Aphasia data from less studied languages

Verb production and sentence comprehension

Roelien Bastiaanse

university of groningen

HIGHER SCHOOL OF ECONOMICS
NATIONAL RESEARCH UNIVERSITY

Goal

- to show how we learn by trail and error
- by studying a problem crosslinguistically

Languages

- Akan
- Chinese
- Dutch
- Indonesian
- Thai
- Turkish

Topics

- production of grammatical morphology of time reference
  - Tense & Aspect inflection
  - aspectual adverbs
  - grammatical tone
- comprehension of sentences with derived word order
  - word order
  - case
  - pragmatic constraints
  - semantic constraints

Aphasia

- language disorder after focal brain damage
- agrammatic aphasia
  - Broca's aphasia (USA)
  - expressive aphasia (Germany)
  - efferent motor aphasia (Russia)

Agrammatic aphasia

- production is non-fluent
- mainly function words
- verbs are particularly impaired
- comprehension is relatively intact

PART I: VERB PRODUCTION

Spontaneous speech

- verb production is impaired
- many utterances without a verb
- when a verb is produced, it is often in nonfinite form
  - infinitive
  - gerund
  - participle
- WHY?

Why are inflected verbs impaired?

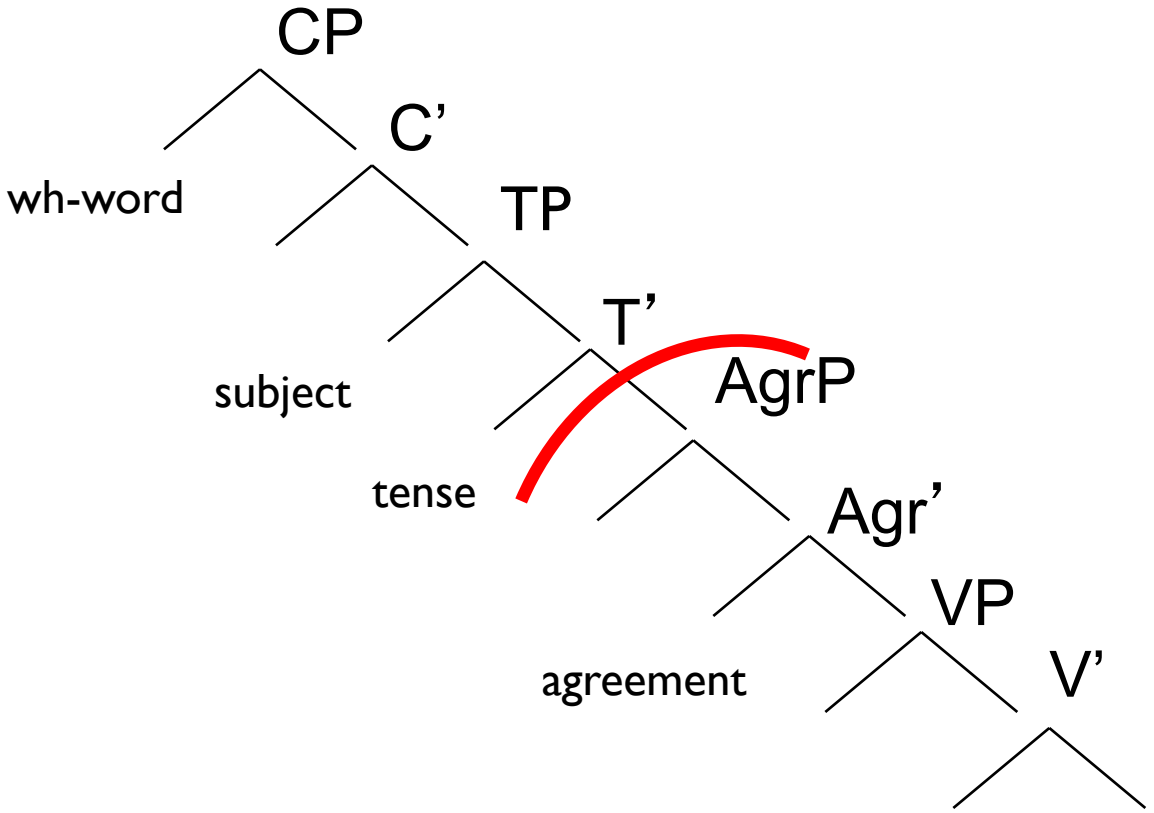
- inflection?
- tense?
- aspect?
- agreement?

Observation

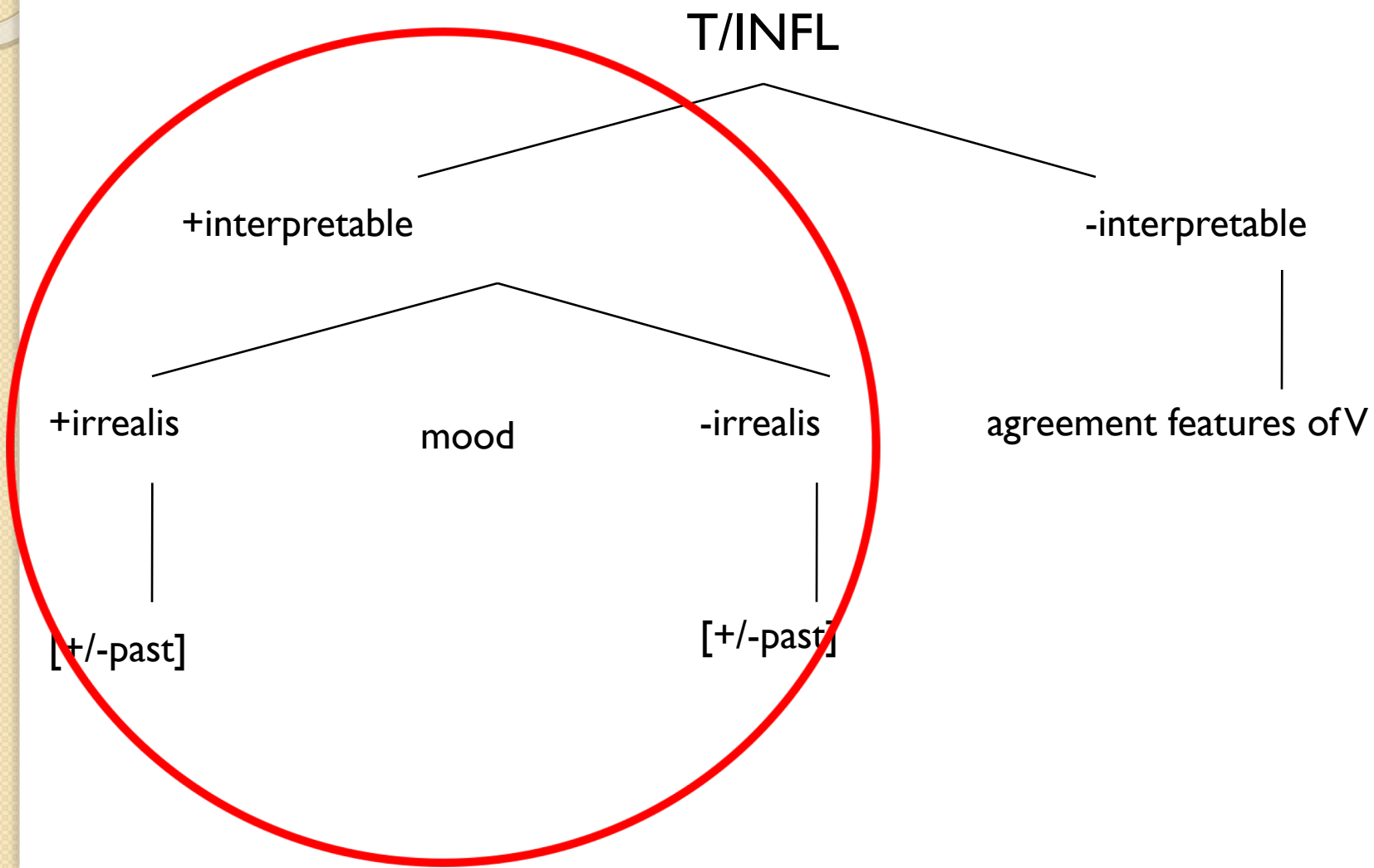
- Tense is more impaired than Agreement

Tree Pruning Hypothesis (TPH)

Friedmann & Grodzinsky. 1997



Tense Underspecification Hypothesis (TUH) Wenzlaff & Clahsen 2005



New observation Bastiaanse, 2008

- verb forms that refer to the past are more difficult to produce than verb forms that refer to the present

  - past tense < present tense
  - perfect aspect < imperfect aspect
  - participle < infinitive, gerund

Tense and discourse linking Zagona, 2004

- present Tense: simultaneity of evaluation time ('speech time') and event time
- past Tense: lacks this simultaneity
  - need for establishing a relation between speech time and an earlier event
  - this requires 'discourse linking'

PAst DIscourse LInking Hypothesis (PADILIH) Bastiaanse, 2013

- reference to the past through verb inflection is difficult for agrammatic speakers
- because reference to the past is discourse linked
  - regardless of position in the tree
  - regardless of the tense of the finite verb

Discourse linking

- Zagona
  - Tense is used for time reference
  - present Tense → simultaneity speech time - event time
  - past Tense → discourse linking
- Bastiaanse
  - time reference can be done by grammatical (verb) morphology
  - present → simultaneity speech time - event time
  - past → discourse linking

PADILIH

- predictions for English

	refers to	tense	expected
◦ he writes	present	present	+
◦ he is writing	present	present	+
◦ he will write	future	present	+
◦ he wrote	past	past	-
◦ he has written	past	present	-

Questions

- is it a tense problem?
  - past tense is selectively impaired
- is it verb morphology?
  - verb forms refering to past are impaired, regardless of tense

Test for Assessing Reference of Time (TART)

- production (and comprehension) of verb forms that refer to past, present and future
- finite and non-finite
- tense and aspect
  - Dutch
  - aspectual adverbs: Chinese and Indonesian
  - grammatical tone: Akan

Test for Assessing Reference of Time (TART)

For this picture I could say now the man drinks the milk and for this picture I could say now the man…

…**pours** the milk

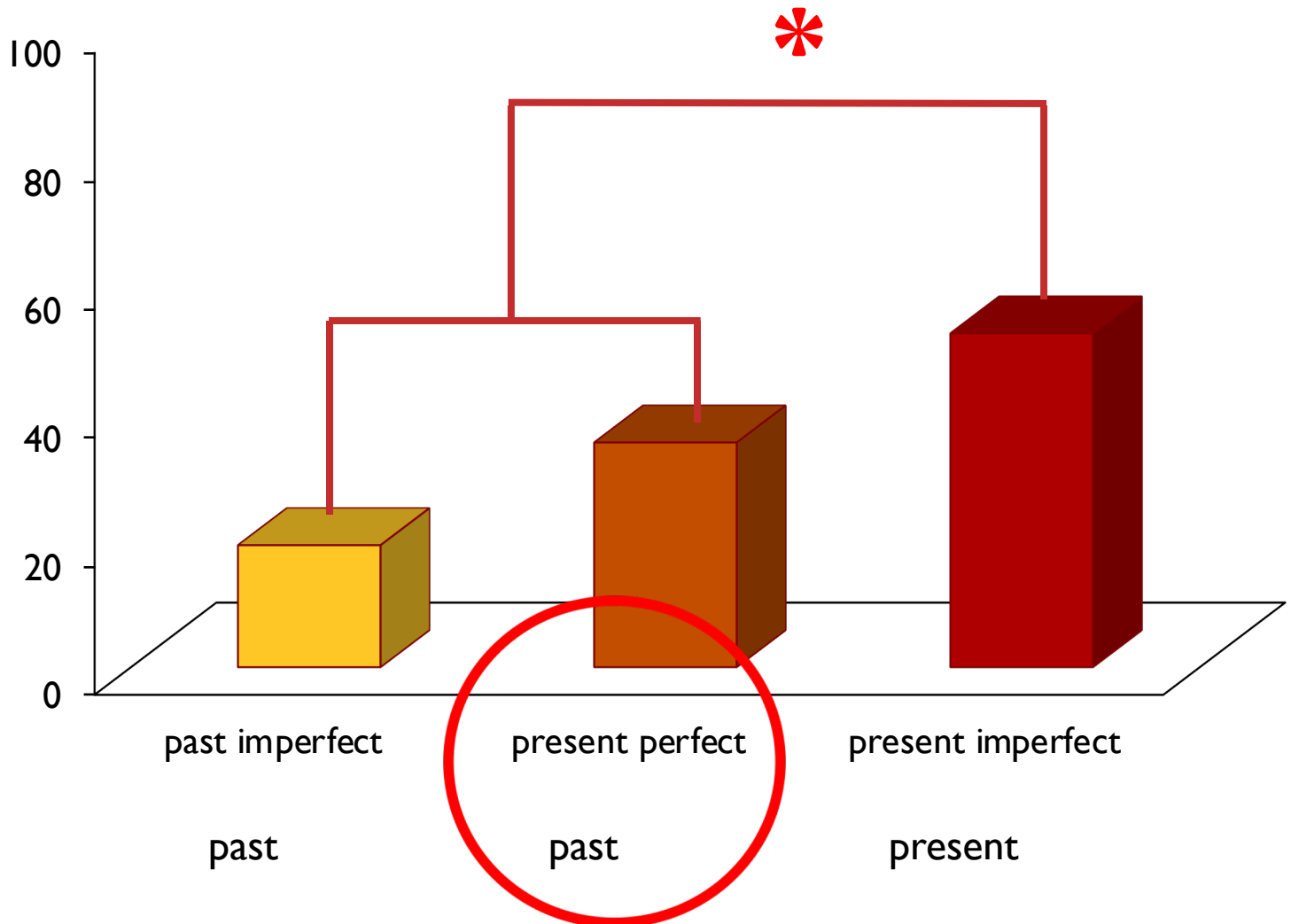
drink

pour

Dutch

- present imperfect → present
- past imperfect → past
- present perfect → past

Dutch results



Dutch results

- reference to the past impaired
- regardless of the tense of the verb

Next question

- is it only reference to the past through verb inflection
- or are other grammatical morphemes for reference to the past impaired as well?

Chinese: time reference through aspectual adverbs

zhe ge ren	zai	du	yi fong sin
the man	[progr]	read	a letter

'the man is reading a letter'

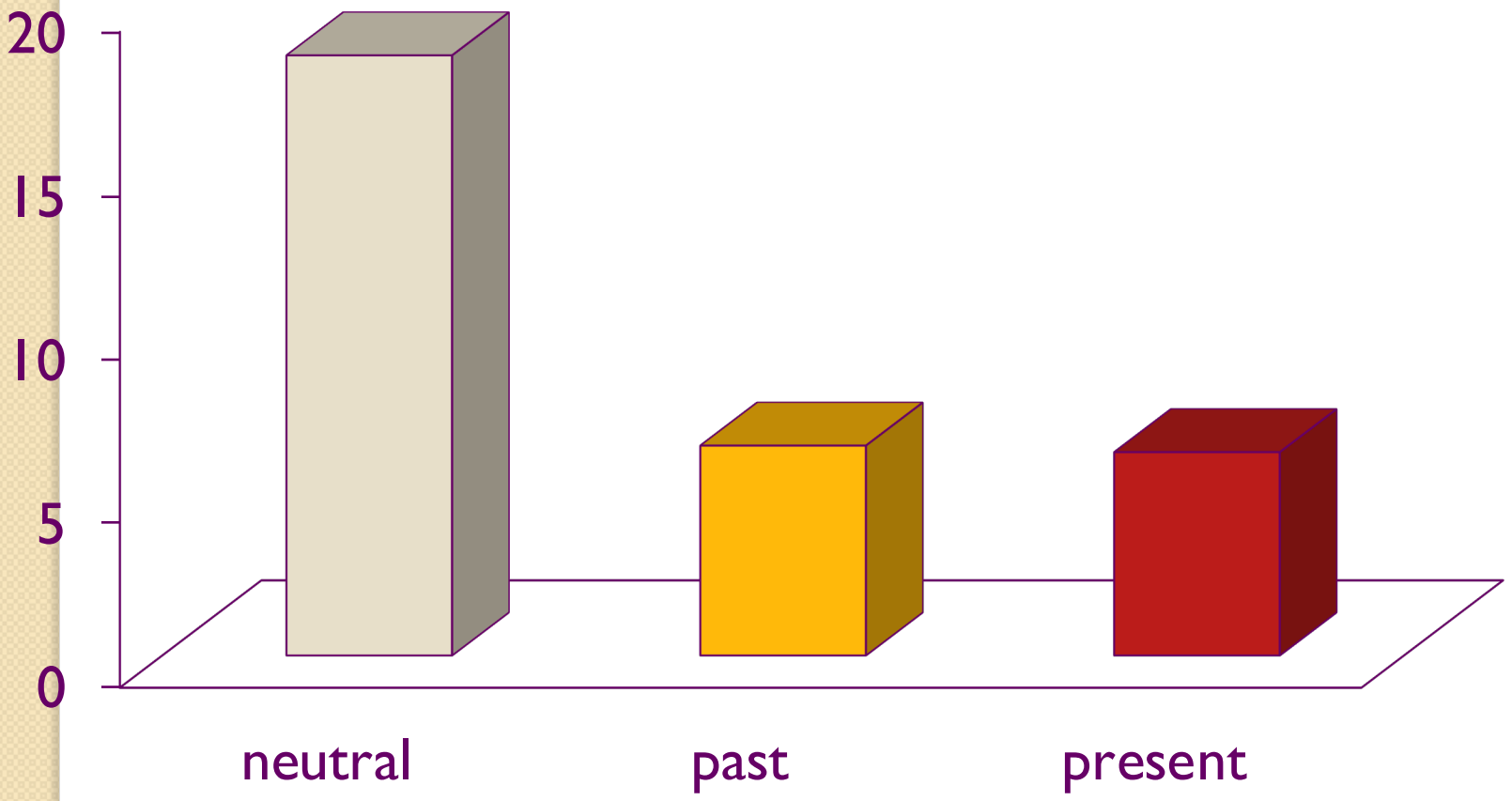
zhe ge ren	du	le	yi fong sin
the man	read	[past]	a letter

'the man read the letter'

Question

- is it verb inflection?
  - reference to past is relatively intact
- is it grammatical morphology?
  - reference to the past selectively impaired

Chinese results



Chinese results

- is it verb inflection?
  - all time frames are relatively well preserved
  - no: all time frames are impaired
- is it grammatical morphology?
  - reference to the past selectively impaired
  - no: all time frames are impaired

Chinese: time reference through aspectual adverbs

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Explanation

- aspectual adverbs are used when time frame is clear from context / discourse

→

- aspectual adverbs are used to link the event to a time frame

→

- they are used for discourse linking

Indonesian Anjarningsih, 2012

dia	sudah	menyetrika	baju
she	*perfektif*	iron	shirt
dia	sedang	menyetrika	baju
she	*duratif*	iron	shirt

Indonesian

- aspectual adverbs are used for discourse linking

→

- the time frames will be equally impaired

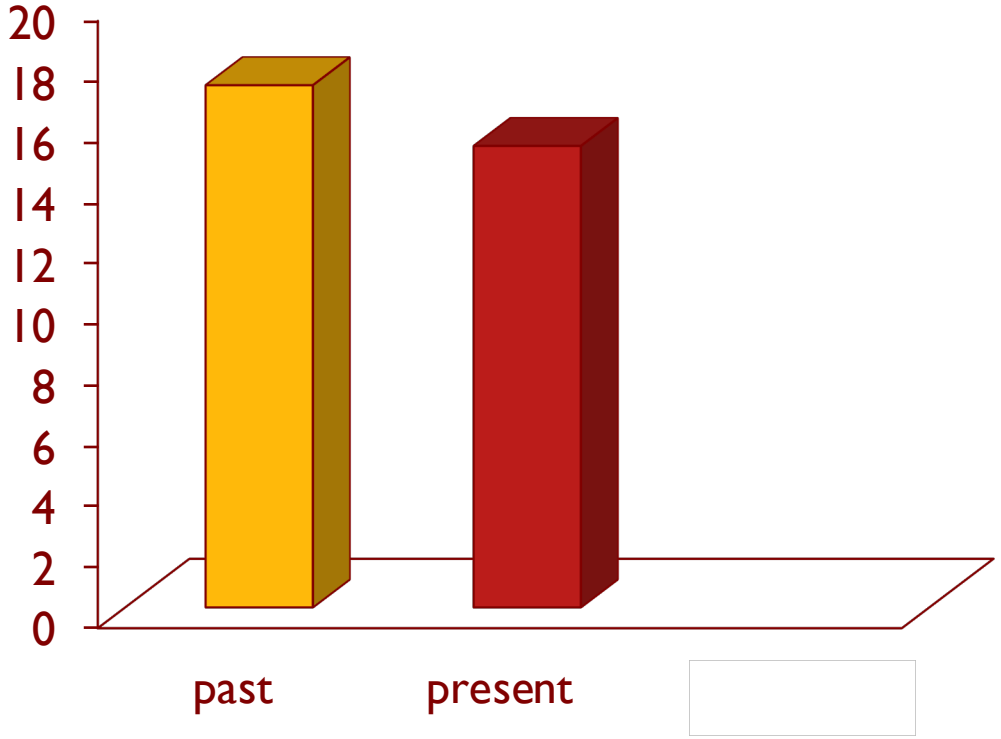
Indonesian production

- revised TART to avoid problems with omission of optional aspectual adverbs

menyetrika

dia	sudah	menyetrika	baju	dia…	[sedang	menyetrika	baju]
she	*perfektif*	iron	shirt	she…	[*duratif*	iron	shirt]

Results Indonesian



Conclusion Indonesian

- no selective deficit for reference to the past

→

PADILIH:

  - due to discourse linking problems
  - time reference through grammatical morphology is impaired
    - past in languages with verb inflection
    - all time frames in languages with aspectual adverbs

Akan

- spoken in Ghana
- lexical and grammatical tone
- difference past and present: tone

Time reference in Akan

- past

  Peter **gyínáá** ho

  Peter standPAST LOC

  'Peter stood here'

- present

  Peter **gyìná** ho

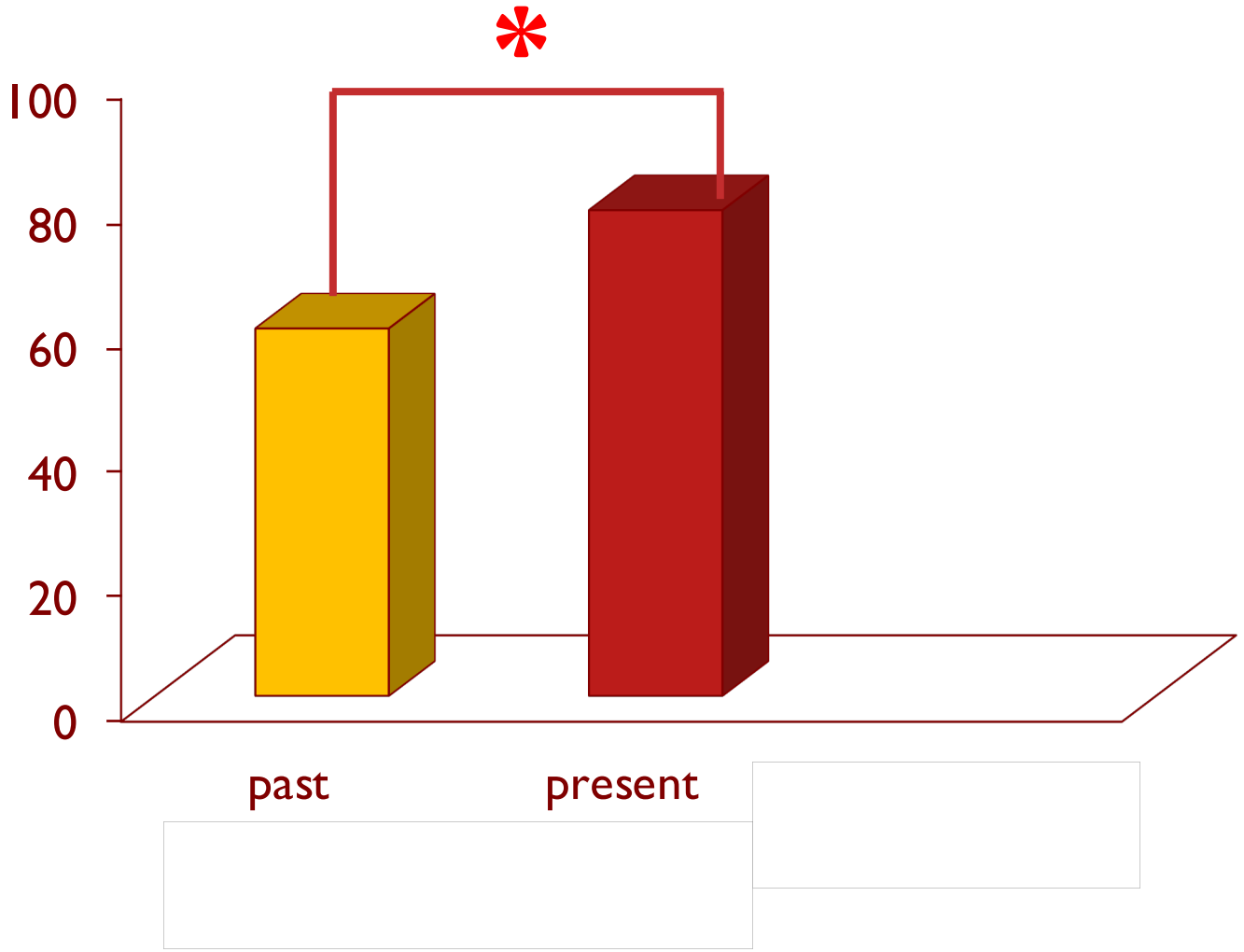
  Peter standPRES LOC

  'Peter is standing here'

Question

- no inflectional affixes
- no free standing morphemes
- is discourse linking also when it is expressed by grammatical tone?

Results Akan



Conclusion Akan

- only reference to the past is discourse linked
- it is expressed through grammatical tone
- and is selectively impaired

Overall conclusion

- Dutch data
  - reference to the past through inflected verb forms is selectively impaired, because these forms are discourse linked
- Chinese and Indonesian data
  - time reference through grammatical morphology is impaired when discourse linked
- Akan data
  - time reference through grammatical morphology and grammatical tone is impaired when discourse linked

PART 2: SENTENCE COMPREHENSION

Prerequisites for sentence comprehension

- understand the single words
- understand information on
  - word order
  - grammatical structure
  - case
  - pragmatic constraints
  - semantic constraints

Some examples

- comprehension of single words
  - the glens raspered the fluckers
- comprehension of word order
  - the man kisses the woman
  - the woman kisses the man
- comprehension of structure
  - it is the woman who the man kisses
  - it is the man who kisses the woman
- comprehension of case
  - der Mann küsst die Frau
  - den Mann küsst die Frau

Word vs sentence comprehension

- if you don't understand the words, you won't understand sentences

but

- that does not mean that if you understand words, you understand sentences

Questions

- how can we tear word and sentence comprehension apart?
- how can we understand whether word order / grammatical structure or case or even other factors influence sentence comprehension?
- by studying aphasia

Word order and thematic roles

- the boy is pulling the girl
- the girl is pulled by the boy
- it is the boy that is pulling the girl
- it is the girl that the boy is pulling
- the boy that is pulling the girl is ....
- the girl that the boy is pulling is ....

Word order and thematic roles

- the boy is pulling the girl
- the girl is pulled by the boy
- it is the boy that is pulling the girl
- it is the girl that the boy is pulling
- the boy that is pulling the girl is big
- the girl that the boy is pulling is big

Test design, usually

Until 1970s

- Broca's / agrammatic aphasia
- sentence production is impaired
  - agrammatic, telegraphic
- word comprehension is spared
- sentence comprehension is spared

Zurif and Caramazza (1976)

- tested individuals with Broca's and Wernicke's aphasia
- sentences like
  - the apple that the boy is eating is red
  - the boy that the girl is pulling is tall
- two pictures
  - tall boy ← pulling → girl
  - tall girl ← pulling → boy

Results

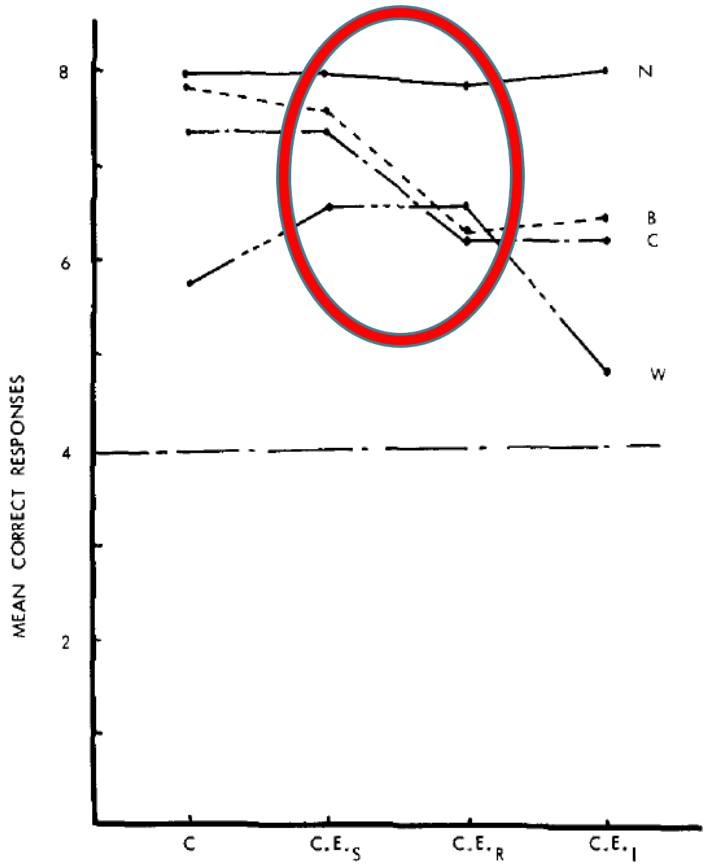


FIG. 1. Mean correct performance for each patient group (N = Normal, B = Broca, C = Conduction, and W = Wernicke) as a function of sentence type (CE_S = semantically constrained, CE_R = reversible, CE_I = improbable, and C = control).

Explanation

- in Broca's aphasia: central deficit
- "brain damage affects a general language processing mechanism that subserves the syntactic component of both comprehension and production." (p. 581)
- Broca patients can understand sentences on the basis of semantic heuristics
  - the apple that the boy is eating is red
- but they have problems with sentence comprehension when syntactic knowledge is required

Schwartz, Saffran & Marin, 1980

- actives compared to passives
  - the dog chases the cat vs. the cat is chased by the dog
- prepositional constructions
  - the circle is behind the square
- conclusion:
- "We conclude that these agrammatic subjects have a syntactic mapping defect such that they are unable to utilize a fixed and principled set of procedures to recover the relational structure of spoken sentences" (p 261)

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Syntactic mapping

- what does that mean and what are the consequences?
- mapping syntactic and thematic roles

  the boy is pulling the girl

Syntactic mapping

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- mapping syntactic and thematic roles

  the $\text{boy}_{\text{subject}}$ is pulling the $\text{girl}_{\text{object}}$

Syntactic mapping

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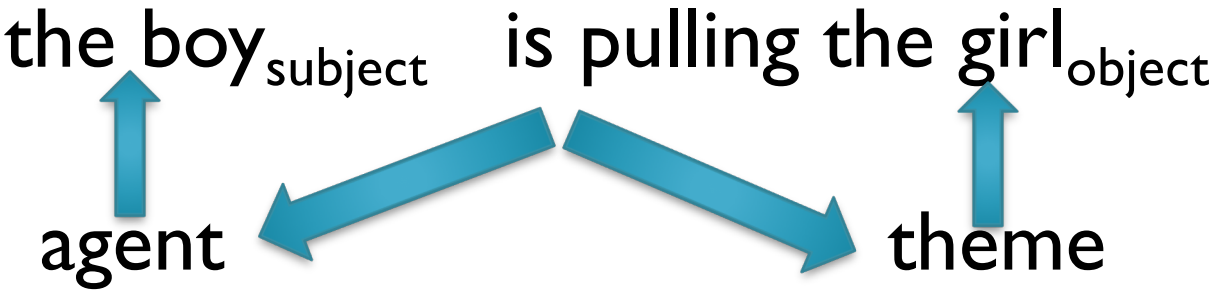

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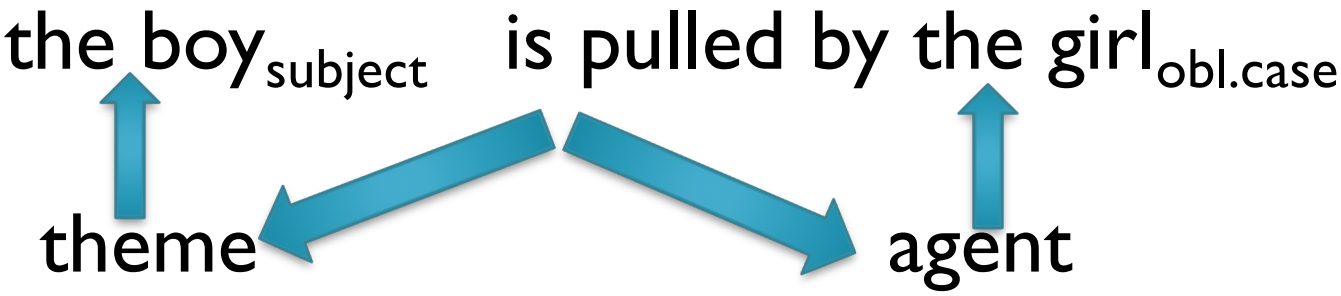


Mapping account

- overarching
  - production and comprehension
- Broca patients have problems with mapping thematic roles
- but what does it explain?
- why can they map the roles correctly in an active but not in a passive sentence?
- and how do they solve this problem?

According to the Schwartz group

- Broca patients have an 'agent first' strategy

  the boy is pulling the girl

  'the boy' is first NP

  → the boy is agent

  → the sentence is correctly understood

According to the Schwartz group

- Broca patients have an 'agent first' strategy

  the boy is pulled by the girl

  'the boy' is first NP

  → the boy is agent

  → the sentence is incorrectly understood

However,

- if the mapping theory is correct:
- how will the patients score on active sentences?
- high
- how will the patients score on passive sentences?
- the patient should score (close to) 0 % correct on passive sentences
- but they score around 50% correct (chance level)

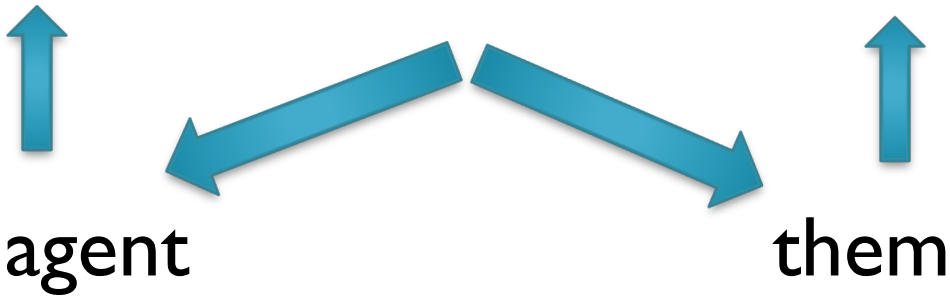
Grodzinsky (1986 etc.)

- on a binary choice test there are three levels of performance
- above chance > 66%
- at chance 34-66%
- below chance < 33%
- actives → above chance
- passives → at chance
- this implies that Broca patients guess when they have to point to a picture after hearing a passive sentence
  - not an agent first strategy

Trace Deletion Hypothesis (TDH)

- comprehending an active sentence

  the $boy_{subject}$ is pulling the $girl_{object}$



Trace Deletion Hypothesis (TDH)

- comprehending a passive sentence
- generative framework (Chomsky)
- in English the base position of the theme is after the verb

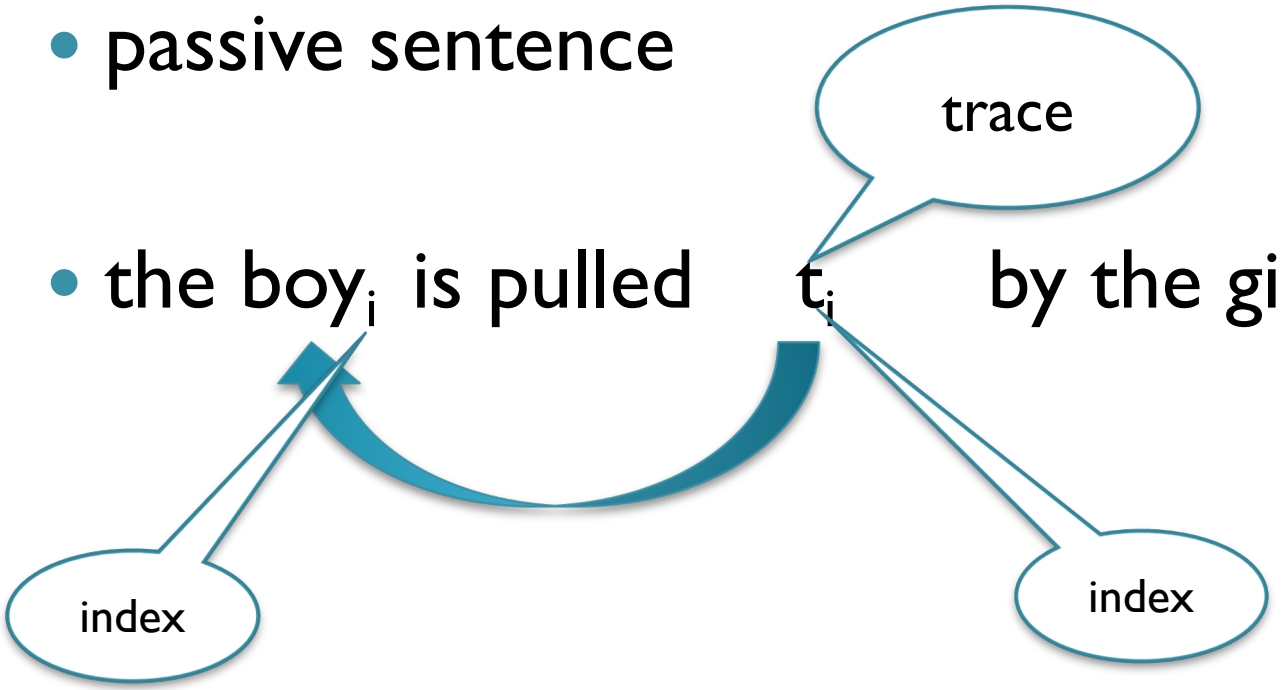
the girl is pulling the boy

Trace Deletion Hypothesis (TDH)

- in a passive sentence, the theme 'moves' to subject position
- leaving behind a trace that is co-indexed with the (new) subject

Thematic role assignment in passives

- passive sentence
- the boy$_i$ is pulled t_i by the girl



Thematic role assignment in passives

- passive sentence
- the boy$_i$ is pulled t_i by the girl

theme

Thematic role assignment in passives

- passive sentence
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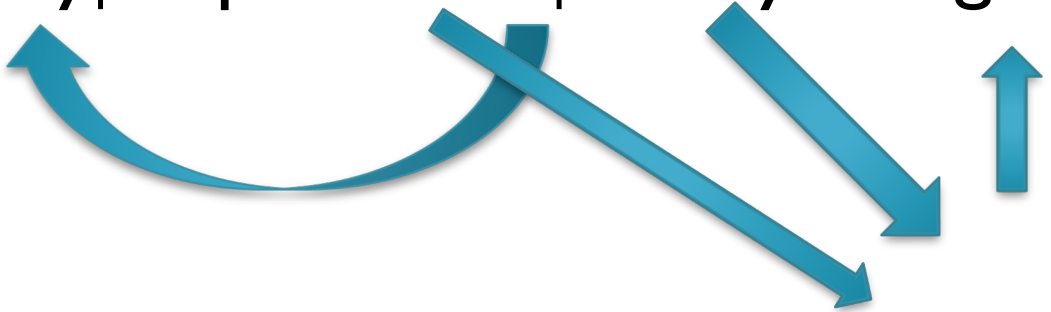

theme agent

Trace Deletion Hypothesis (TDH)

- in Broca's aphasia, the traces are deleted from the representation
- the boy$_i$ is pulled t_i by the girl

theme agent

Trace Deletion Hypothesis (TDH)

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Trace Deletion Hypothesis (TDH)

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- the boy$_i$ is pulled by the girl

agent

Trace Deletion Hypothesis (TDH)

- in Broca's aphasia, the traces are deleted from the representation
- the boy is pulled by the girl

agent

- problem: no role for first NP

Default strategy

- an NP that has no thematic role gets the role according to its position in the sentence
- if this is the first NP, it gets the role of agent

Trace Deletion Hypothesis (TDH)

- first NP gets the role of agent

- the boy is pulled by the girl

agent

Trace Deletion Hypothesis (TDH)

- first NP gets the role of agent
- the boy is pulled by the girl

agent

agent

- problem: two agents

Trace Deletion Hypothesis (TDH)

- first NP gets the role of agent
- the boy is pulled by the girl

agent

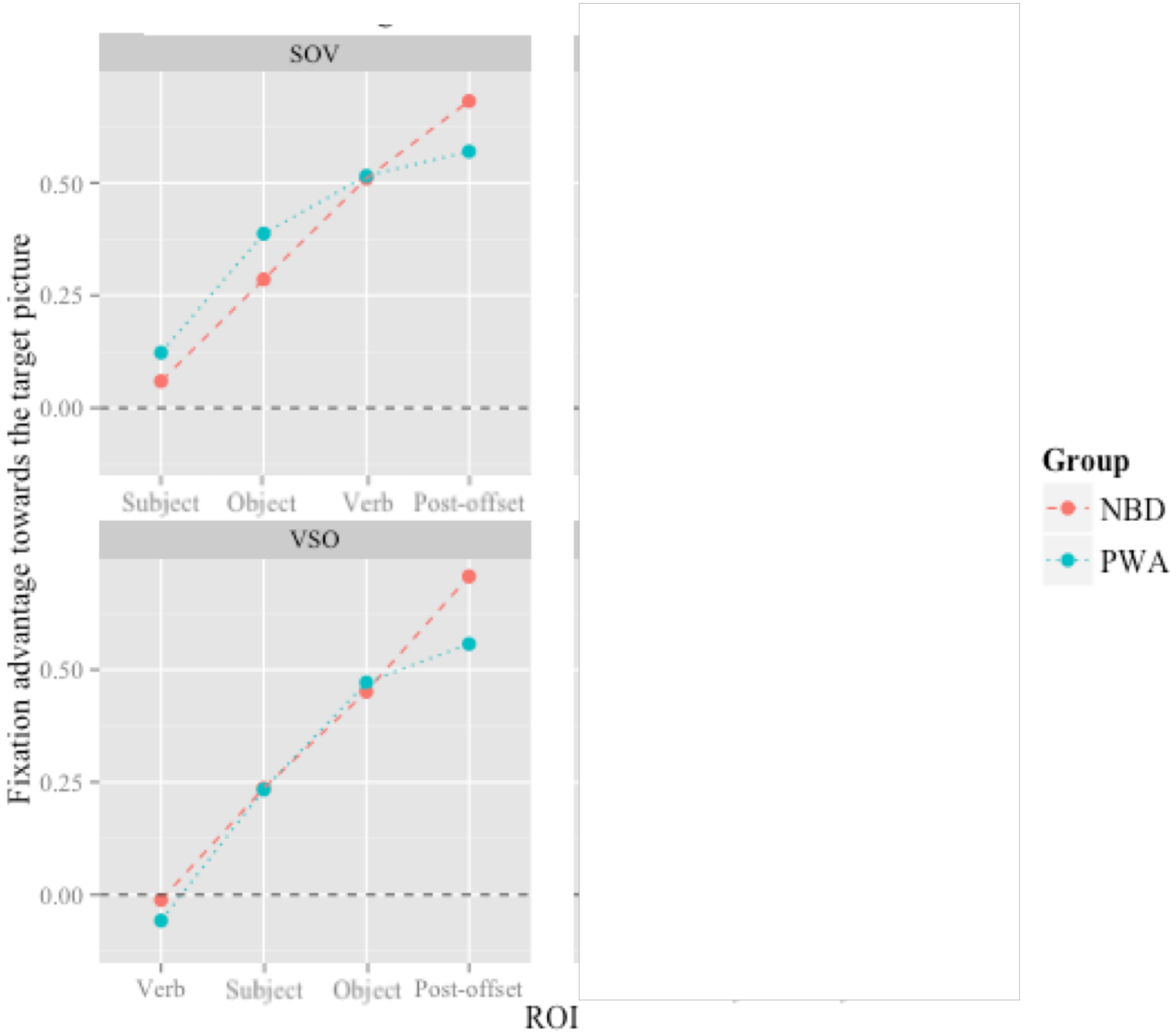
agent

- problem: two agents
- chance level performance

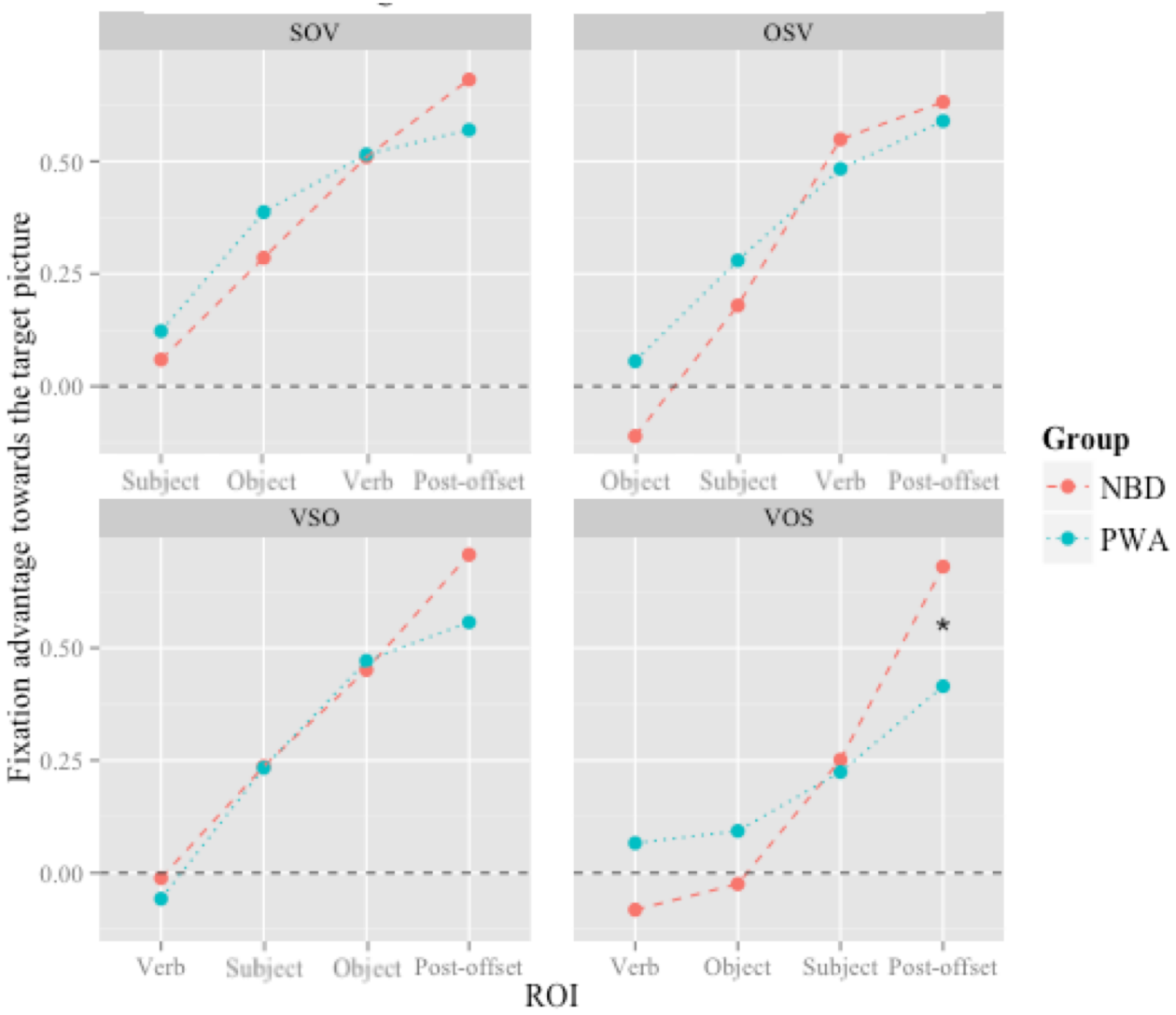
Trace Deletion Hypothesis (TDH)

- elegant theory that can be tested
- very much opposition
- never really falsified
  - although Eye Tracking data do not support TDH

Eye tracking results from Basque (Arantzeta et al., 2018)



Eye tracking results from Basque (with Miren Arantzeta, Arantzeta et al., 2018)



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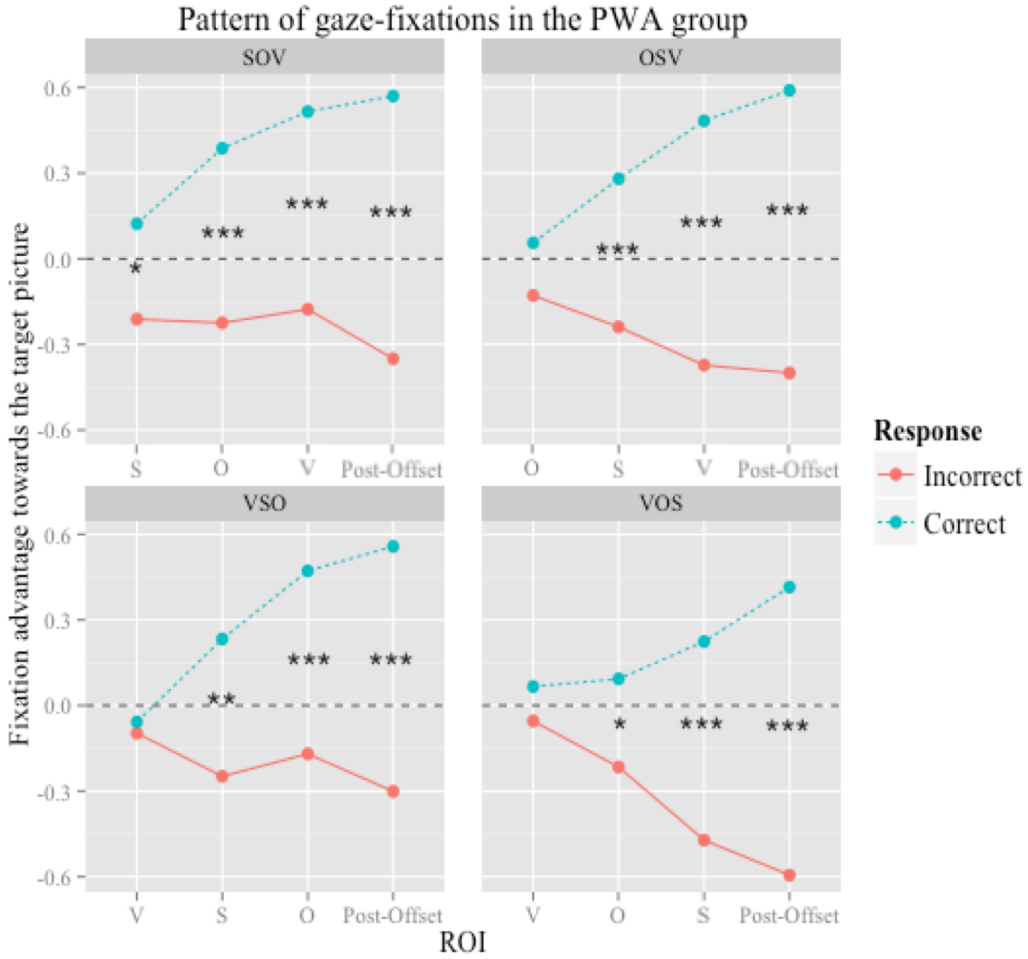

Trace Deletion Hypothesis (TDH)

- elegant theory that can be tested
- very much opposition
- never really falsified
  - although Eye Tracking data do not support TDH
- has been modified several times, but the idea remains the same:
  - traces are deleted
  - default strategy

Trace Deletion Hypothesis (TDH)

- main objections:
  - only for comprehension
  - it is a representational account, meaning that the syntactic representation are wiped from the brain
  - which does not allow for much variation
  - usually it is not strictly active above chance, passive at chance
  - when statistics are done:
    - passive < actives
    - object clefts < subject clefts
    - object relatives < subject relatives

Derived Order Problem Hypothesis (DOP-H Bastiaanse & Van Zonneveld, 2005)

- relatively theory independent
- processing account
- overarching theory
  - holds for both comprehension and production

Derived Order Problem Hypothesis

- every language has a base word order
- all other word orders are derived through linguistic operations
- [through movement, merge or whatever]
- sentences with derived word order are relatively difficult to comprehend and produce for agrammatic patients

SOME CROSSLINGUISTIC DATA

The role of case: data from Turkish
Yarbay Duman et al., 2011

- base order: subject – object – verb
- relatively free word order
- subject and object are marked for case
  - subject → nominative
  - object → accusative
- … but not always

Some examples from Turkish

- base order:
  - subject $\text{agent}_{\text{nom}}$ – object $\text{theme}_{\text{acc}}$ – verb
- scrambled
  - object $\text{theme}_{\text{acc}}$ – subject $\text{agent}_{\text{nom}}$ – verb
- subject relative
  - object $\text{theme}_{\text{acc}}$ – verb – subject $\text{agent}_{\text{nom}}$
- object relative
  - subject $\text{agent}_{\text{gen}}$ – verb – object $\text{theme}_{\text{acc}}$
- passive
  - subject $\text{theme}_{\text{nom}}$ – by-phrase $\text{agent}_{\text{nom}}$ – verb

Agent first

- base order:
  - subject,agent$_{nom}$ – object theme$_{acc}$ – verb
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  - object theme$_{acc}$ – verb – subject,agent$_{nom}$
- object relative
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If case helps

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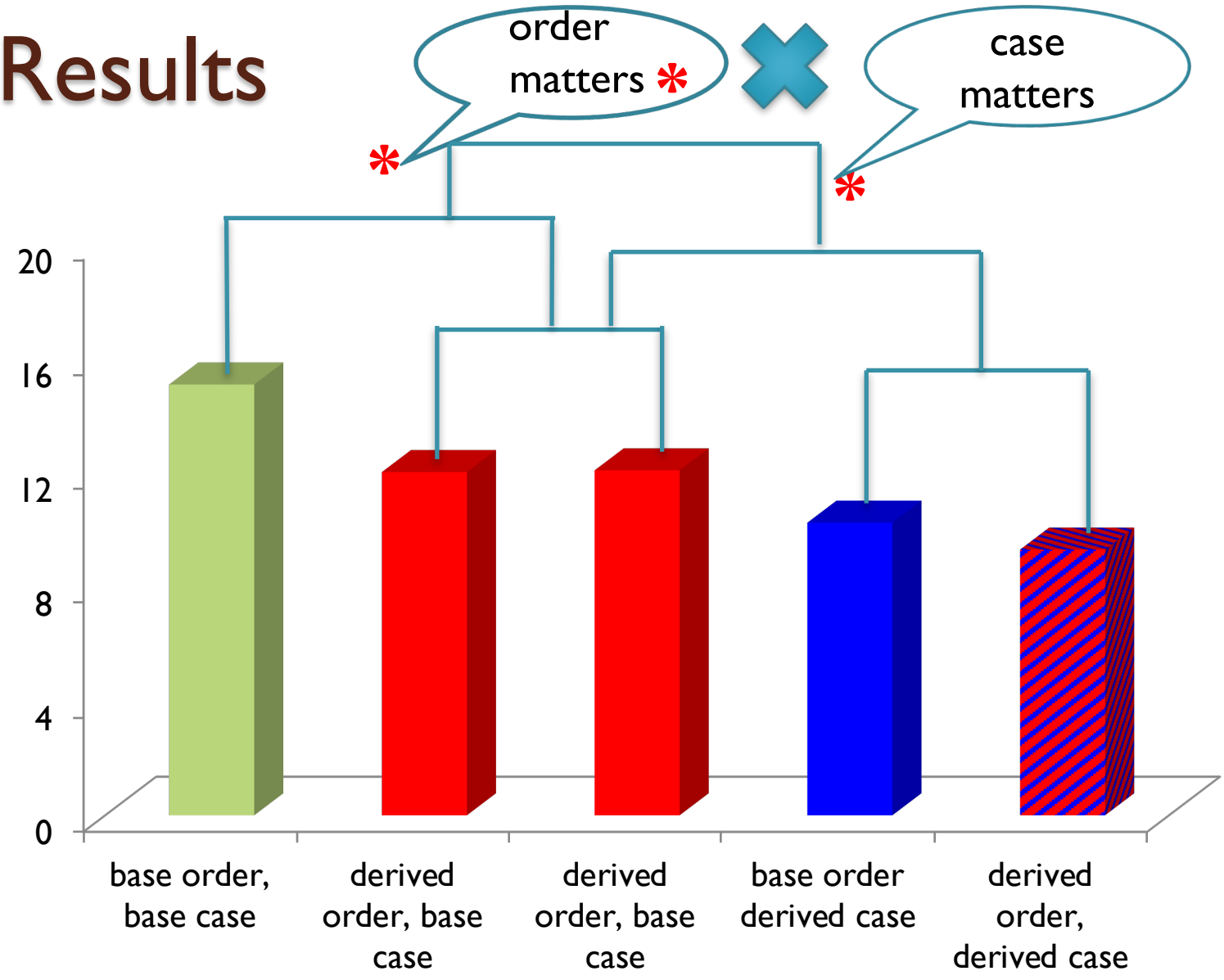
THD? DOP-H?

- none of these

Results


order matters *
*
case matters
*
20
16
12
8
4
0
base order, base case
derived order, base case
derived order, base case
base order derived case
derived order, derived case

Conclusion

- TDH and DOP-H cannot fully explain the results of Turkish
- non-base case complicates sentence comprehension as well

Standard Indonesian

Jap et al., 2016

- SVO language, no verb inflection for tense, agreement, number
  - verb inflection for voice
- active sentence
  - subject,agent – **ME**verb – object,theme
- passive sentence
  - subject,theme – **Di**verb – (oleh) agent

Passives in Standard Indonesian

- acquired early: around 2 years
  - English 4-5 years
- input frequency children: 28-35%
  - English 4-5%
- in written form: 30-40%
  - English 9%
- passives are polite forms

Comprehension of derived order sentences in Standard Indonesian

- actives
  - subject,agent – verb – object, theme
- subject clefts
  - subject, agent, - verb – object theme
- object clefts
  - object, theme – subject, agent – verb
- passives
  - subject, theme – verb – oleh, agent

Comprehension of derived order sentences in Standard Indonesian

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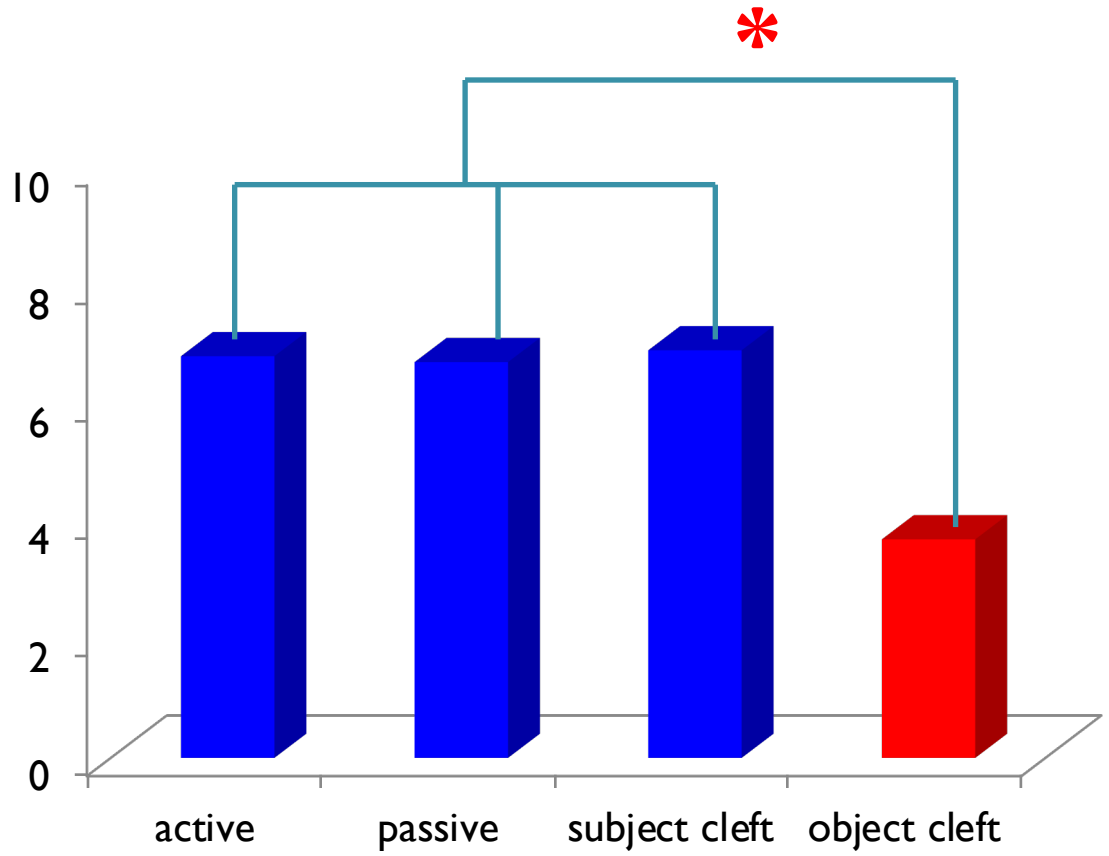
Results



Conclusions

- TDH and DOP-H cannot fully explain the results of Standard Indonesian
- pragmatic constraints and / or frequency protect comprehension of passives in SI
  - same for production

Overall conclusion

- sentences in which the thematic roles are in derived position are hard to understand for agrammatic speakers
  - data from many languages: Basque, Dutch, English, German, Spanish etc.
- the problems can be worstened when other sources of information (case) are not basic (Turkish)
- the problems can be partially overruled by pragmatic (Standard Indonesian) and semantic (Thai) constraints

In processing terms

- agrammatic speakers seem to have less processing resources available
- this leads to problems in comprehending grammatical structures
- sentences in which the thematic roles are in derived order are hard to understand
- processing can be worstened by other non-basic grammatical information
- processing can be helped by pragmatic and semantic constraints

Interestingly

- basically a very minor deficit
- but most often studied
- many theories
  - mapping account
  - TDH
  - DOP-H
  - Double Depency Hypothesis
    - (Mauner et al.)
  - Differential Chain Deficit Hypothesis
    - (Hickok & Avrutin)
  - ….

Overall conclusion

- only by studying languages that are structurally different from English
- we can understand the underlying deficit in agrammatic aphasia
- and, thus, about how language is stored in the brain

Thank you for your attention