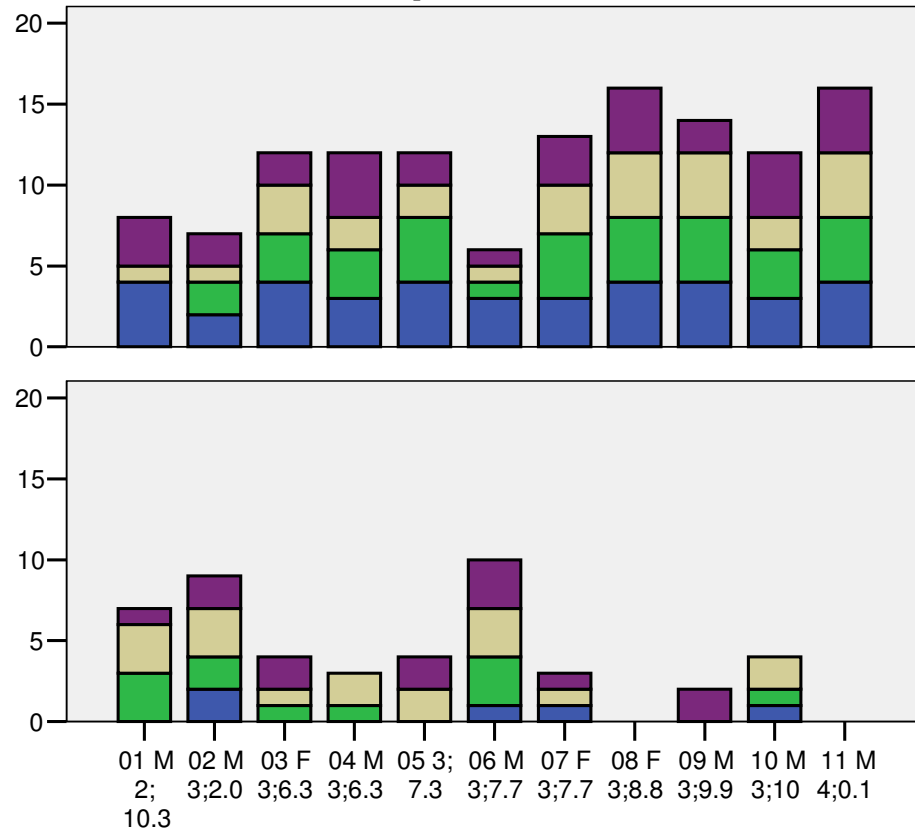


(In)correct Answers:

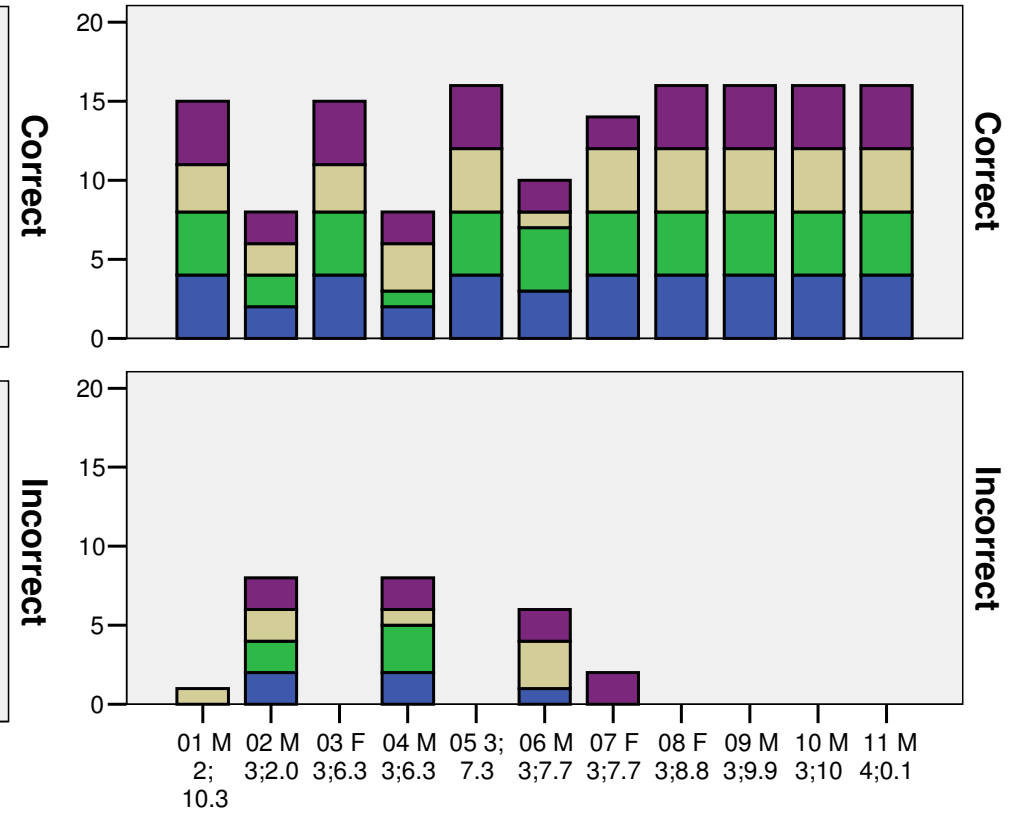
Counts by Condition



Comprehension



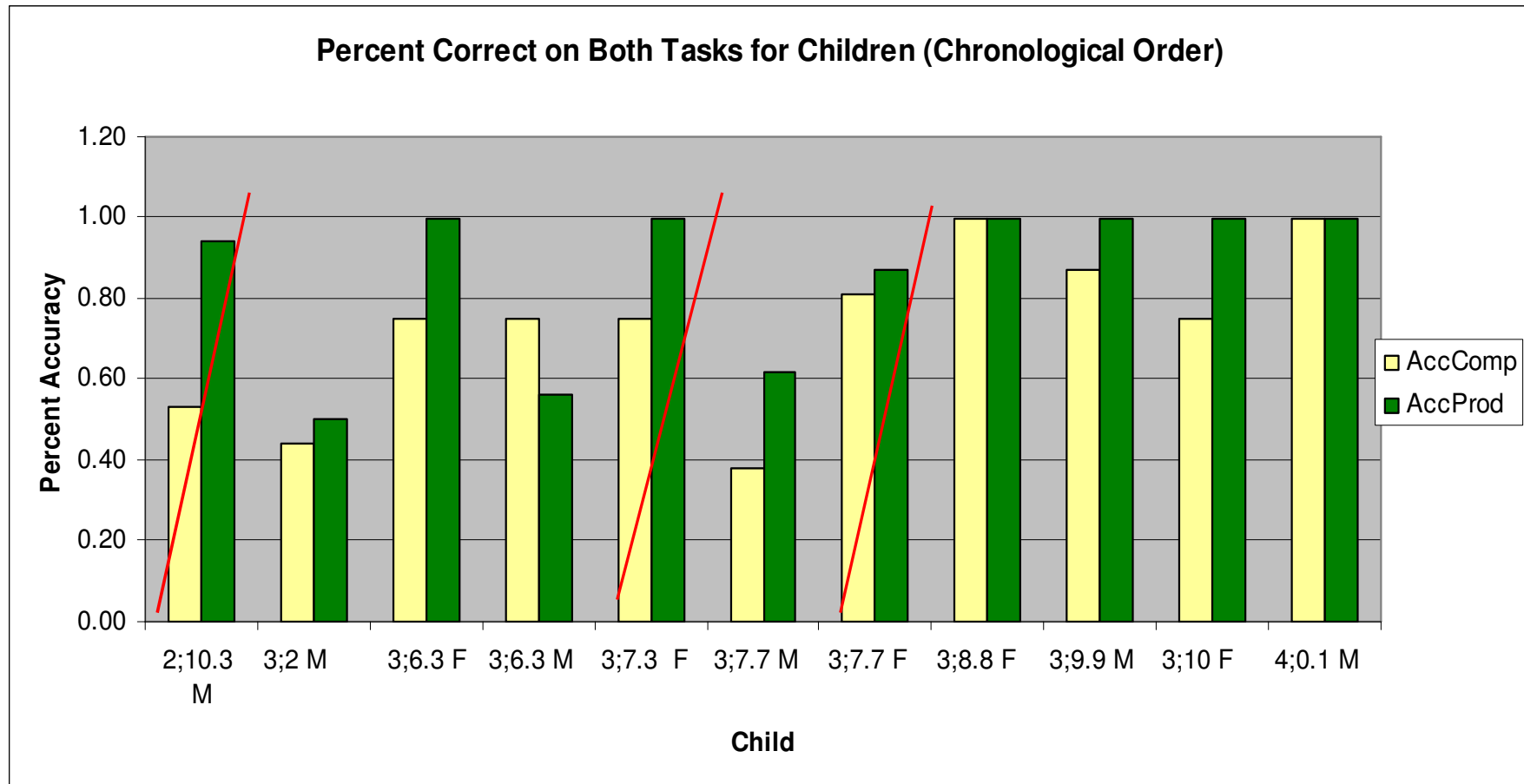
Production



Child

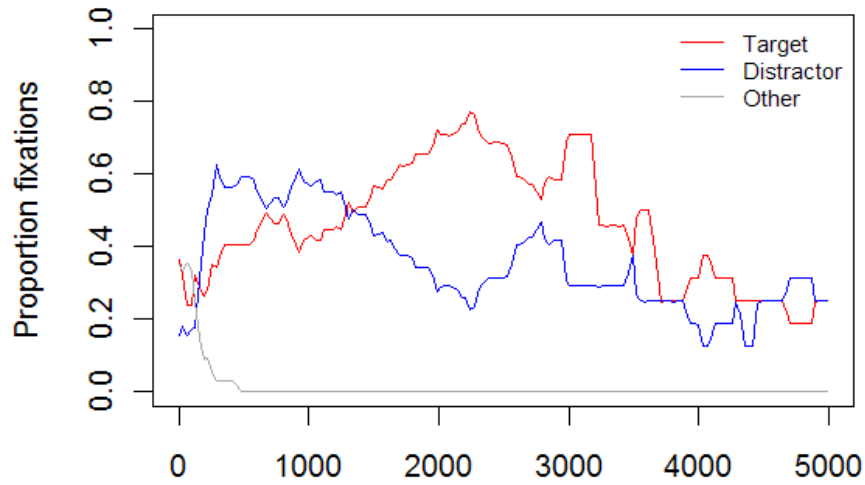
Child

Track Loss

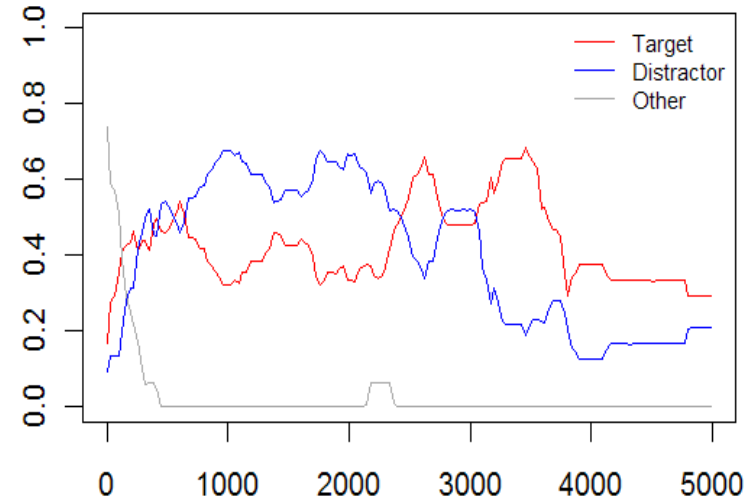


Children (5s)

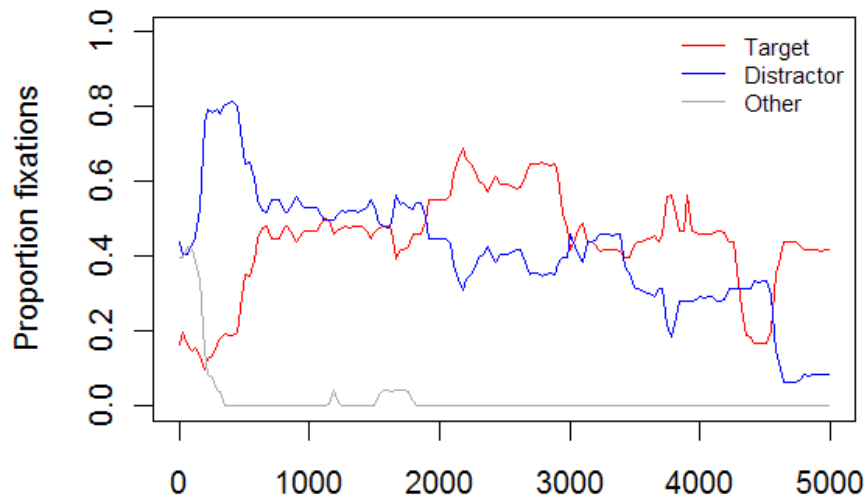
CONDITION +-



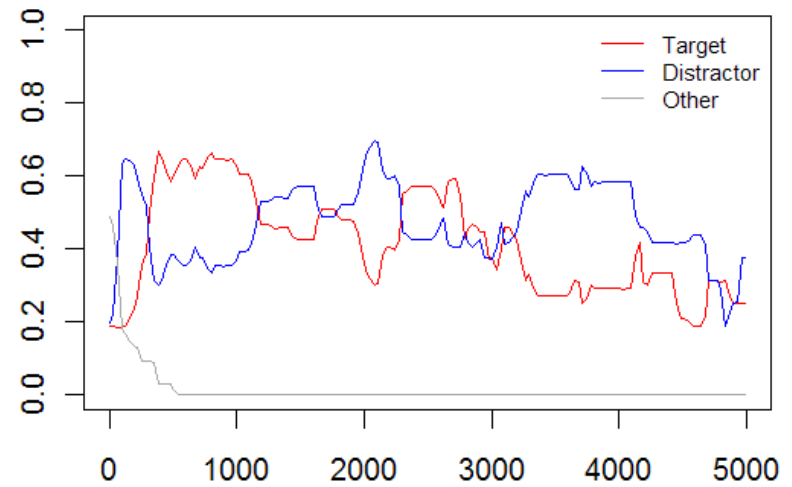
CONDITION -+



CONDITION ++



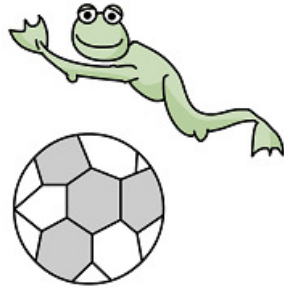
CONDITION --



Time (ms)

Time (ms)

Practice items - Children



de kikker springt over de beer
de trekker botst tegen de fiets
de beer ligt op de aap

kikkerSpringtBeer2.bmp
trekkerBotstBoom2.bmp
beerLigtAap2.bmp

beerOpFiets2.bmp
trekkerBotstFiets2.bmp
aapKustBeer2.bmp

de kikker springt over de poes
de beer zit(rijdt) op de fiets
de bal ligt op de poes

kikkerSpringtPoes.bmp
beerOpFiets.bmp
balOpPoes.bmp

de kikker springt over de bal
de poes staat op de beer

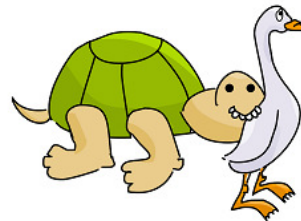
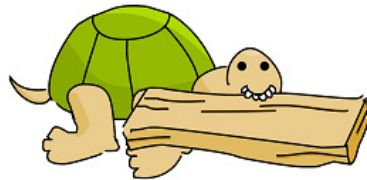
kikkerSpringtPoes2.bmp
poesStaatBeer2.bmp

kikkerSpringtBal2.bmp
beerLigtAap2.bmp

de poes staat op de beer
de boom valt op de fiets

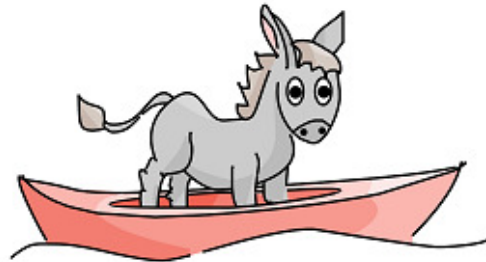
poesStaatBeer.bmp
boomOpFiets.bmp

Adult Fillers



[+ +]	L	de geit bijt het varken	geitBijtVarken2.bmp	varkenBijtGeit2.bmp	>	Reversed	SVO
[+ +]	W	de haai bijt de gans	gansBijtHaai2.bmp	haaiBijtGans2.bmp	<	Reversed	SVO
[+ +]	L	het konijn springt over de poes	poesSpringtKonijn2.bmp	konijnSpringtPoes2.bmp	>	Reversed	SVPO
[+ +]	W	de kikker springt over de schildpad	kikkerSpringtSchildpad2.bmp	schildpadSpringtKikker2.bmp	<	Reversed	SVPO
[+ -]	W	de schildpad bijt de plank	schildpadBijtPlank2.bmp	schildpadBijtGans2.bmp	>	Different	SVO
[+ -]	L	het varken bijt de bal	konijnBijtBal2.bmp	varkenBijtBal2.bmp	>	Different	SVO
[+ -]	L	de poes springt over de bakfiets	poesSpringtBakfiets2.bmp	poesSpringtVarken2.bmp	<	Different	SVPO
[+ -]	W	de gans vliegt over het vrachtschip	kikkerSpringtVrachtschip2.bmp	gansVliegtVrachtschip2.bmp	<	Different	SVPO
[- +]	L	de vrachtauto vervoert de kikkers	vrachtautoVervoertFlessen2.bmp	vrachtautoVervoertKikkers2.b	>	Different	SVO
[- +]	L/W	het vrachtschip vervoert de konijnen	vrachtschipVervoertKonijnen2.bm	treinVervoertKonijnen2.bmp	>	Different	SVO
[- +]	W	de plank ligt op de haai	haaiLigtPlank2.bmp	plankLigtHaai2.bmp	<	Reversed	SVPO
[- +]	L	de stoel staat op de geit	stoelStaatGeit2.bmp	geitStaatStoel2.bmp	<	Reversed	SVPO
[- -]	L	de bakfiets vervoert de flessen	bakfietsVervoertFlessen2.bmp	bakfietsVervoertPoezen2.bmp	>	Different	SVO
[- -]	W/L	de trein vervoert de planken	vrachtschipVervoertPlanken2.bmp	treinVervoertPlanken2.bmp	<	Different	SVO
[- -]	L	de bal ligt op de stoel	BalOnderStoel2.bmp	balLigtStoel2.bmp	<*	Reversed	SVPO
[- -]	L	de fles staat op de plank	flesStaatPlank2.bmp	plankLigtFles2.bmp	>*	Reversed	SVPO

Practice - Adults



[+ +] L de ezel schopt de haan
[+ -] W het schaap staat in een kano
[- -] L de boom valt op de fiets

paardSchoptHaan2.bmp
schaapStaatKano2.bmp
boomOpFiets2adult.bmp

ezeSchoptHaan2.bmp
ezelStaatKano2.bmp
trekkerTegenBoom2adult.bmp

[+ -] W de ezel staat in een kano
[- -] L de boom valt op de fiets
[+ +] L de paard schopt de haan


ezeStaatKano.bmp
boomOpFietsadult.bmp
paardSchoptHaan.bmp

Unscorable Adult Responses


Unscorable response	Target	Type	Cond	Part	1st Task
Een eend . . . zwemt achter de vis	de eend duwt de vis	Static/Location	[+ +]	12	P
De vis . . . zwemt achter de boot	de vis duwt de boot	Static/Location	[+ -]	12	P
De eend wrijft z'n kont tegen een vliegtuig	het vliegtuig duwt de eend	?!	[- +]	19	P
Een eend voor een vliegtuig	het vliegtuig duwt de eend	No verb	[- +]	7	P
Een watervliegtuig drijft achter een eend	het vliegtuig duwt de eend	Static/Location	[- +]	2	P
Een hond zit vast aan een bus	de bus trekt de hond	Static/Location	[- +]	2	P
De hond staat achter de bus	de bus trekt de hond	Static/Location	[- +]	6	C
De hond staat achter de bus	de bus trekt de hond	Static/Location	[- +]	13	C
Een hond zit vast aan een bus	de bus trekt de hond	Static/Location	[- +]	14	P
Een vliegtuig zit boven op een watervogel	het vliegtuig duwt de eend	Static/Location	[- +]	15	P
De vis duwt de boot	de boot trekt de vis	Verb reversal	[- +]	13	C
Een watervliegtuig voor de boot	de boot duwt het vliegtuig	No verb	[- -]	7	P
Een watervliegtuig en een boot botsen	de boot duwt het vliegtuig	S&S V	[- -]	2	P
De bus staat achter de auto	de bus duwt de auto	Static/Location	[- -]	6	C
Ja, nee, de boot ligt achter het vliegtuig	de boot duwt het vliegtuig	Static/Location	[- -]	6	C
Een bus botst met een auto	de bus duwt de auto	SVPO	[- -]	21	P
Een . . . uh een vliegtuig trekt een boot	de boot duwt het vliegtuig	Verb reversal	[- -]	14	P
Een vliegtuig trekt een boot – OF	de boot duwt het vliegtuig	Verb reversal	[- -]	15	P

Correctly Ranked Constraints

Adult's **production**

Input = meaning	Output = form	PRECEDENCE	PROMINENCE
<the car is pushing the cow> 	"The car is pushing the cow"		
	"The cow is pushing the car "	*!	

Adult's **comprehension**

Input = form	Output = meaning	PRECEDENCE	PROMINENCE
"the car is pushing the cow" 	<The car is pushing the cow >		*!
	<'The cow is pushing the car >	*	

OT & Processing



the car...	CASE	AGREEMENT	SELECTION	PRECEDENCE	PROMINENCE
SVO					*
OVS				*	



...pushes	CASE	AGREEMENT	SELECTION	PRECEDENCE	PROMINENCE
SVO					*
OVS				*	



...the cow	CASE	AGREEMENT	SELECTION	PRECEDENCE	PROMINENCE
SVO					**
OVS				*	