Psikohizkuntzalaritza
Gillen Mtz de la Hidalga
2019-2020

4. Perpausak prozesatzen

a. Perpausen prozesamendua

eman ta zabal zazu
Universidad del País Vasco
Euskal Herriko Unibertsitatea

The Bilingual Mind

vs.

Sintaxia

Sintaxia

Mikelek

Sintaxia

Miren

Sintaxia

ikusi

Sintaxia

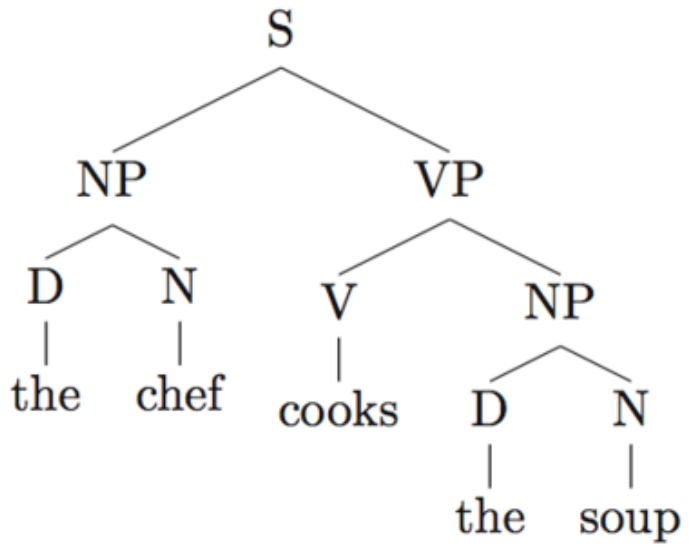
du

Sintaxia

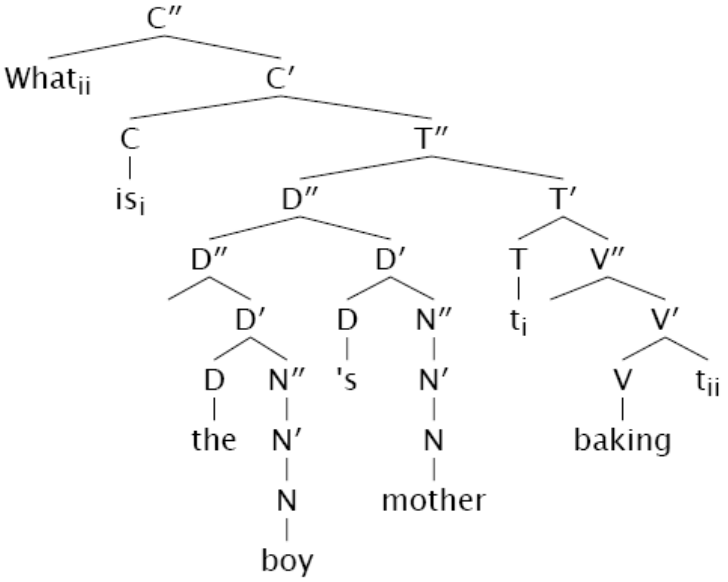
Sintaxia

Chomsky

-Arau sortzaileak/hierarkia



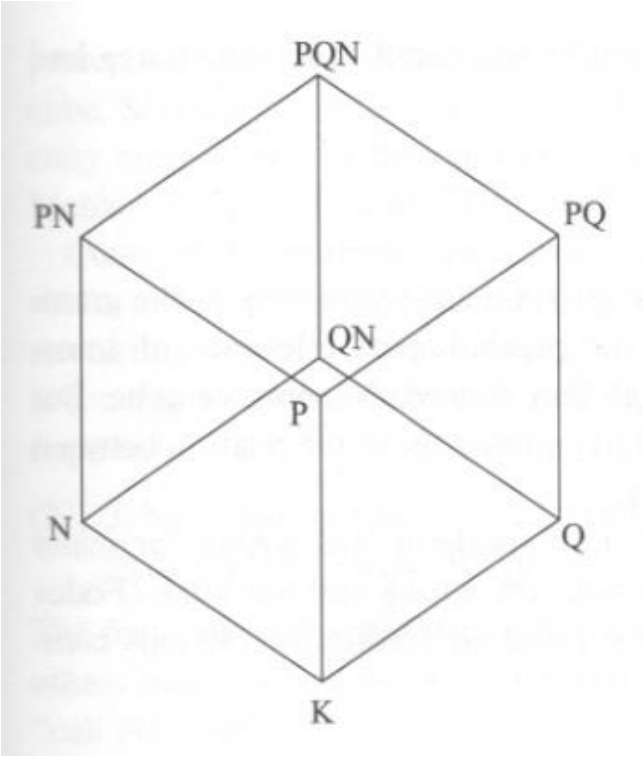
-Transformazioak



Miller (1962)

Some psychological studies of grammar

Transformational Cube



(22) a.	Mary hit Mark.	K
b.	Mary did not hit Mark.	N
c.	Mark was hit by Mary.	P
d.	Did Mary hit Mark?	Q
e.	Mark was not hit by Mary.	NP
f.	Didn't Mary hit Mark?	NQ
g.	Was Mark hit by Mary?	PQ
h.	Wasn't Mark hit by Mary?	PNQ

Egitura sintaktikoa

Ingeles bere zen ikaragarri bi orain
Irlandara dela zuen urte joan
hobetu eta maila Miren

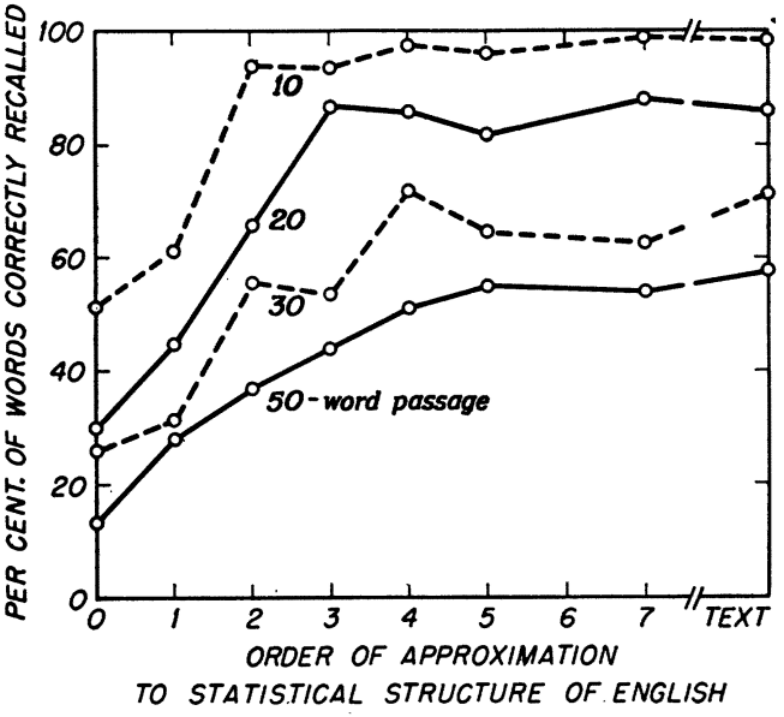


FIG. 1. Percentage of Words of the Lists of Different Lengths that were Correctly Recalled at the Various Orders of Approximation to the Statistical Structure of English.

Miller & Selfridge (1950)

Egitura sintaktikoa

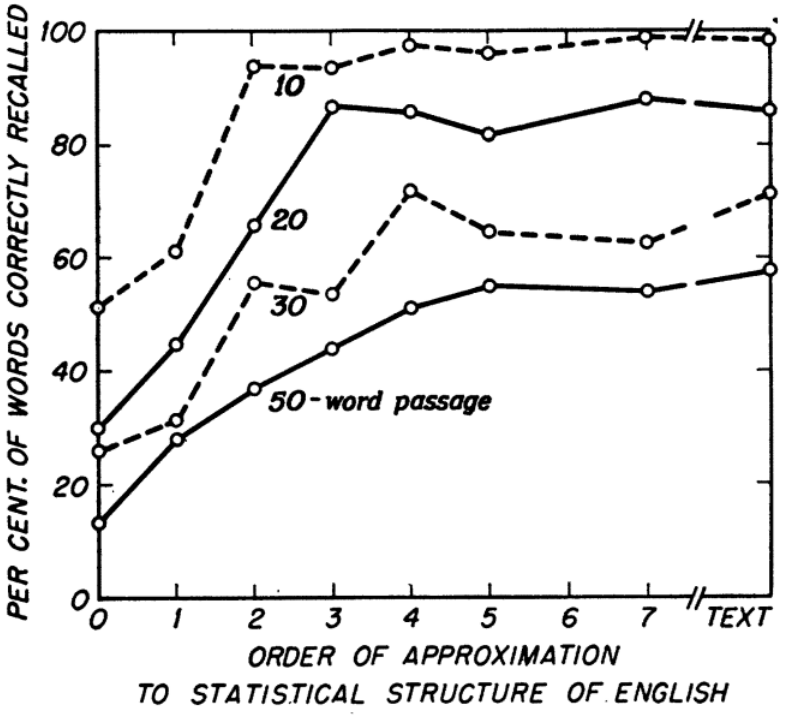
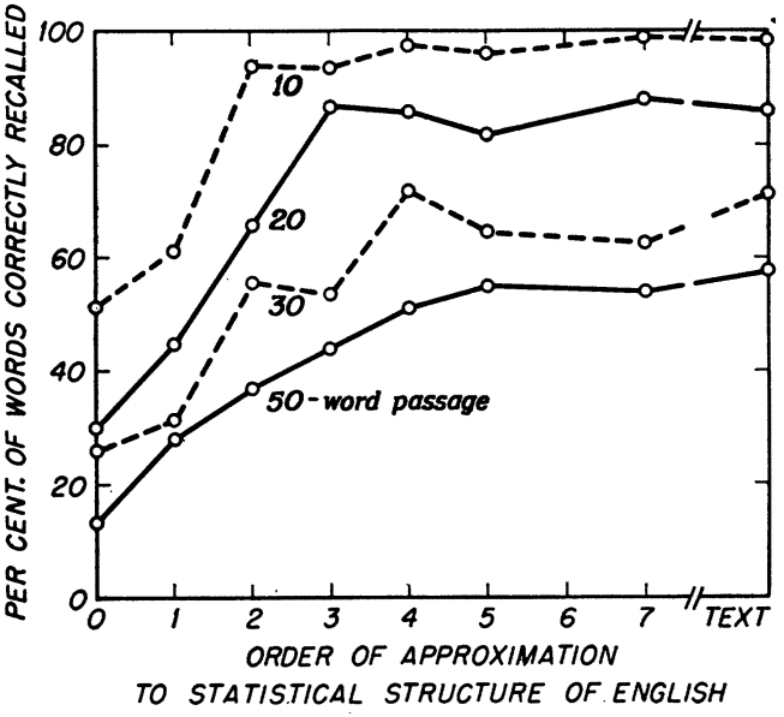


FIG. 1. Percentage of Words of the Lists of Different Lengths that were Correctly Recalled at the Various Orders of Approximation to the Statistical Structure of English.

Miller & Selfridge (1950)

Egitura sintaktikoa

Orain dela bi urte Miren Irlandara joan zen eta bere ingeles maila ikaragarri hobetu zuen



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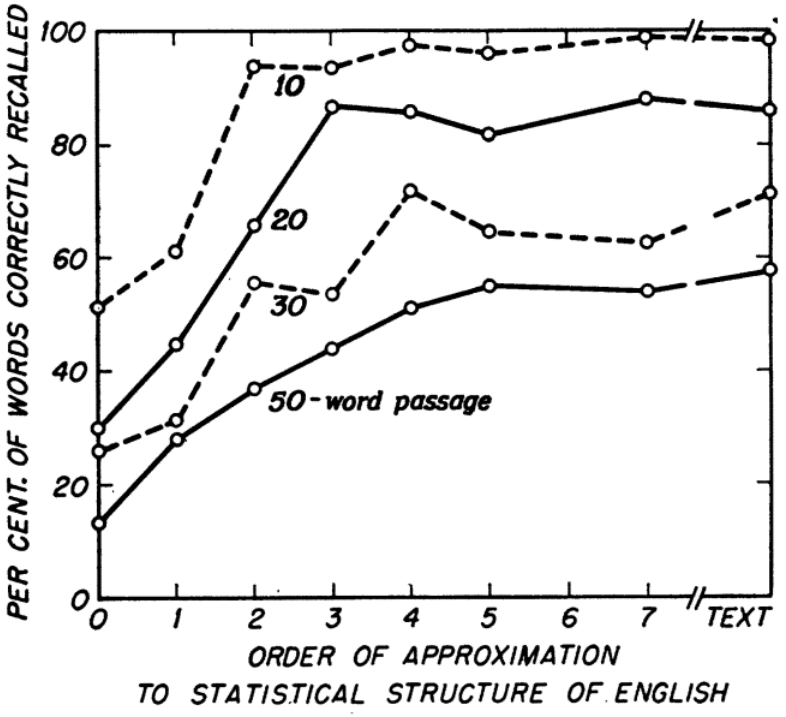


FIG. 1. Percentage of Words of the Lists of Different Lengths that were Correctly Recalled at the Various Orders of Approximation to the Statistical Structure of English.

Miller & Selfridge (1950)

GRAMATIKALTASUNA

Ingeles bere zen ikaragarri bi orain Irlandara dela zuen urte joan hobetu eta maila Miren

Orain dela bi urte Miren Irlandara joan zen eta bere ingeles maila ikaragarri hobetu zuen

Perpaus hipotesia (clausal hypothesis)

- Perpausa hipotesia (Carroll & Bever, 1976; Fodor, Bever, & Garrett, 1974):
  - Perpausa hizkuntza ulermeneko oinarrizko egitura da, eta beraz, ulermen prozesuetan perpaus egituren mugak bilatzen ditugu.
  - Perpausa aditz bat duen esaldi barruko hitz multzo bat da
  - Hizkuntza "multzokatzea" esaldi egituretan oinarrituta egiten dugu, adibidez, esaldiak perpaus egituretan multzokatzen ditugu.

John walked.

They ride on donkeys.

John wanted to leave work early.

The man who John saw was very tall.

"Chunking" prozesuak: zenbaki segida luzeak hobeto gogoratzen ditugu multzokatuta

945014678

945 014 678

Sintagmak

a. [In her hope of marrying] [Anna was surely impractical].

b. [[Your hope of marrying Anna] was surely impractical].

Fodor & Bever (1965)

Sintagmak

a. Mirabelle knows the boys next door.
b. Mirabelle knows the boys are rowdy.

PARSING

Parsing

- Entzuten ditugun hitzekin egitura sintaktikoa eraikitzeari *parsing* deitzen diogu.
- Egitura sortzeko erabiltzen ditugun mekanismo eta prozedurei *parser* deitzen zaie.

Nola egiten du lan parserrak?

Hitz guztiak entzunez amaitzera eta euren esanahia memorian berreskuratzera itxaroten dugu taldekatze sintaktikoa edo egituratzea hasi aurretik?

- Ezetz ematen du.

Parserra hitzak errekonozitzeko sistema bezain ona, azkarra eta pazientziarik gabea da.

Inkrementalitatea

While Susan was dressing the baby played on the floor

While Susan was dressing herself the baby played on the floor

AREAGOTZEA (*INCREMENTALITY*)

Parserra hitzak errekonozitzeko sistema bezain ona, azkarra eta pazientziarik gabea da.
Entzuten ari garen hizketa kateari buruzko informazio partzialarekin ere esanahiei buruzko susmoak edo suposizioak eraikitzen ditugu.

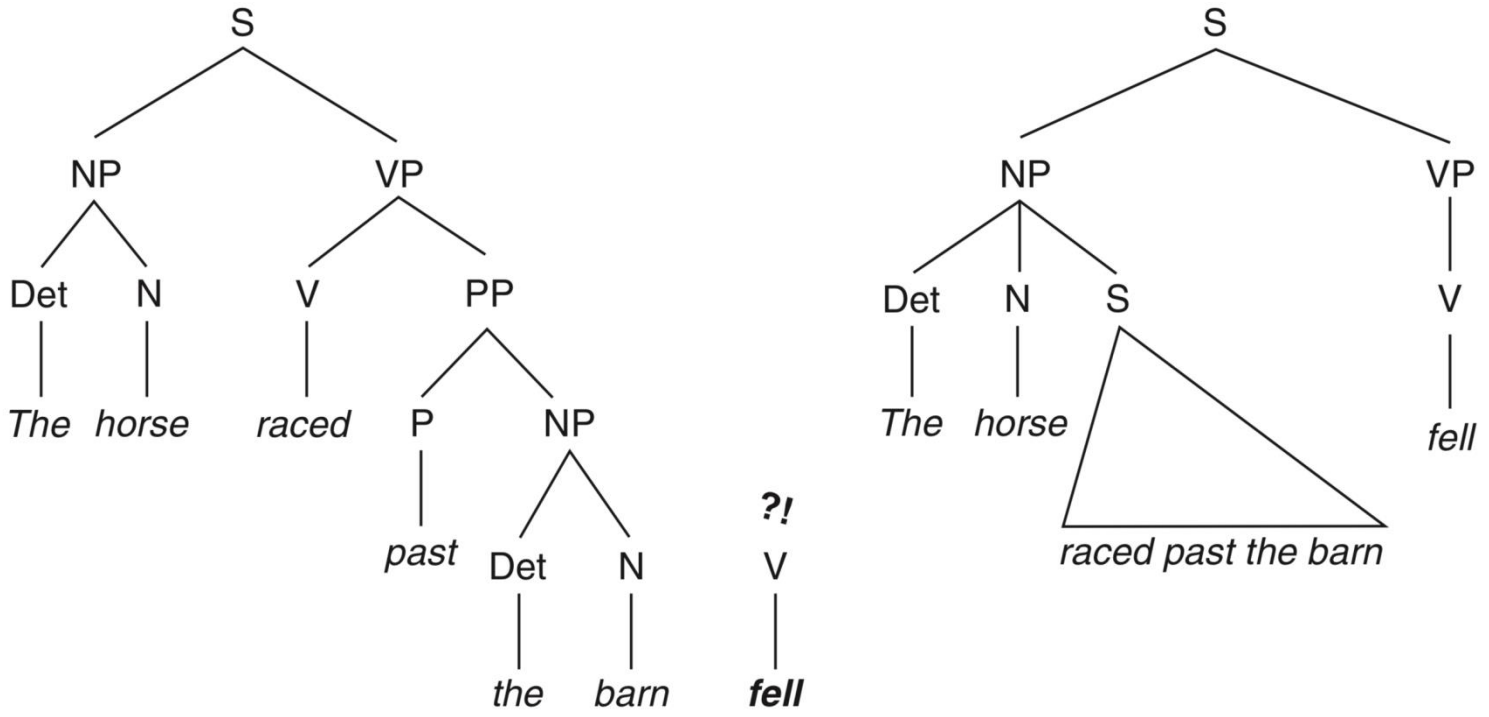
Hizkuntzaren prozesamendua inkrementala da

Esanahia eraikitzen doa diskurtsoa aurkeztu ahala, material linguistiko guztia pilatzeari itxaron gabe.

garden-path perpausak

The horse raced past the barn fell.

[[The horse [raced past the barn]] fell]



garden-path perpausak

- Gramatikalki zuzena den esaldi bat, hasierak okerra den interpretazio batera bideratzen gaituena. Hau da, esaldiaren hasierako egituratze sintaktikoa ezinezko bihurtzen da une batean, esaldiaren ezinezko interpretazio batera eramanez eta berriz interpretatu beharra daukagu.

“garden-path” /saltxitxa modeloa

Lyn Frazier

Analizatzaile sintaktikoak (parser) estrategia orokorrak erabiltzen ditu esfortzu kognitiboak minimizatzeko:

- Minimal attachment
- Late closure

Labirintu esaldien prozesamendua:

(Frazier & Fodor, 1978)

- Anbiguitatea konpontzeko bi prozesamendu estrategia nagusi:

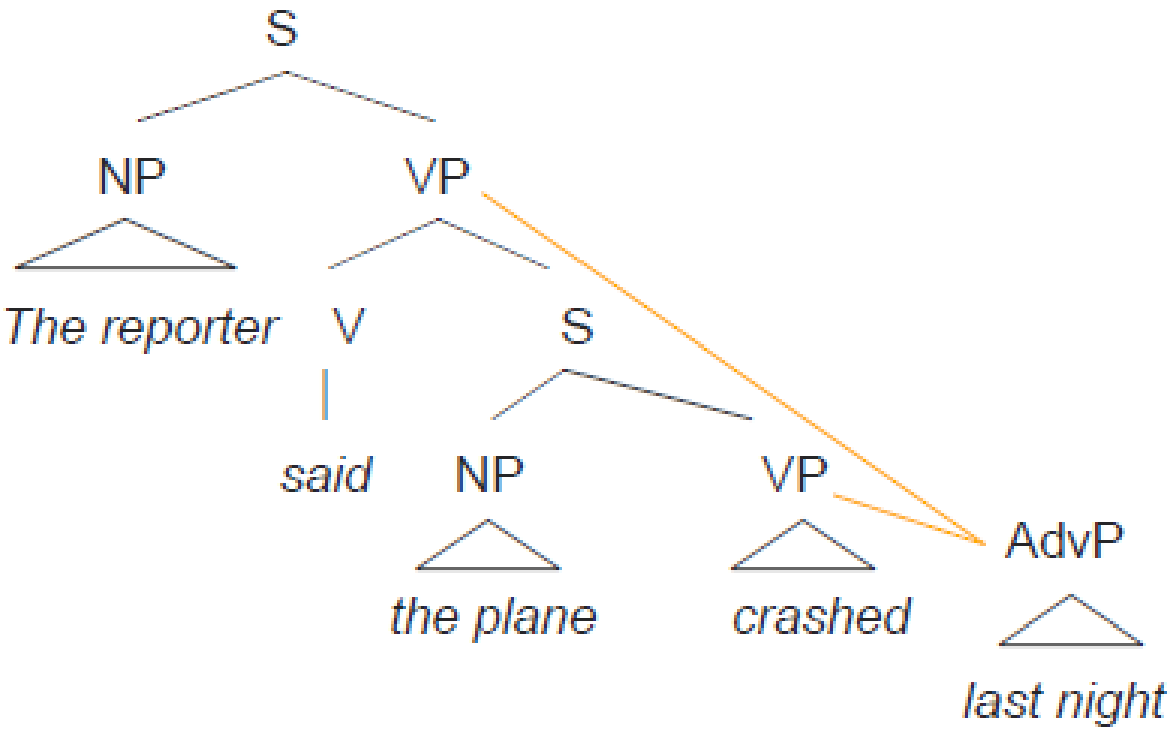
  - Late closure: Lotu datorren materiala sortu berri duzun gertuen dagoen egiturara

  - Minimal attachment: Erabili nodo gutxien sortzea eskatuko dizun analisia

Labirintu esaldien prozesamendua:

(Frazier & Fodor, 1978)

- Late Closure: Beheko lotura lehenetsi
  - Prefer 'low attachment'



Labirintu esaldien prozesamendua:

(Frazier & Fodor, 1978)

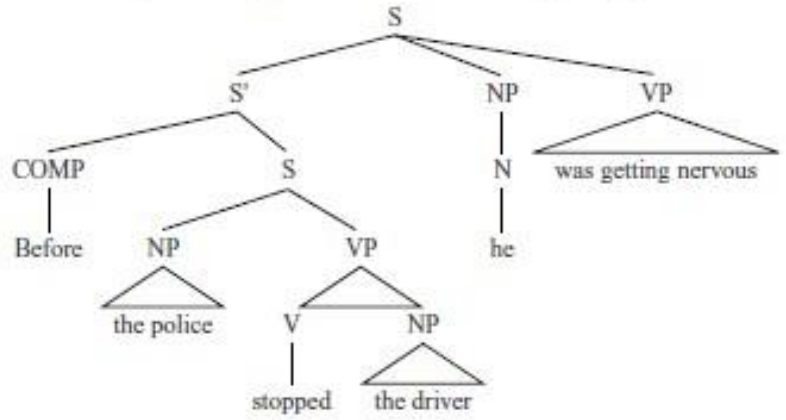
- Late Closure:

- *The driver*-era ailegatzerakoan, hiztunek 10.42ko interpretazioa nahiago (late closure, *stopped*-en irakurketa trantsitiboa, *the driver* objektua)

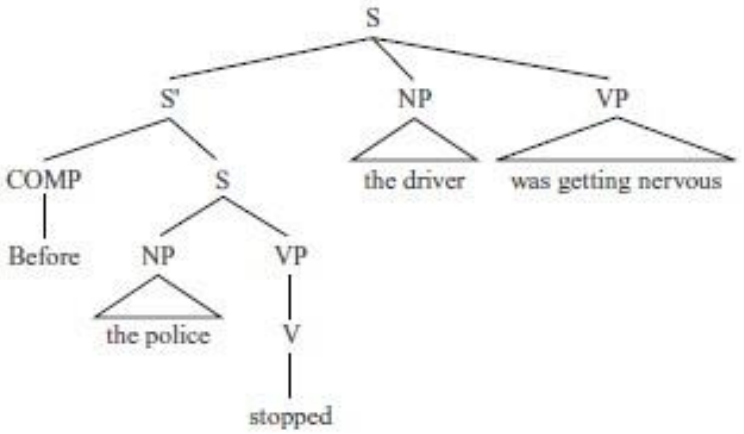
- 10.43n *stopped* intrantsitiboa, beraz, lehen perpausa goiz itxi. *the driver* bigarren perpauseko subjektua

Ulerme

(10.42) Before the police stopped the driver he was getting nervous.



(10.43) Before the police stopped the driver was getting nervous.

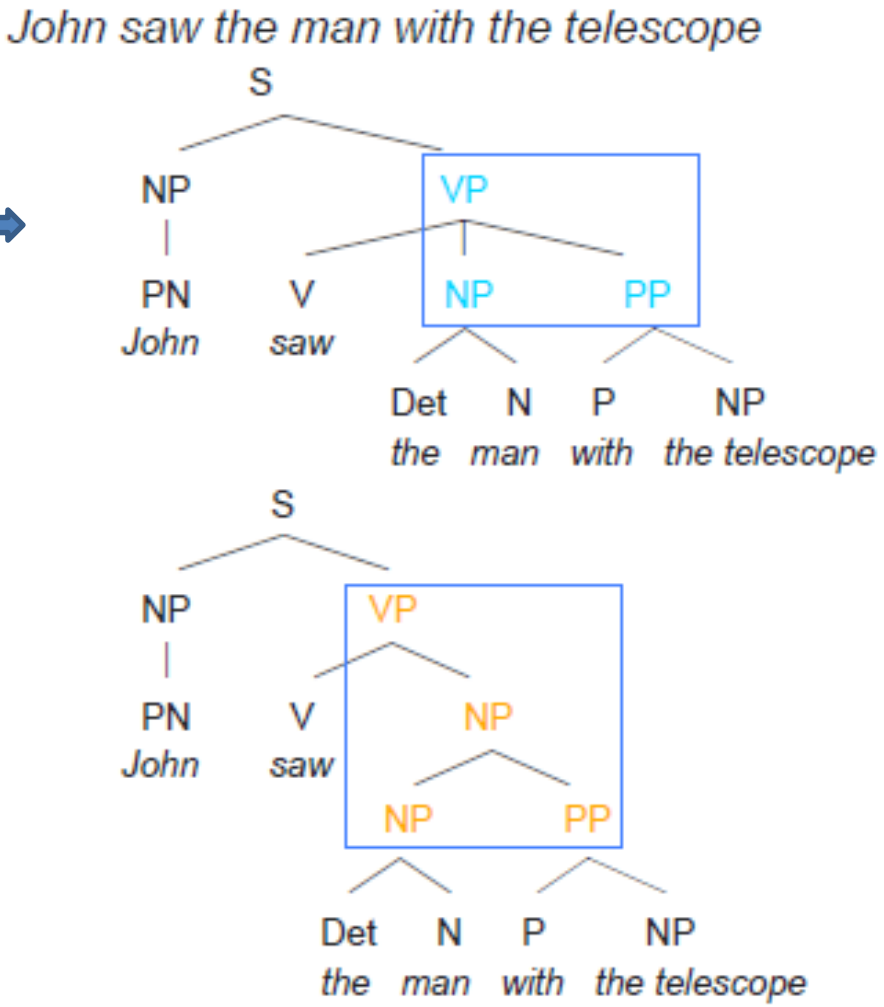


Labirintu esaldien prozesamendua:

(Frazier & Fodor, 1978)

- Minimal attachment:

  VP attachment



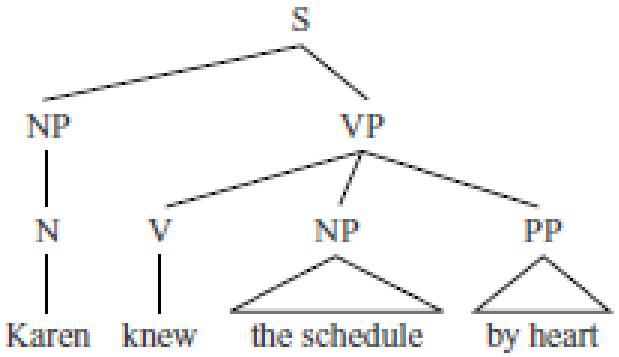
Labirintu esaldien prozesamendua:

(Frazier & Fodor, 1978)

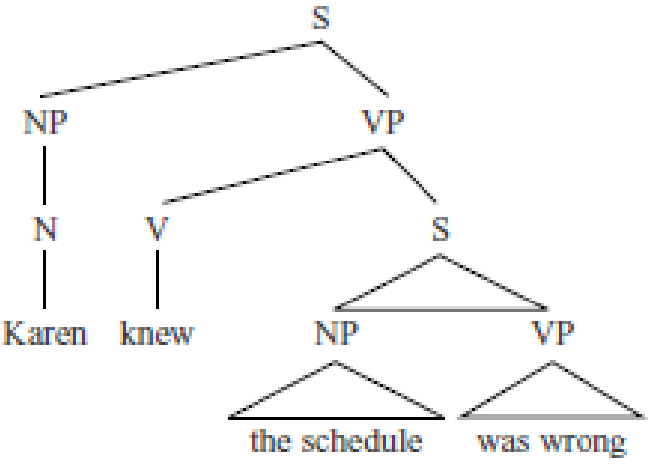
- Minimal attachment:
- Bi kasuetan *the schedule* VP-ra lotua (late closure estrategia)
- 10.44n, lotura minimoa jarraituz, *knew*-ren objektua
- 10.45n, lotura ez-minimoa egin beharra, tartean beste perpaus bat dagoelako, eta honen subjektua da *the schedule*

10.45 prozesatzea zailagoa (eye-tracking)

(10.44) Karen knew the schedule by heart.



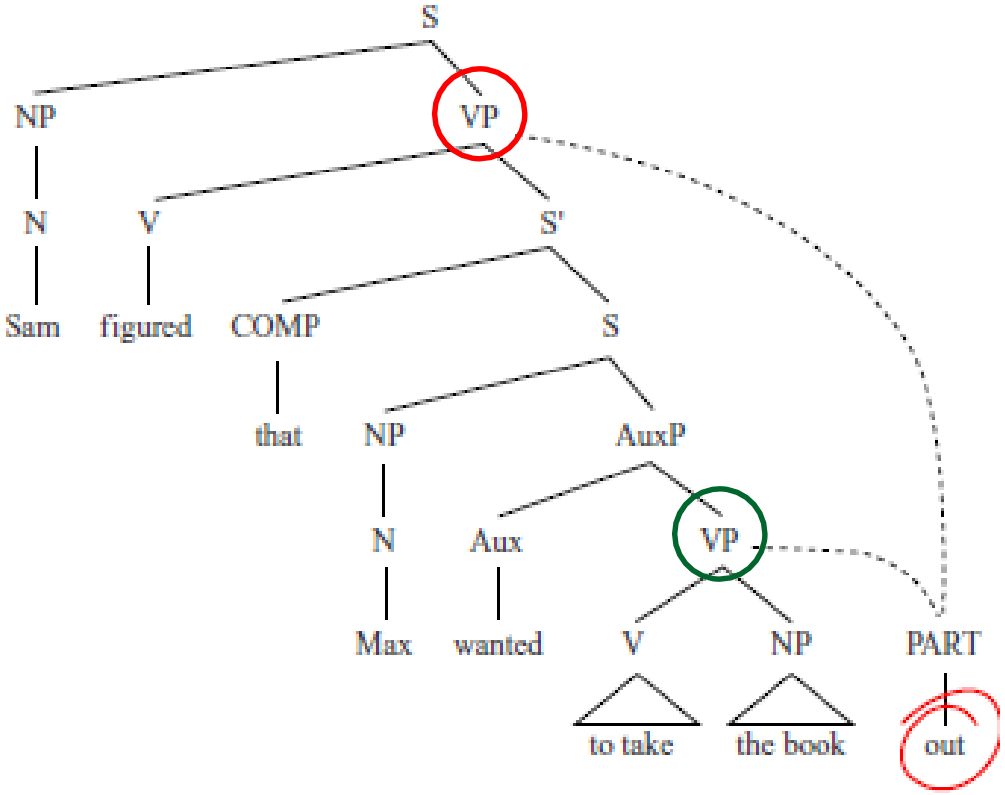
(10.45) Karen knew the schedule was wrong.



Labirintu esaldien prozesamendua:

(Frazier & Fodor, 1978)

Sam figured that Max wanted to take the book out

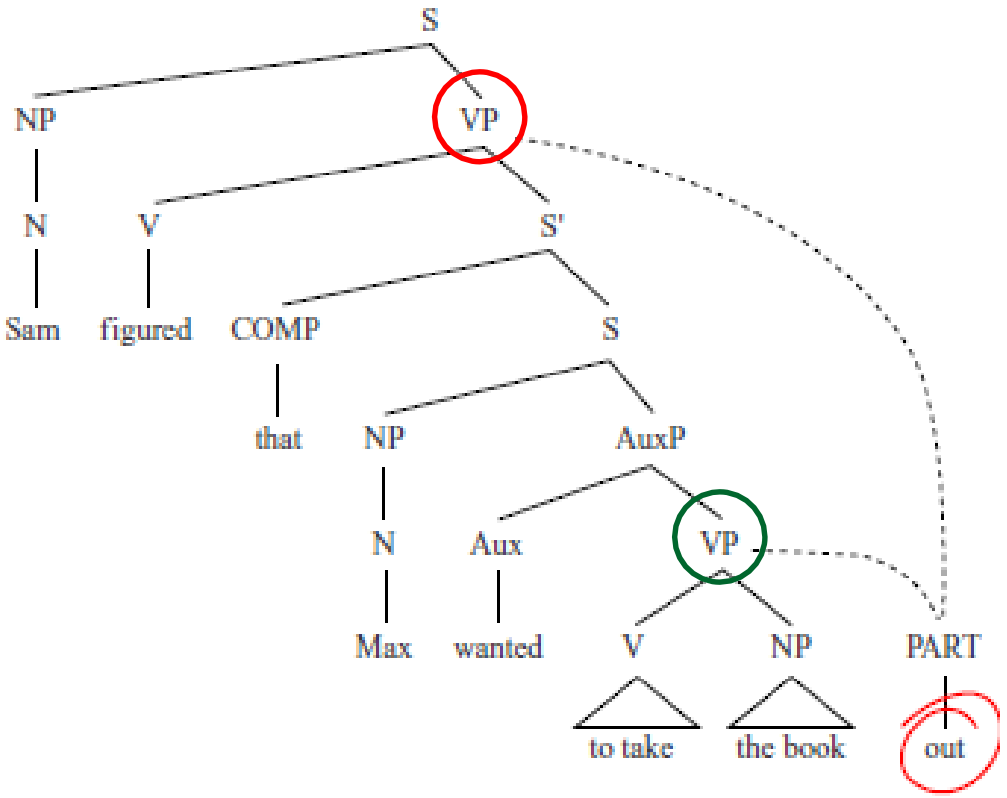


Labirintu esaldien prozesamendua:

(Frazier & Fodor, 1978)

Lehentasun mota honi eskuineko elkartea deitzen zaio (Kinball, 1973):

Ixte berantiarra edo *lotura minimoa* estrategiek kontrakorik adierazi ezean, lotu elementu berriak gertuen (beherago) dauden elementuekin



“constraint-based” modeloak

Maryellen MacDonald

Analizatzaile sintaktikoak (parser) erabilgarri dauden informazio iturri guztiak erabiltzen ditu.

Testuinguru efektuak

- El ladrón reventó la caja fuerte con la cerradura oxidada.

- El ladrón estaba preparando su próximo golpe. Sabía que en el almacén había dos caja fuertes. Aunque una era nueva, la otra llevaba diez años a la intemperie bajo la lluvia. El ladrón reventó la caja fuerte con la cerradura oxidada.

Good-enough parsing

Fernanda Ferreira

Benetan analizatzen dugu dena sintaktikoki?

Batzutan ez da beharrezkoa dena analizatzea.

Good-enough parsing

HUNT

Good-enough parsing

-While the hunter was stalking the deer in the zoo drank from the puddle.

-The hunder was stalked by the deer.

Was the hunter stalking the deer?

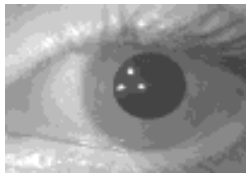
Alaba gaztea zoriontzen ari da

Kategoria sintaktikoen anbiguetatea

- Kategoria anbiguetatea:

Alaba gaztea zoriontzen ari da

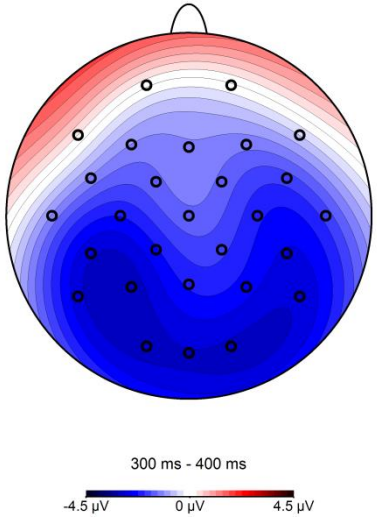
[x][Alaba gaztea] zoriontzen ari da
[Alaba] [gaztea] zoriontzen ari da
[gaztea] [Alaba] zoriontzen ari da
[Alaba gaztea] [x] zoriontzen ari da

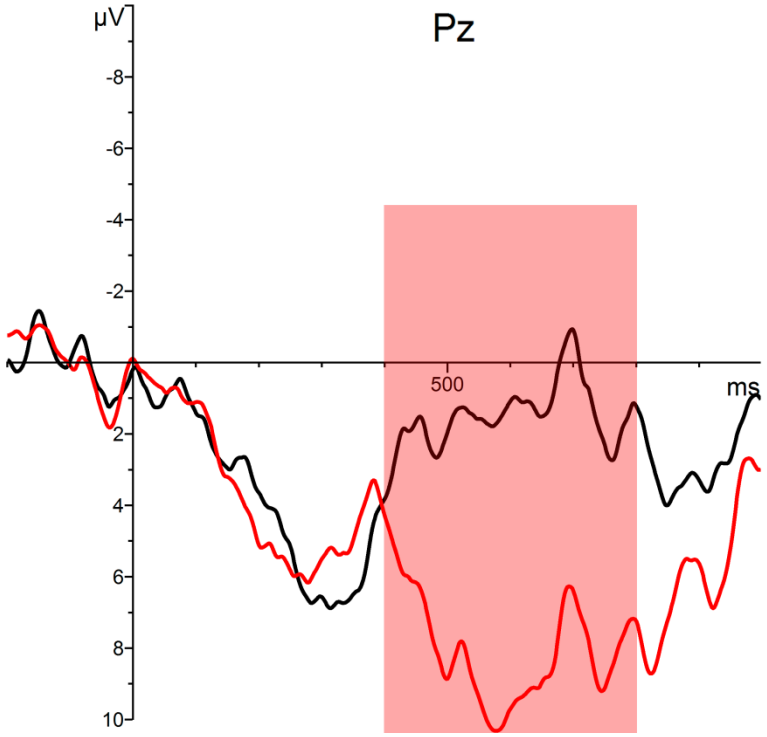


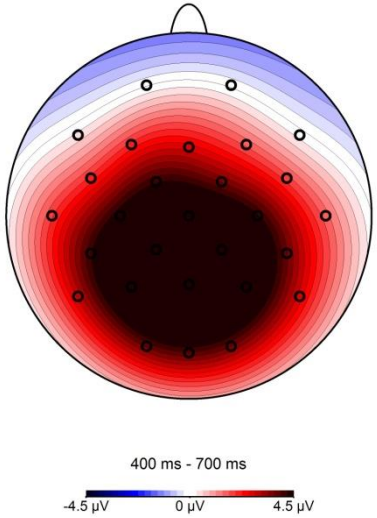
Eye Tracking

- What eye movements during reading reveal about processing speed
- Irakurketa begi mugimenduak adibidea

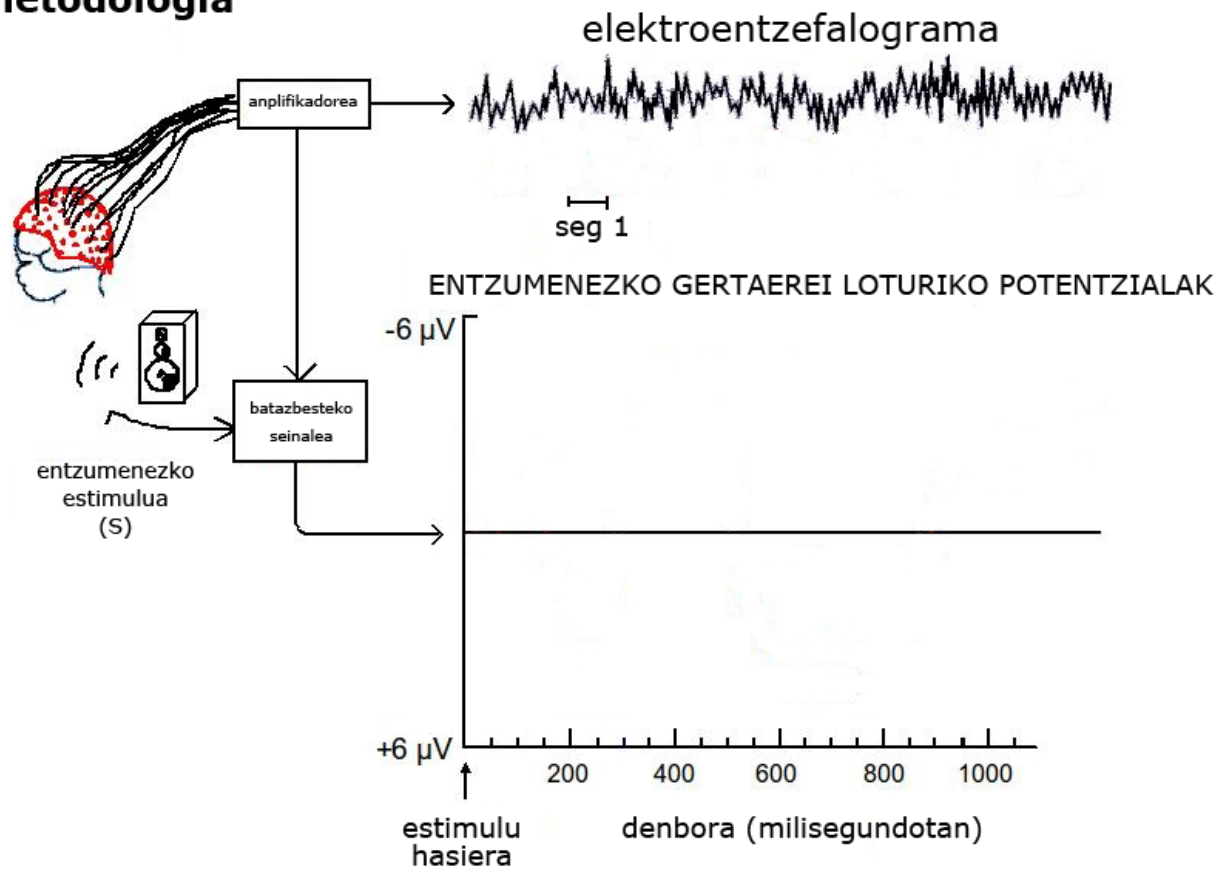
Gertaerei loturiko potentzialak (ERP)

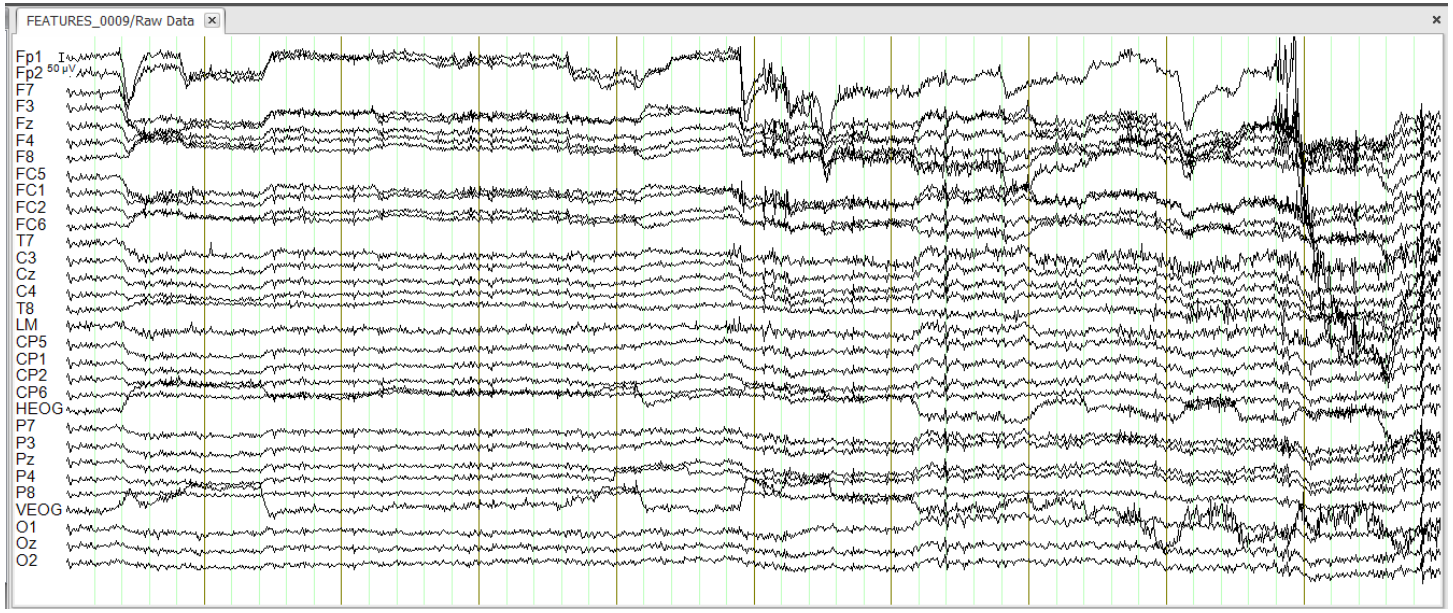






ERP metodologia

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Fp2
50 µV
F7
F3
Fz
F4
F8
FC5
FC1
FC2
FC6
T7
C3
Cz
C4
T8
LM
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CP1
CP2
CP6
HEOG
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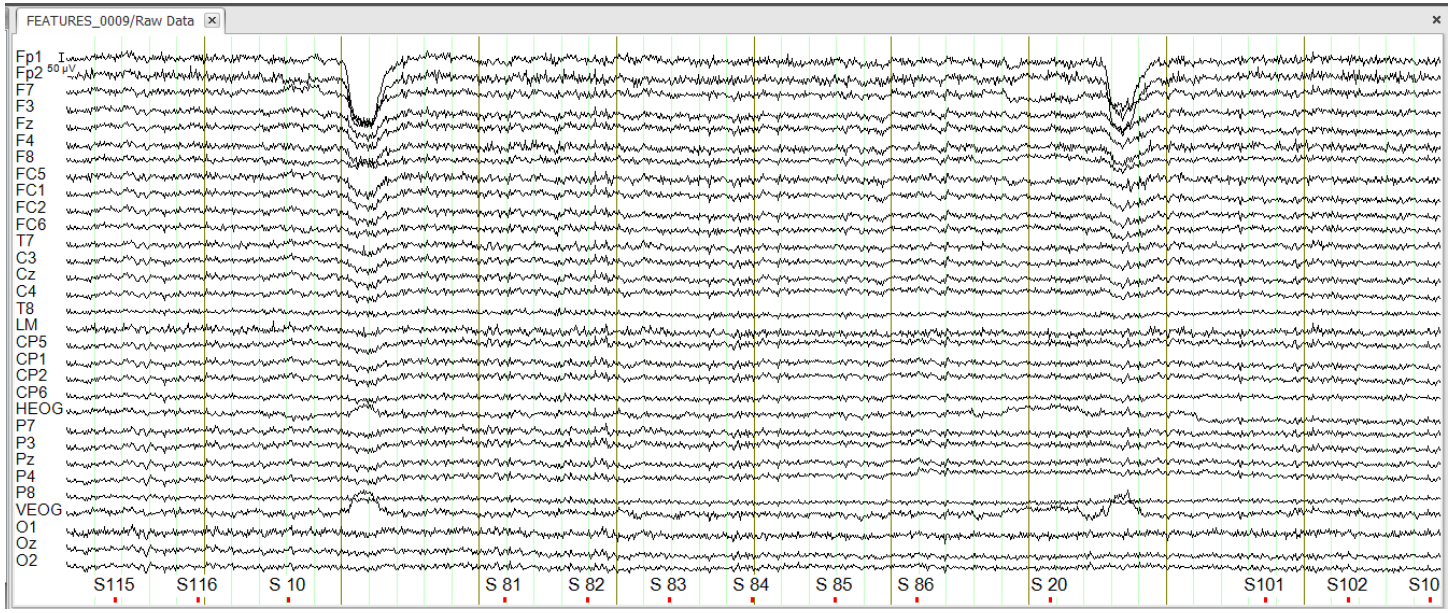
P3
Pz
P4
P8
VEOG
O1
Oz
O2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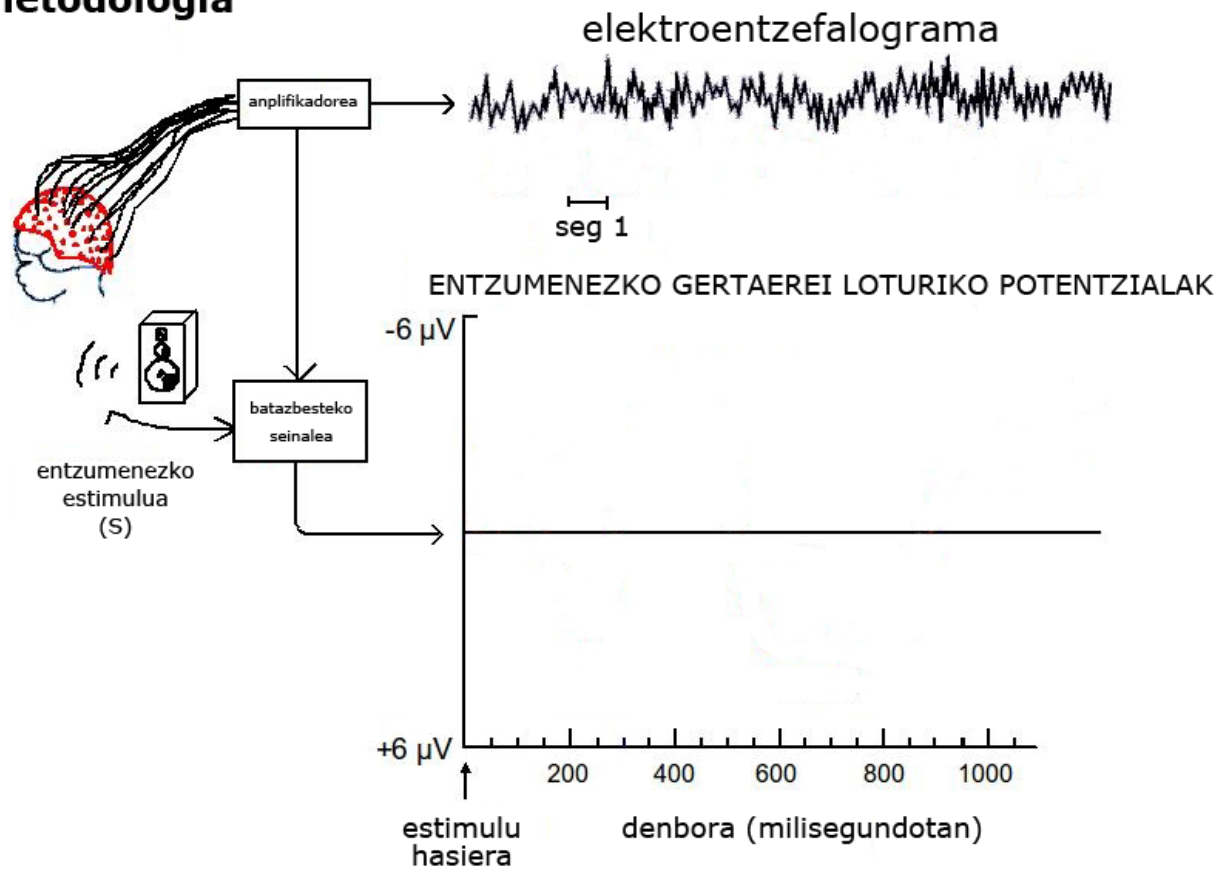
P7
P3
Pz
P4
P8
VEOG
O1
Oz
O2
S115
S116
S 10
S 81
S 82
S 83
S 84
S 85
S 86
S 20
S101
S102
S10

ERP metodologia



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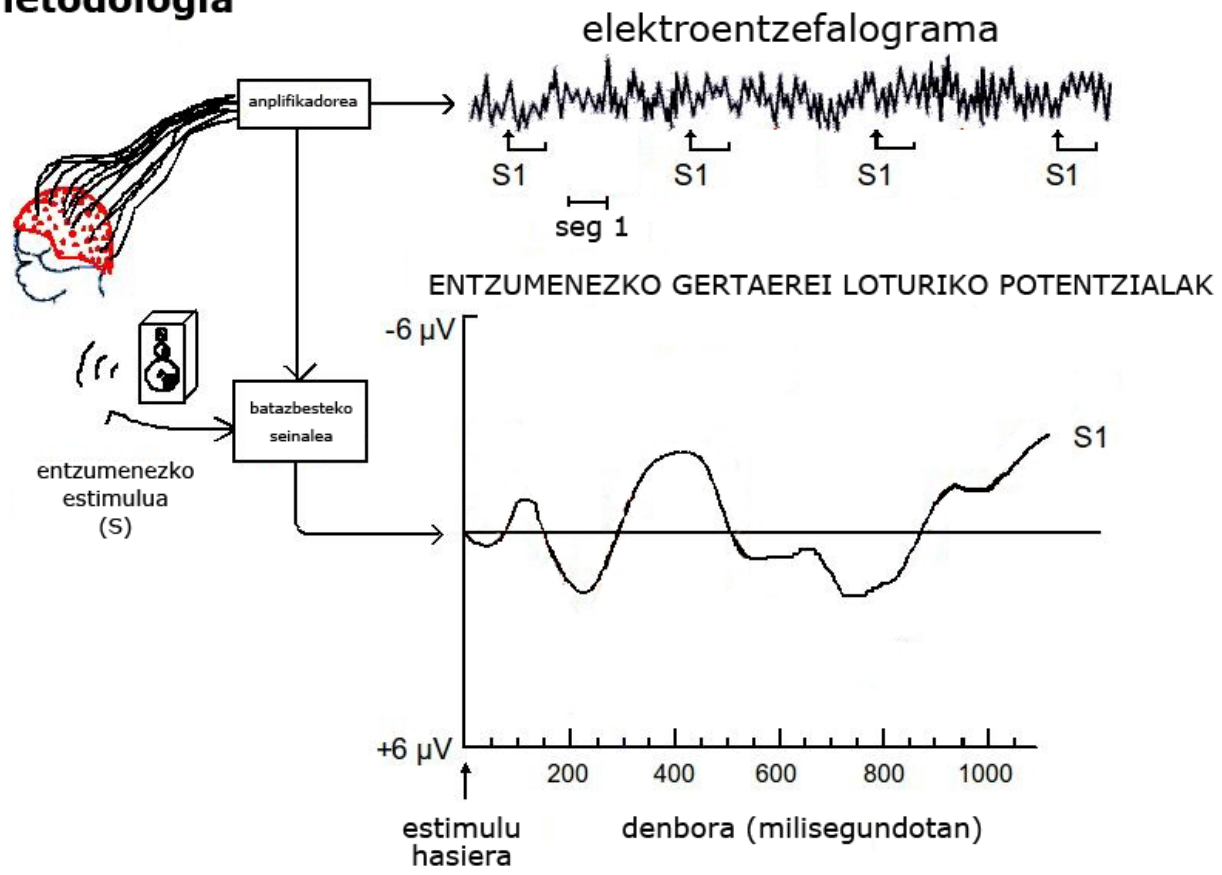
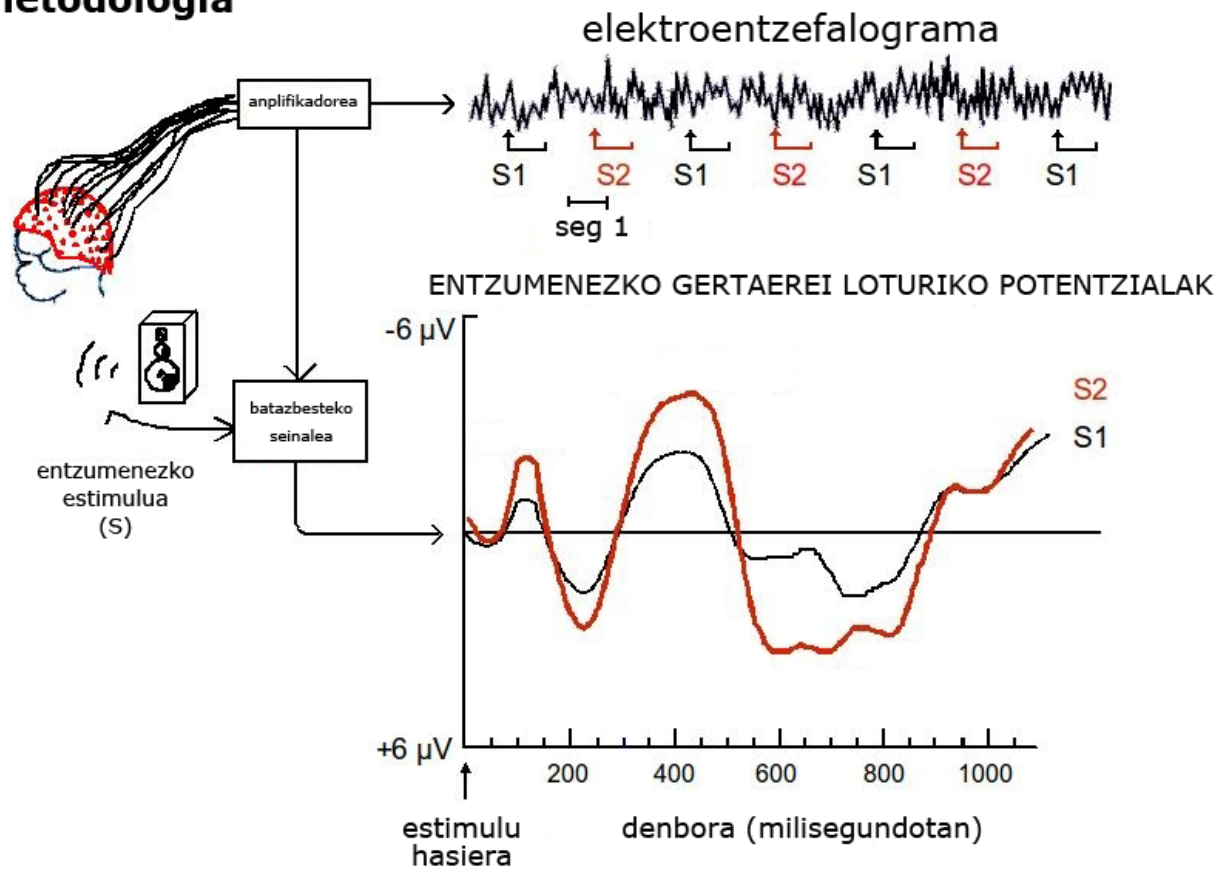
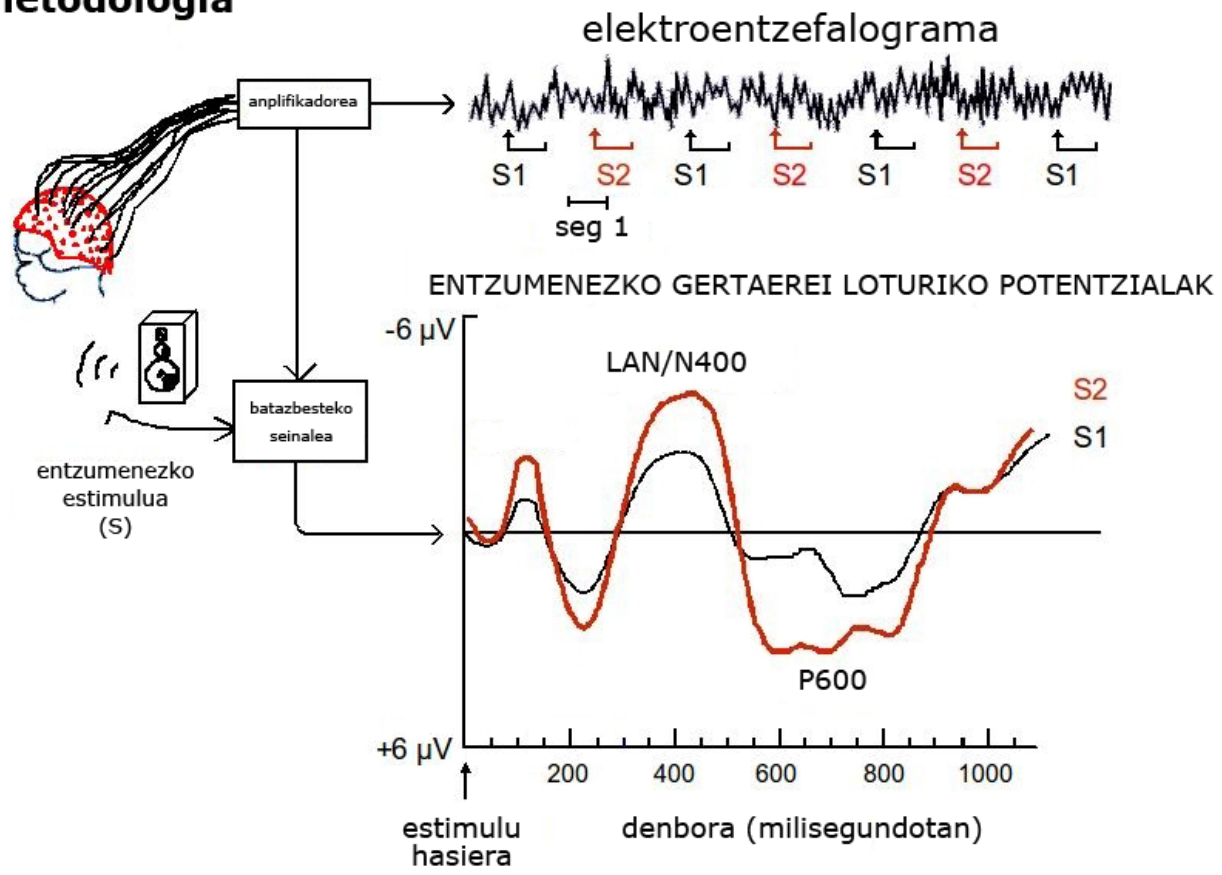


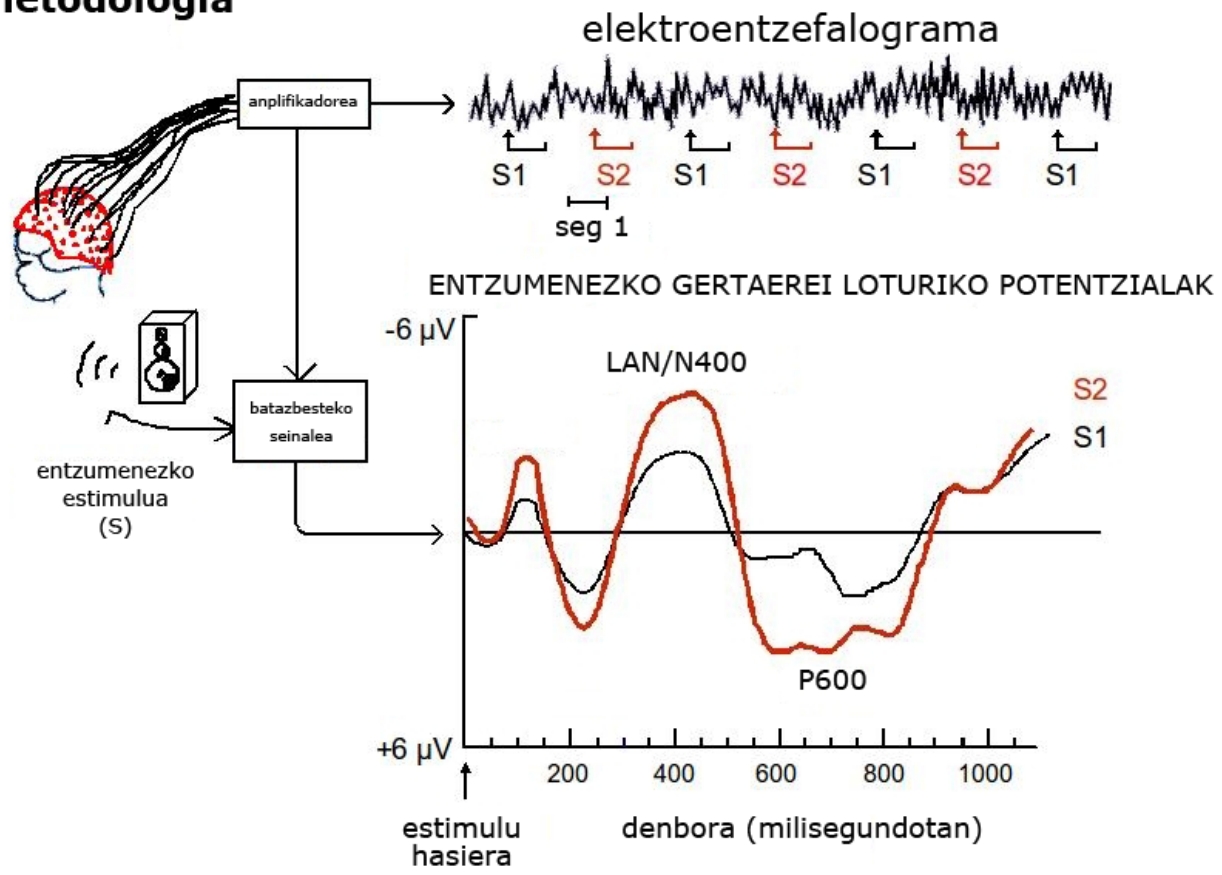
ERP metodologia

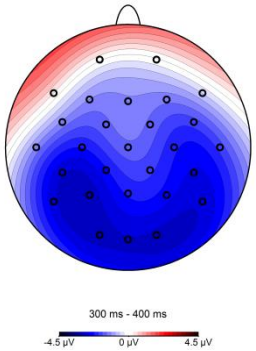


ERP metodologia



ERP metodologia





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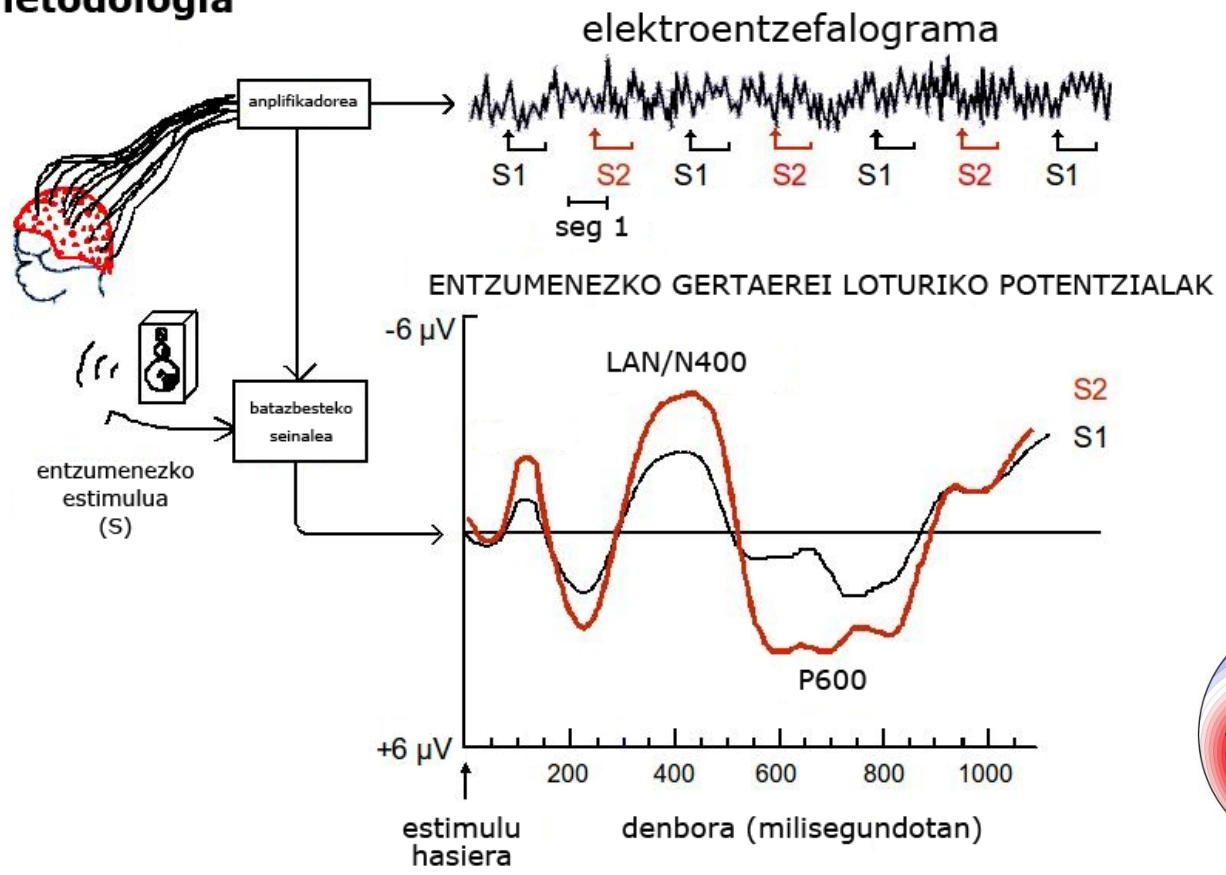
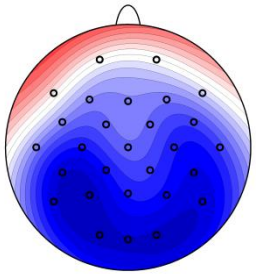
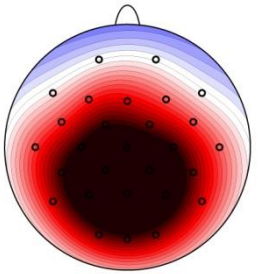






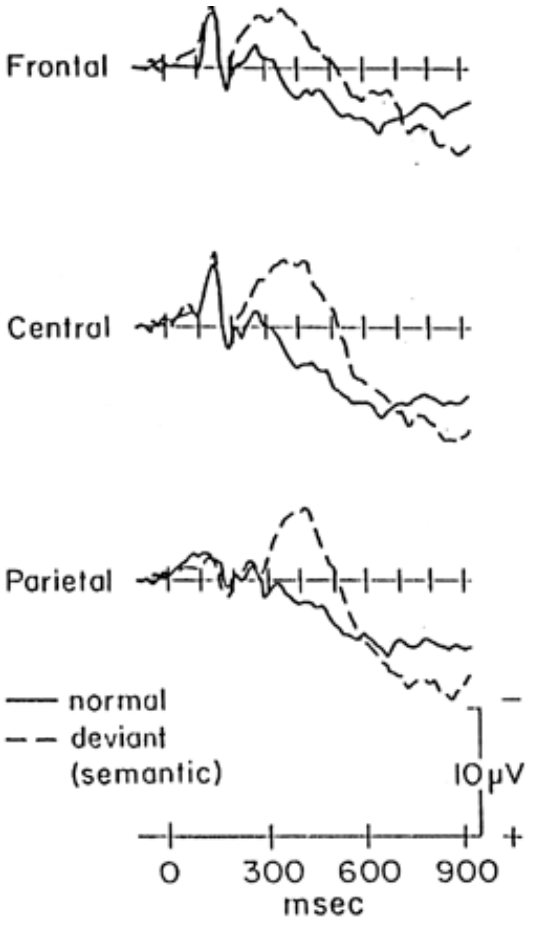
ZUZEN

?

OKER

N400

He spread the warm bread with… **BUTTER** / **SOCKS**



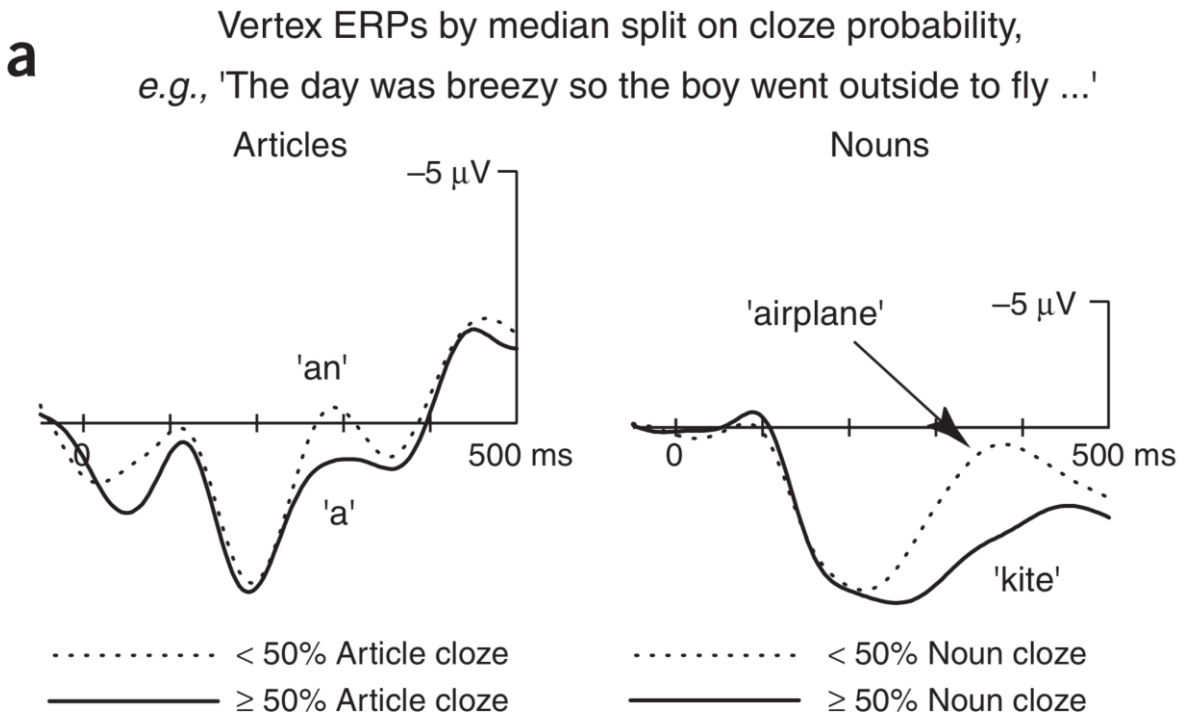
N400 osagaia

Kutas & Hillyard (1980)

The day was breezy so the boy went outside to fly…

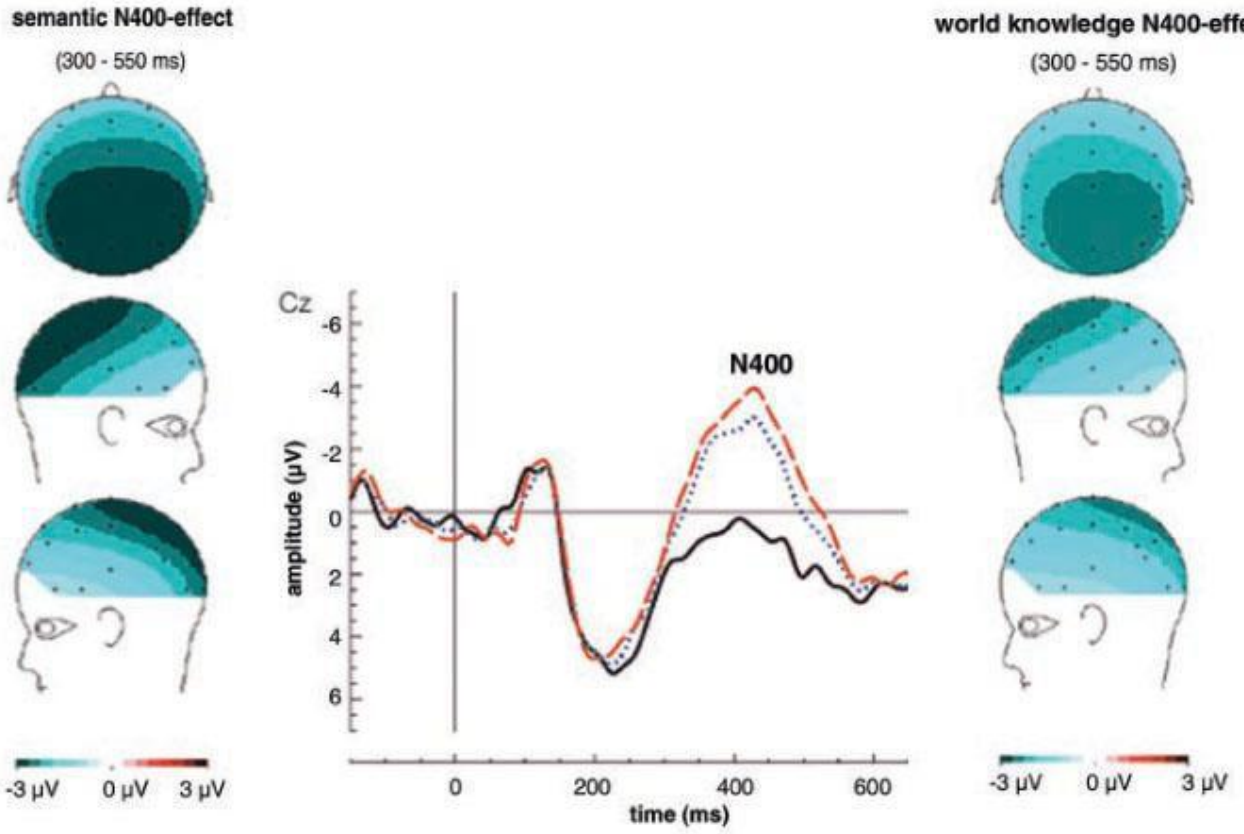
The day was breezy so the boy went outside to fly… **A KITE** / **AN AIRPLANE**

N400
osagaia



Urbach, Kutas & Delong (2005)

N400 osagaia munduaren ezagutzarekiko sentibera da



correct: The Dutch trains are yellow and very crowded.
world knowledge violation: The Dutch trains are white and very crowded.
semantic violation: The Dutch trains are sour and very crowded.

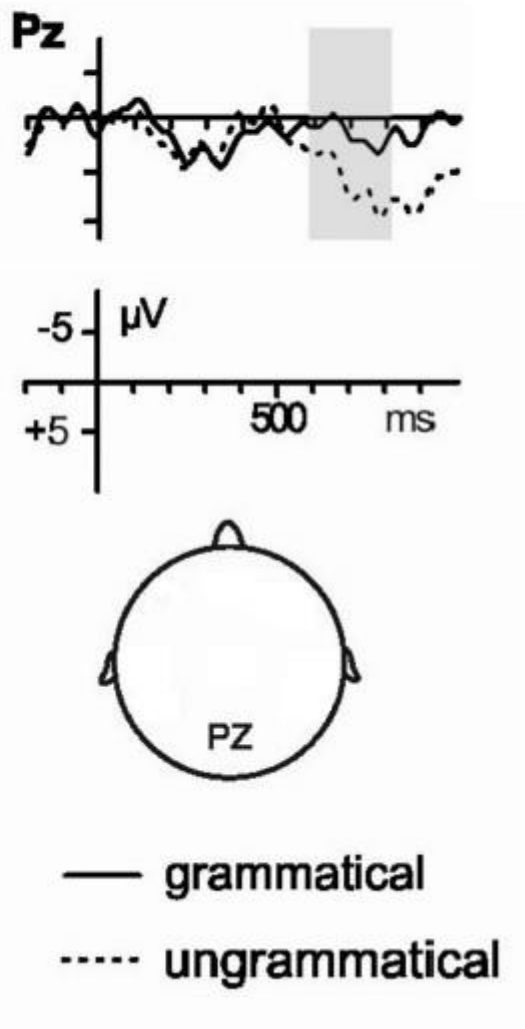
Hagoort et al. (2004)

P600

P600 ERAGITEN DUTEN FAKTOREAK: GRAMATIKA AKATSAK

A P600 may be elicited by several kinds of grammatical errors in sentences, such as problems in agreement (SV, OV, tense, gender, number, and case, as well as phrase structure violations).

- Subjektu-aditz komunztadura (Hagoort et al., 1993):
  "The spoilt child **throw* the toys on the ground."
- Osagarri-aditz komunztadura (Zawiszewski & Friederici, 2009):
  "Zuk ni etxera eraman **duzu* goizean."
- Denbora (Allen et al., 2003):
  "The man will **worked* on the platform."
- Generoa (Barber & Carreiras, 2005):
  "La **piano* estaba . . . "
- Numeroa (Barber & Carreiras, 2005):
  "Los **piano* estaban . . . "
- Kasua (Coulson et al., 1998):
  "The plane took **we* to paradise and back."



Event-Related Brain Potentials Elicited by Failure to Agree

LEE OSTERHOUT AND LINDA A. MOBLEY

University of Washington

Event-related potentials (ERPs) were recorded from 13 scalp electrodes while subjects read sentences, some of which contained violations of number or gender agreement. Subjects judged the acceptability of sentences in Experiments 1 and 2 and passively read sentences in Experiment 3. In Experiment 1, violations of subject–verb number, reflexive–antecedent number, and reflexive–antecedent gender agreement elicited a widely distributed positive-going wave (P600). Subject–verb agreement violations also elicited a left-hemisphere negativity. In Experiment 2, personal pronouns that mismatched in gender with the subject noun elicited a P600, but only when subjects judged such sentences to be unacceptable. Semantically anomalous words elicited an enhanced N400 component. In Experiment 3, subject–verb number disagreement elicited a P600 and semantic anomalies elicited an enhanced N400. ERPs to reflexive–antecedent agreement violations did not differ from those to controls. We evaluate the speculation that agreement between sentence constituents reflects syntactic constraints rather than semantic or discourse factors.

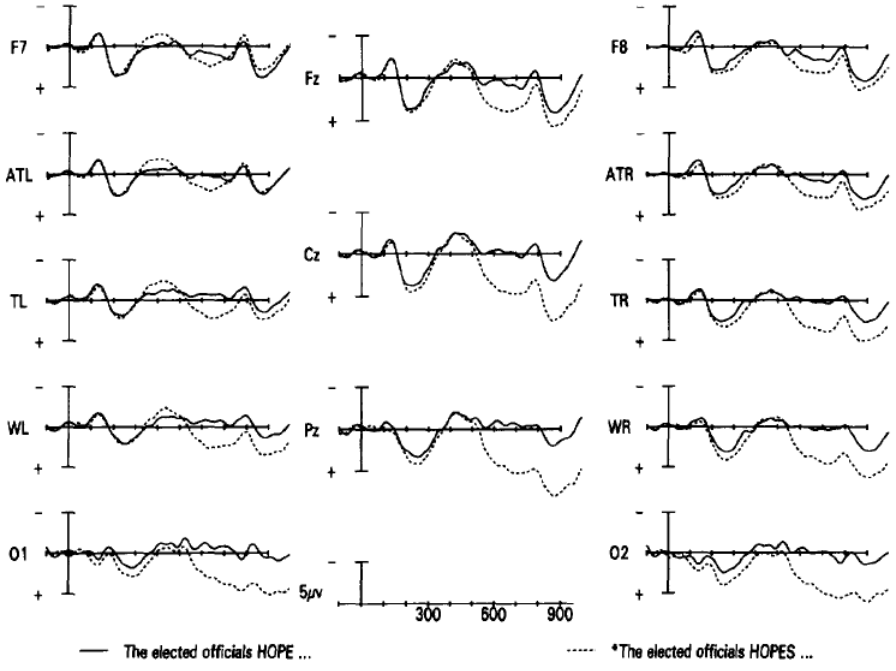


FIG. 1. Grand average ERPs recorded over three midline and 10 lateral sites to subject–verb number violations and controls. Onset of the critical words in non-violating (solid line) and agreement-violating (dashed line) conditions is indicated by the vertical bar. Each hash mark represents 100 ms. Positive voltage is plotted down.

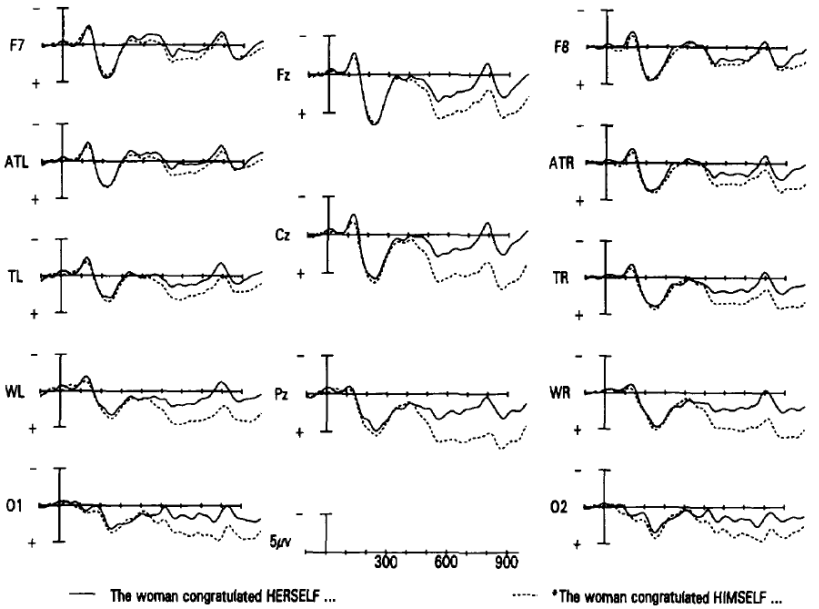
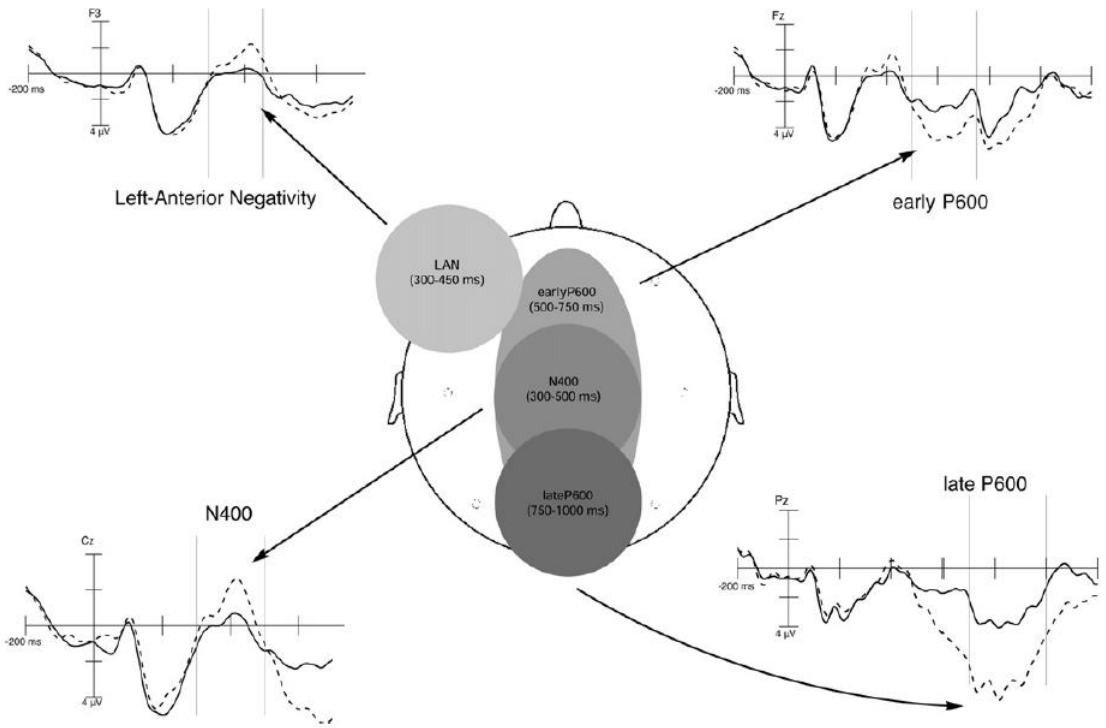


FIG. 3. Grand average ERPs to reflexive-antecedent gender violations (dashed line) and controls (solid line).


F3
-200 ms
4 µV
Left-Anterior Negativity
Fz
-200 ms
4 µV
early P600
LAN
(300-450 ms)
earlyP600
(500-750 ms)
N400
(300-500 ms)
lateP600
(750-1000 ms)
N400
Cz
-200 ms
4 µV
late P600
Pz
-200 ms
4 µV

Aditz komunztadura

Nik

zuri oparitu dizkizut.

liburuak

Subjektu vs. Objektu-aditz komunztadura prozesatzen

BRAIN RESEARCH 1284 (2009) 161–179

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Research Report

Processing canonical and non-canonical sentences in Basque: The case of object–verb agreement as revealed by event-related brain potentials

Adam Zawiszewski[a,b,*], *Angela D. Friederici*[a]

[a]*Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany*
[b]*University of the Basque Country (EHU-UPV), Vitoria-Gasteiz, Spain*

Aditz komunztadura

(a) Zuk ni betiko galdu nauzu agian. (SA, GRAM)

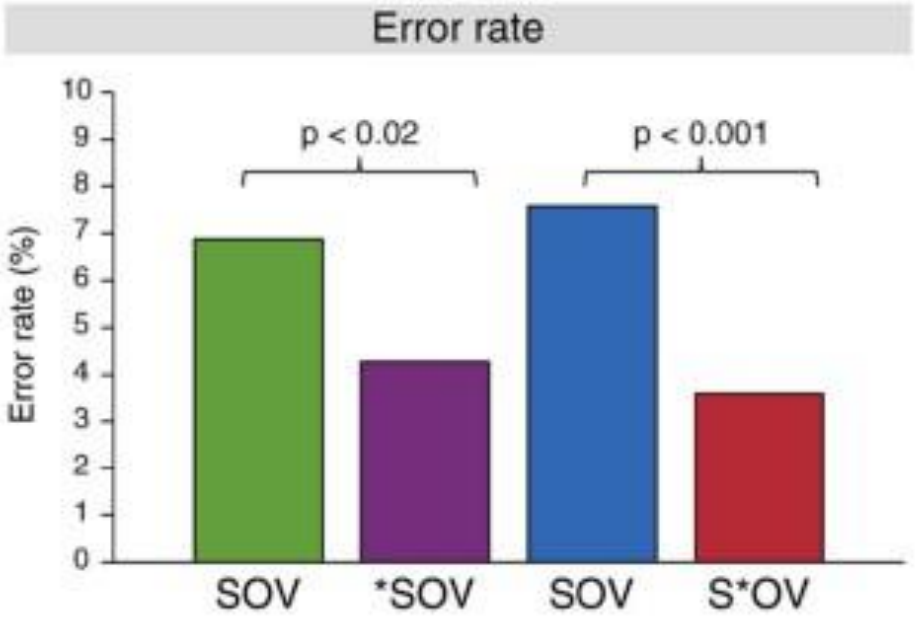
(b) Zuk ni betiko galdu nau*te agian. (SA, EZ-GRAM)

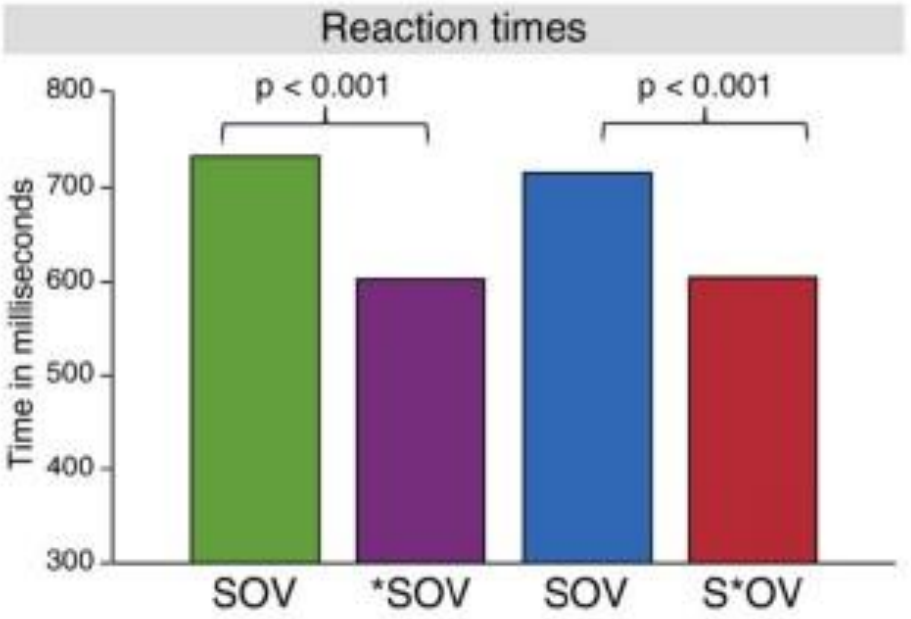
(c) Zuk ni askotan eramaten nauzu hondartzara. (OA, GRAM)

(d) Zuk ni askotan eramaten *duzu hondartzara. (OA, EZ-GRAM)

Zawiszewski & Friederici (2009)

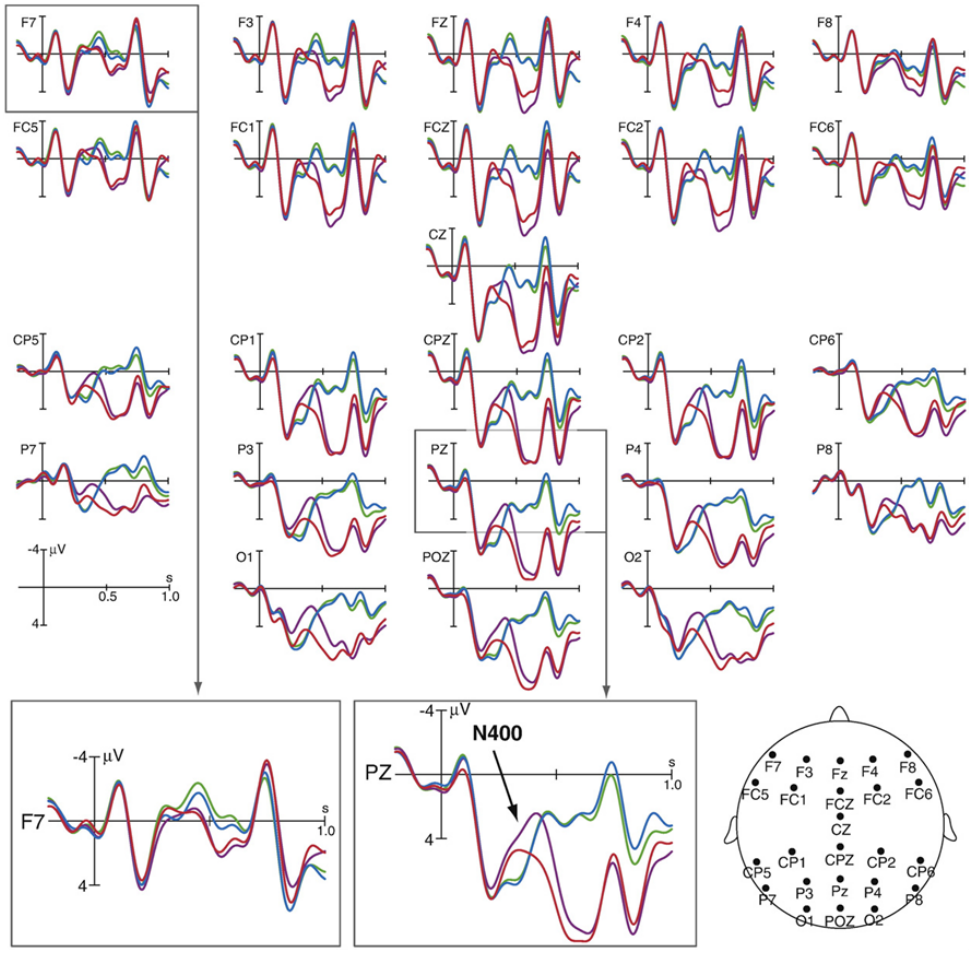
Portaerazko erantzunen emaitzak





ITURRIA: Zawiszewski, A. and Friederici, A.D. (2009) Processing OV agreement in canonical and non-canonical word orders in Basque: Evidence from ERPs. Brain Research 1284, 161-179.

Emaitzak



SOA

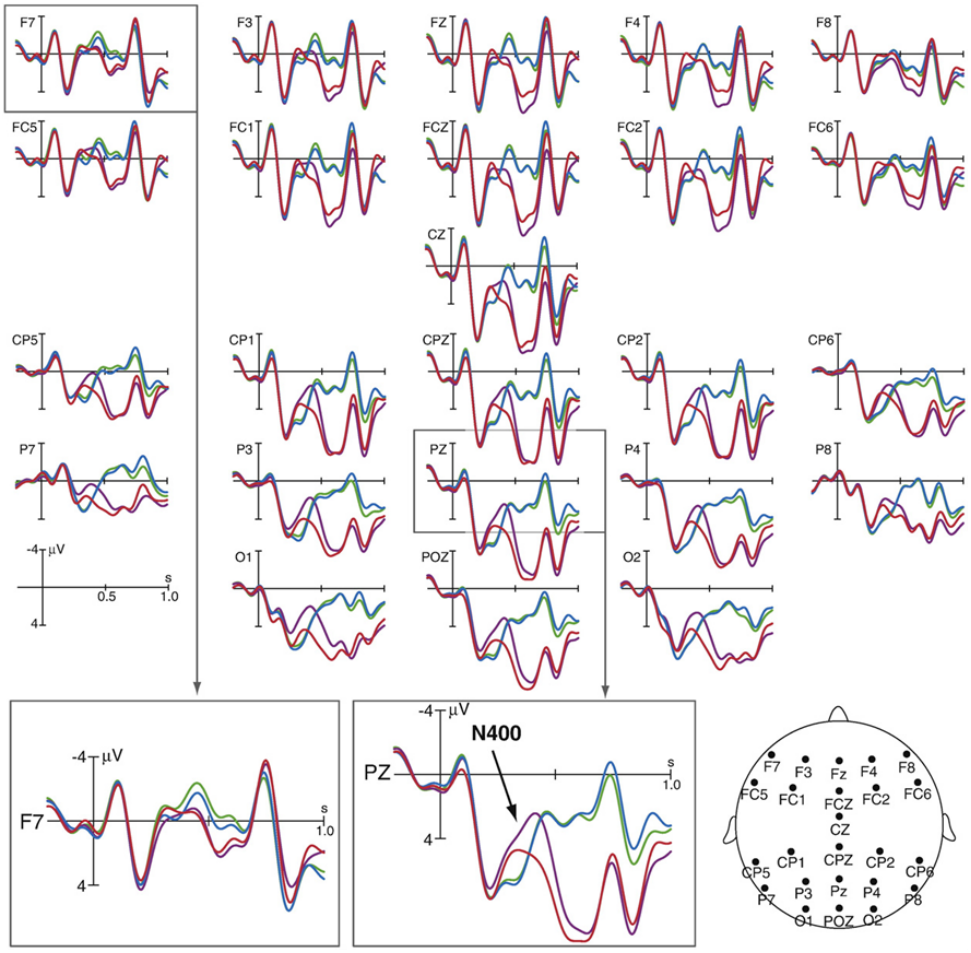
*SOA

SOA

S*OA

Zawiszewski & Friederici (2009)

Emaitzak



Subjektu vs. Objektu komunztadura konparatzen:

N400: Subjektu-aditz komunztadura urraketek (esaldi ez-gramatikaletan) N400 handiagoa sorrarazten dute objektu-aditz komunztadura urraketekin konparatuta

P600: Objektu-aditz komunztadura urraketek P600 handiagoa sorrarazten dute subjektu-aditz komunztadura urraketekin konparatuta

Zawiszewski & Friederici (2009)

journal of Neurolinguistics 24 (2011) 357-373

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On the cross-linguistic validity of electrophysiological correlates of morphosyntactic processing: A study of case and agreement violations in Basque

Begoña Díaz [a,*], Núria Sebastián-Gallés [b], Kepa Erdocia [c], Jutta L. Mueller [a], Itziar Laka [e]

[a] Max Planck Institute for Human Cognitive and Brain Sciences, Stephanstrasse 1a, 04103 Leipzig, Germany
[b] Brain and Cognition, Universitat Pompeu Fabra, Roc Boronat 138, 08018 Barcelona, Spain
[c] Department of Linguistics and Basque Studies, Faculty of Arts, University of the Basque Country UPV/EHU, Unibertsitatea 5, 01006 Vitoria-Gasteiz, Spain

Aditz komunztadura

Mikelen arrebek egunkaria saskian ekarri dute kioskotik (SA, GRAM)

Mikelen arrebek egunkaria saskian ekarri ***du** kioskotik (SA, EZ-GRAM)

Mikelen arrebek egunkariak saskian ekarri dituzte kioskotik (OA, GRAM)

Mikelen arrebek egunkariak saskian ekarri ***dute** kioskotik (OA, EZ-GRAM)

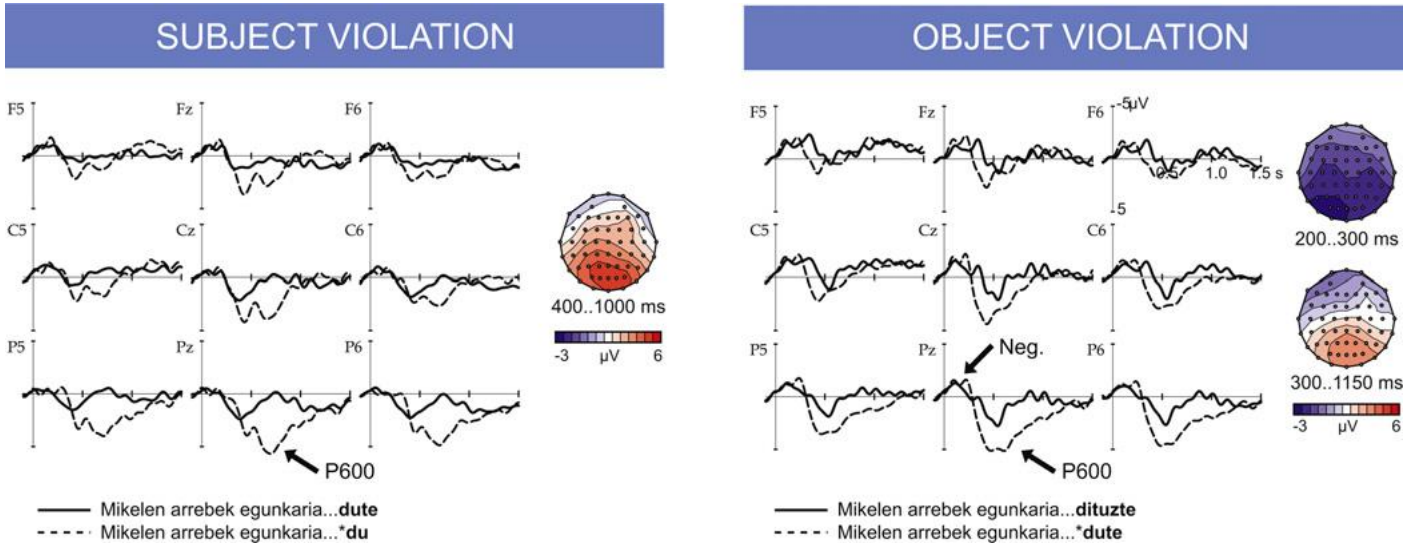
Díaz et al. (2011)

Aditz komunztadura




Díaz et al. (2011)

Emaitzak



Díaz et al. (2011)

Pertsona eta zenbaki komunztadura prozesuak konparatzen

Applied Psycholinguistics, page 1 of 26, 2015
doi:10.1017/S014271641500017X

Phi-features reloaded: An event-related potential study on person and number agreement processing

ADAM ZAWISZEWSKI, MIKEL SANTESTEBAN, and ITZIAR LAKA
University of the Basque Country

Aditz komunztadura

1. Zuk mutila bakarrik utzi du**zu** kalean. (GRAM)

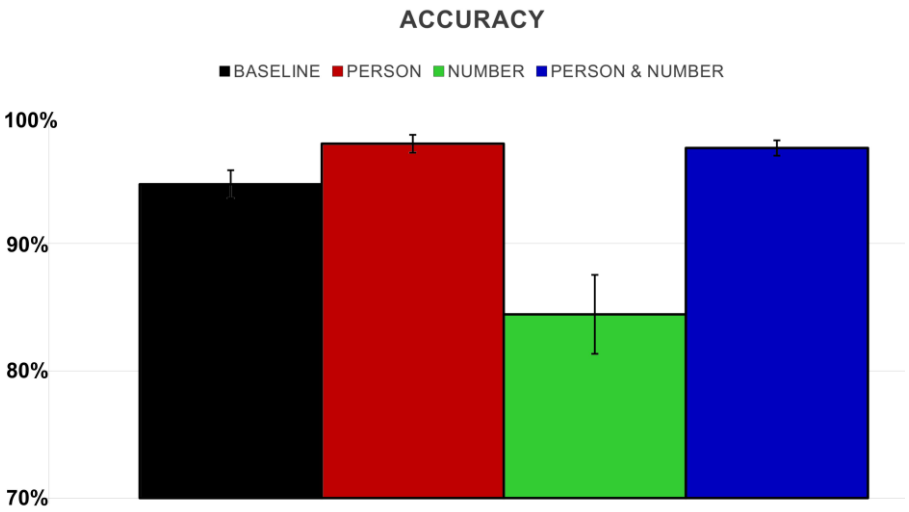
2. Zuk mutila bakarrik utzi ***du**t* kalean. (*PER)

3. Zuk mutila bakarrik utzi ***duzu**e* kalean. (*ZENB)

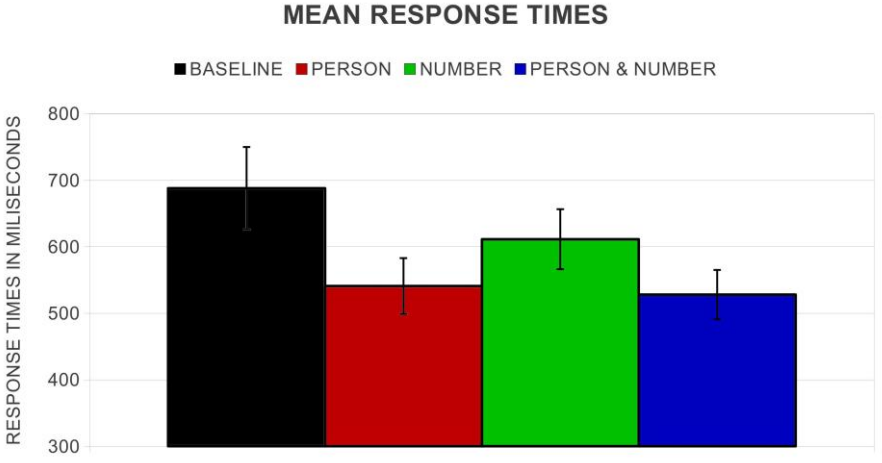
4. Zuk mutila bakarrik utzi ***du**gu* kalean. (*PER+ZENB)

Zawiszewski, Santesteban & Laka (2016)

Komuztadura: Portaerazko emaitzak

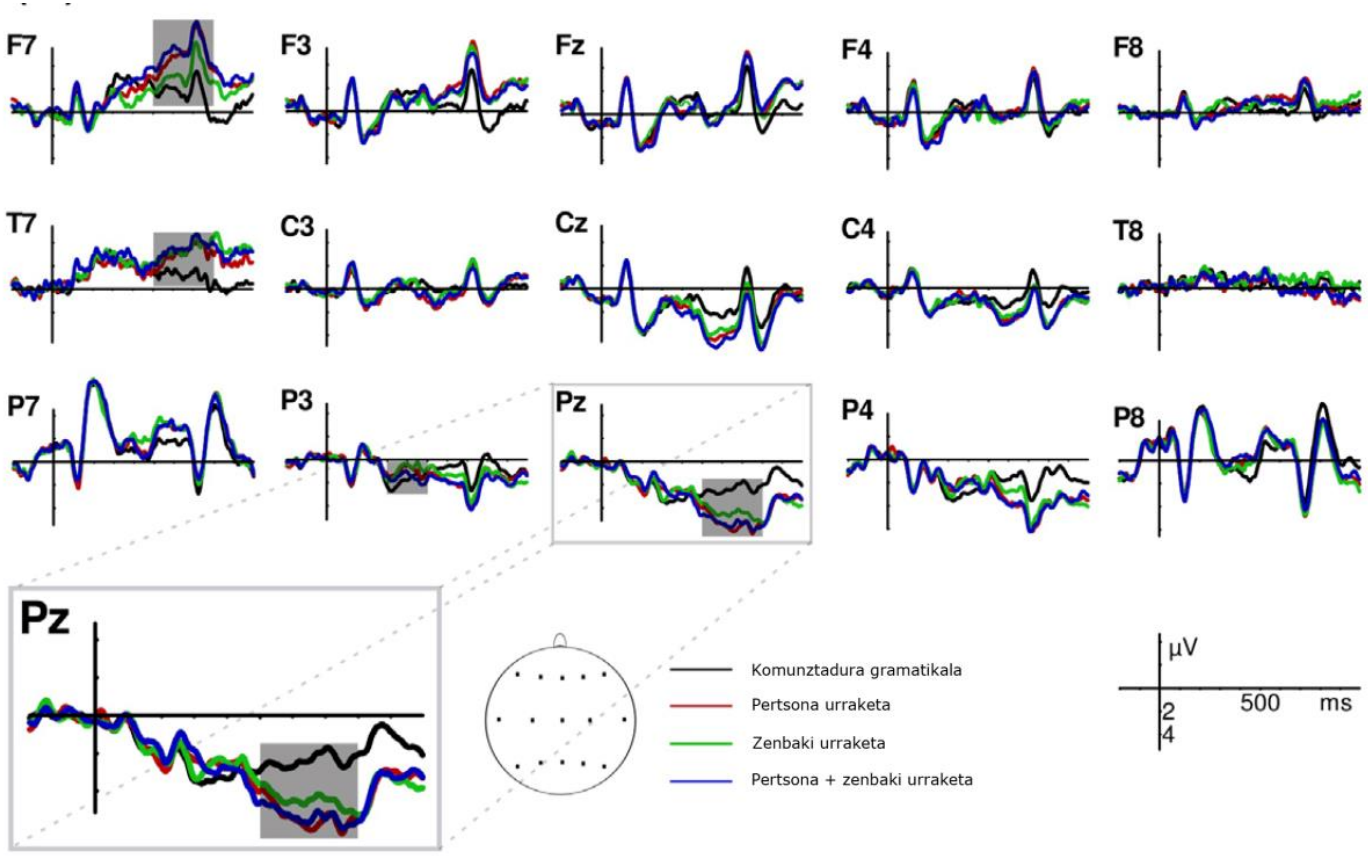


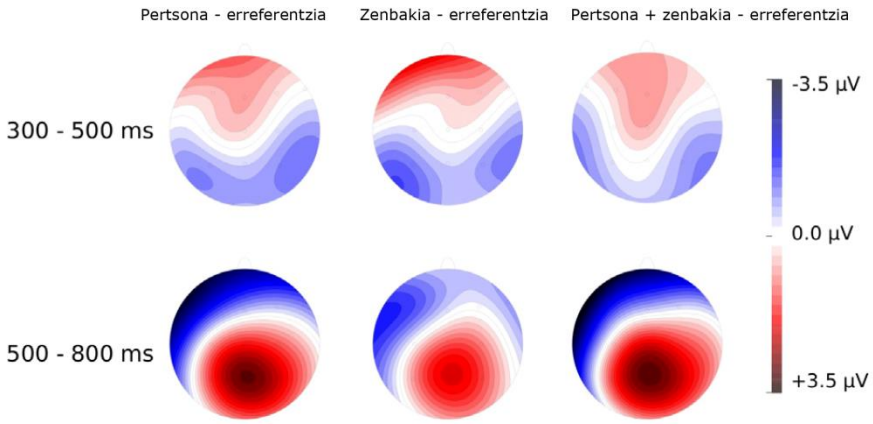
Zehaztasun handiagoz detektatu ziren petsona eta pertsona eta numero urraketak, numero urraketak baino.



Partaideek denbora gehiago behar izan zuten numero urraketak detektatzeko, petsona eta pertsona eta numero urraketak detektatzeko baino.

Zawiszewski, Santesteban & Laka (2016)

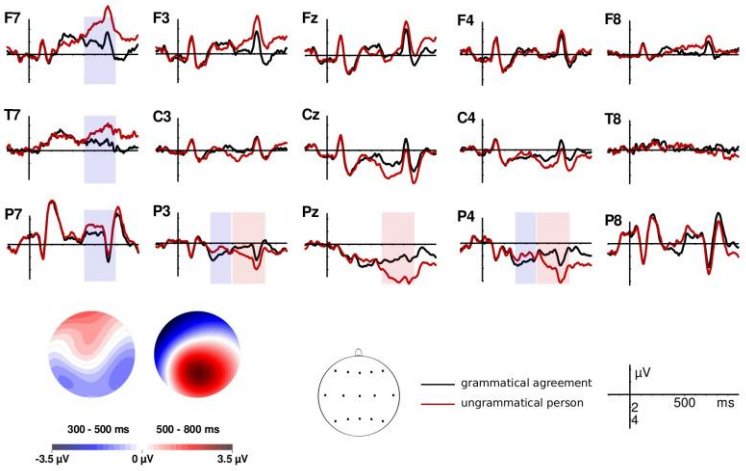




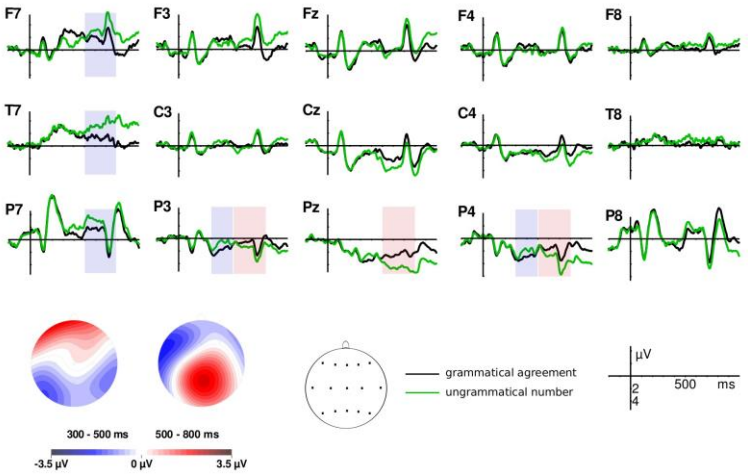
Emaitza elektrofisiologikoak

Zawiszewski, Santesteban & Laka (2016)

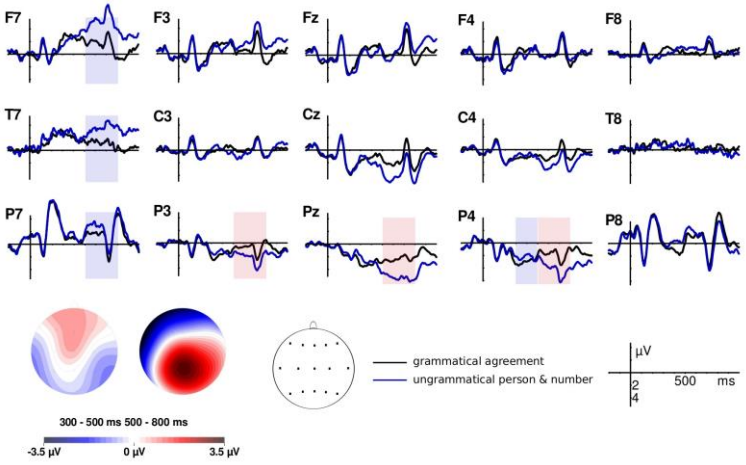
PERSON AGREEMENT

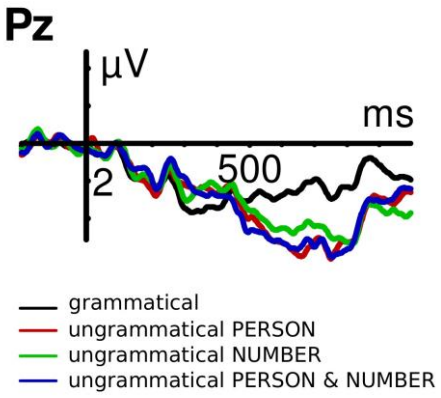


NUMBER AGREEMENT



PERSON & NUMBER AGREEMENT





- ERP osagai berdinak urraketa guztietan: N400 eta P600
- P600 handiagoa Pertsona urraketan eta urraketa Bikoitzean (Pertsona eta Numeroa), Numero komuztadura urraketan baino.

HITZ HURRENKERA

HITZ HURRENKERA

JAN

HITZ HURRENKERA

SOA Otsoak ardia jan du.

OSA Ardia otsoak jan du.

SAO Otsoak jan du ardia.

OAS Ardia jan du otsoak.

HITZ HURRENKERA

SOA Otsoak ardia jan du.

OSA Ardia otsoak jan du.

~~SAO Otsoak jan du ardia.~~

~~OAS Ardia jan du otsoak.~~

Erdocia et al. (2009)

Portaerazko 1. esperimentua: Materialak

SOA Otsoak ardia jan du.

OSA Ardia otsoak jan du.

Experiment 1	
Canonical SOV	Non-Canonical OSV
7a. Emakume-ak gizon-a ikusi du	7b. Gizon-a emakume-ak ikusi du
Woman-the(S) man-the(O) seen has(V)	Man-the(O) woman-the(S) seen has(V)
'The woman has seen the man'	*'The woman has seen the man'*

Erdocia et al. (2009)

Perpaus konplexuen prozesamendua: Helduak

Helburua

Ikustea sintaktikoki konplexuak diren perpausak (OSV) zailagoak direla prozesatzeko sintaktikoki sinpleak diren perpausak baino (SOV).

Perpaus konplexuen prozesamendua: Helduak

Helburua

Ikustea sintaktikoki konplexuak diren perpausak (OSV) zailagoak direla prozesatzeko sintaktikoki sinpleak diren perpausak baino (SOV).

Materialak

Emakumeak gizona ikusi du

Perpaus konplexuen prozesamendua: Helduak

Helburua

Ikustea sintaktikoki konplexuak diren perpausak (OSV) zailagoak direla prozesatzeko sintaktikoki sinpleak diren perpausak baino (SOV).

Materialak

Emakumeak gizona ikusi du

Gizona emakumeak ikusi du

Perpaus konplexuen prozesamendua: Helduak

Helburua

Ikustea sintaktikoki konplexuak diren perpausak (OSV) zailagoak direla prozesatzeko sintaktikoki sinpleak diren perpausak baino (SOV).

Materialak

Emakumeak gizona ikusi du

Gizona emakumeak ikusi du

ERREAKZIO DENBORA: Irakurketa gidatua + ulermen ariketa

_____ ____- ____- ____

Gizonak ——— ——— ———

——- emakumea —— ———

ikusi


du

Egia al da emakume batek gizon bat ikusi duela?

Irakurketa gidatua + ulermen ariketa

IRAKURKETA GIDATUA

- Partaideek erabakitzen dute zenbat denbora behar duten perpauseko elementu bakoitza irakurtzeko.
- Perpauseko elementu bakoitza irakurtzeko erabilitako denborak gehituz, perpaus osoaren irakurketa denbora daukagu.

Irakurketa gidatua + ulermen ariketa

IRAKURKETA GIDATUA

- Partaideek erabakitzen duten zenbat denbora behar duten perpauseko elementu bakoitza irakurtzeko.
- Perpauseko elementu bakoitza irakurtzeko erabilitako denborak gehituz, perpaus osoaren irakurketa denbora daukagu.

ULERMEN ARIKETA

- Partaideek esperimentuko perpausak irakurri dituztela ziurtatzeko balio du.
- Esperimentuko perpausen prozesatzeko zailtasunari buruzko informazioa ematen du.
  - Ulermen ariketan **akats** gehien eragiten duten perpausak prozesatzeko zailagoak izango dira.
  - Irakurtzeko **denbora** gehien behar duten perpausak prozesatzeko zailagoak izango dira.

Konplexutasun sintaktikoa Erreakzio Denboren bidez

Emakumeak gizona ikusi du

Gizona emakumeak ikusi du

Konplexutasun sintaktikoa Erreakzio Denboren bidez

Emakumeak gizona ikusi du

Gizona emakumeak ikusi du

- Zein baldintzak beharko du irakurketa denbora gehiago?
- Elementu konkreturen baten irakurketa denbora beste elementuren batena baino motelagoa izango da?
- Zein baldintzak sortuko ditu ulermen arazo gehiago?

Konplexutasun sintaktikoa Erreakzio Denboren bidez

Emakumeak gizona ikusi du

Gizona emakumeak ikusi du

- Zein baldintzak beharko du irakurketa denbora gehiago?
- Elementu konkreturen baten irakurketa denbora beste elementuren batena baino motelagoa izango da?
- Zein baldintzak sortuko ditu ulermen arazo gehiago?

Aurreikuspenak?

Konplexutasun sintaktikoa Erreakzio Denboren bidez

Emakumeak gizona ikusi du

Gizona emakumeak ikusi du

- Zein baldintzak beharko du irakurketa denbora gehiago?
- Elementu konkreturen baten irakurketa denbora beste elementuren batena baino motelagoa izango da?
- Zein baldintzak sortuko ditu ulermen arazo gehiago?

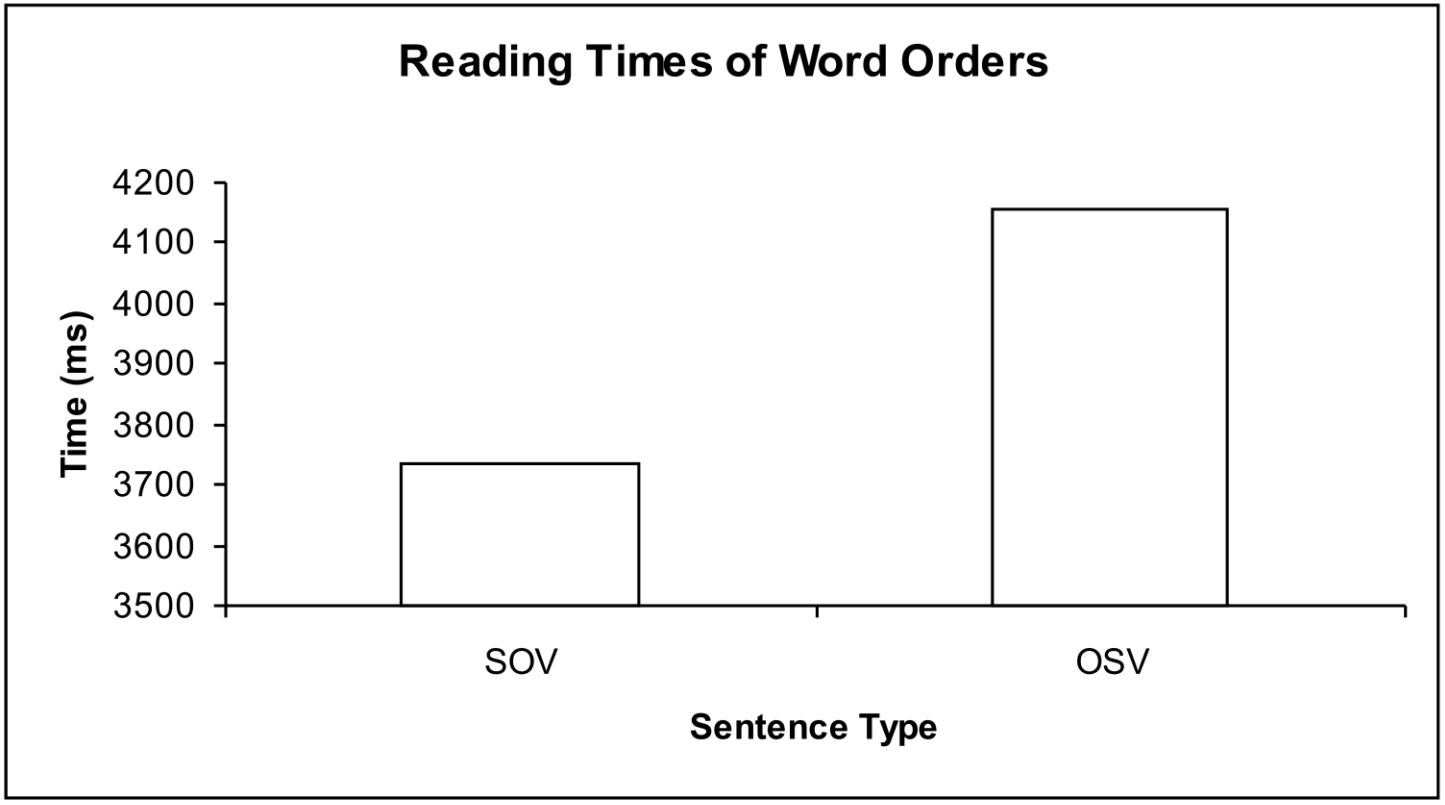
Aurreikuspenak?

Objektu-Subjektu-Aditz perpausek

- irakurketa denbora gehiago
- denbora gehiago ulermen ariketa burutzeko
- akats gehiago ulermen ariketa gauzatzeko

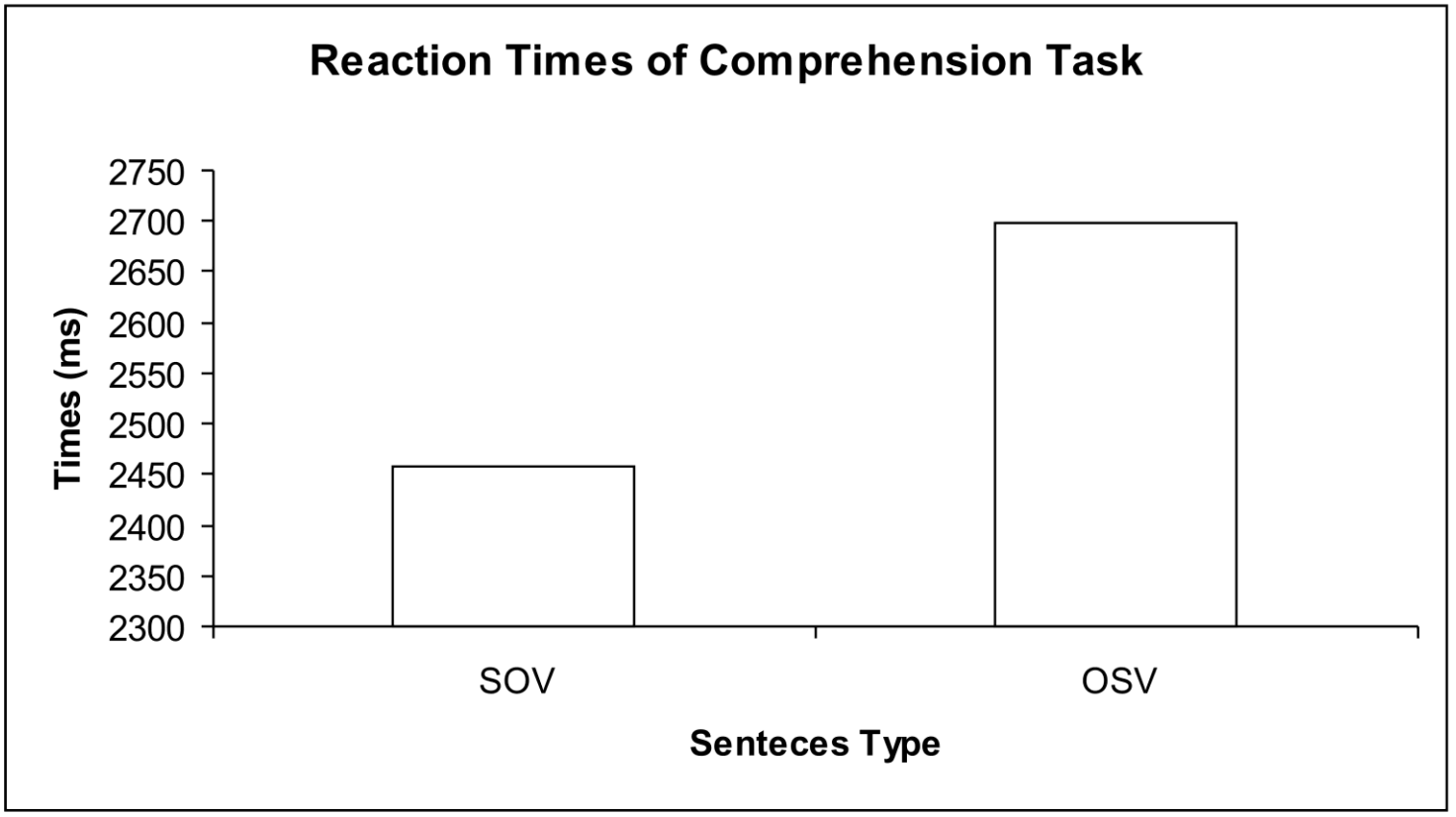
EMAITZAK: Perpausen irakurketa denborak

Subjektu-Objektu-Aditz hurrenkera azkarrago irakurtzen da



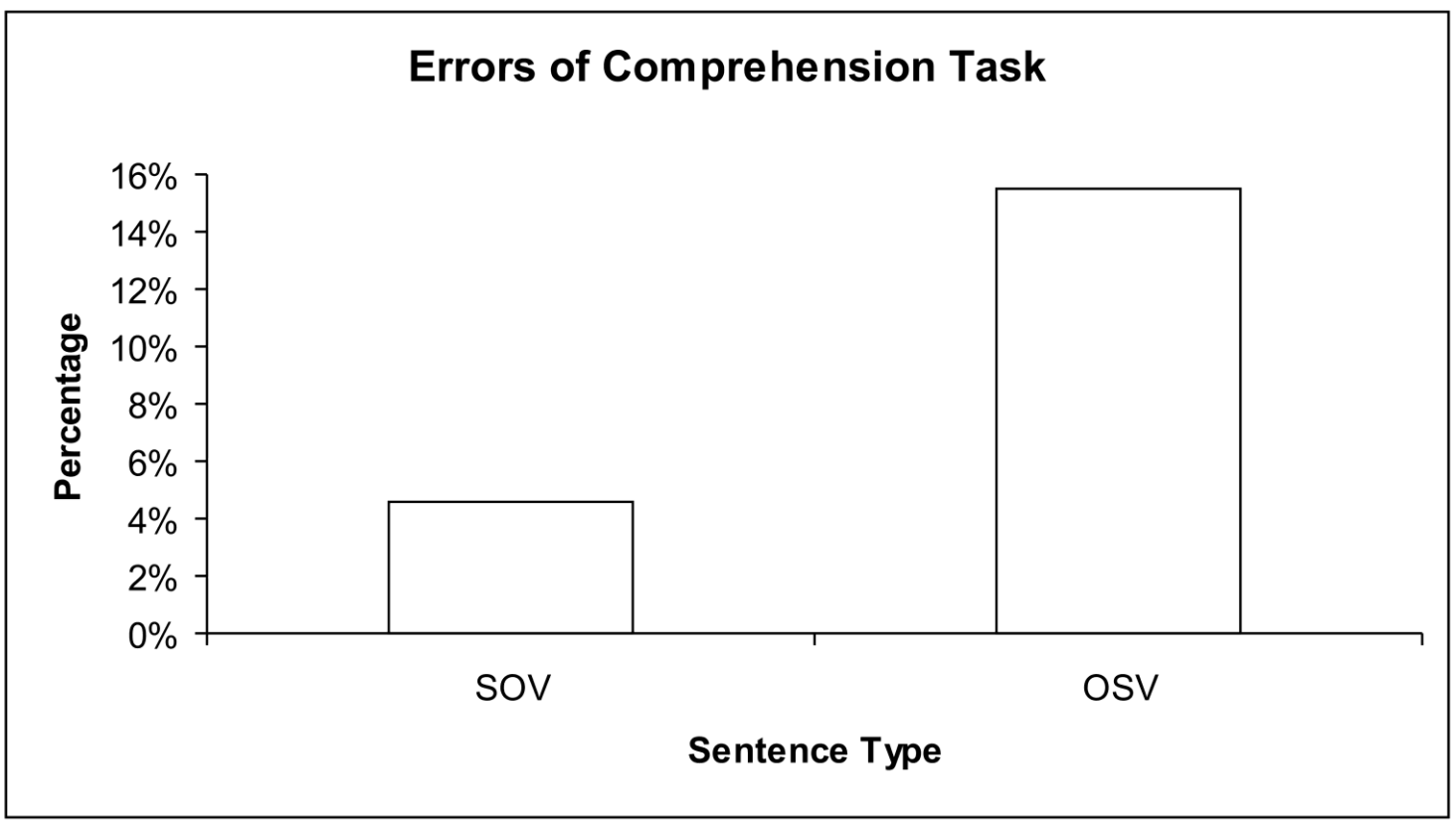
EMAITZAK: Ulermen ariketa burutzeko denbora

SOVri buruzko ulermen galderak azkarrago erantzun ziren.



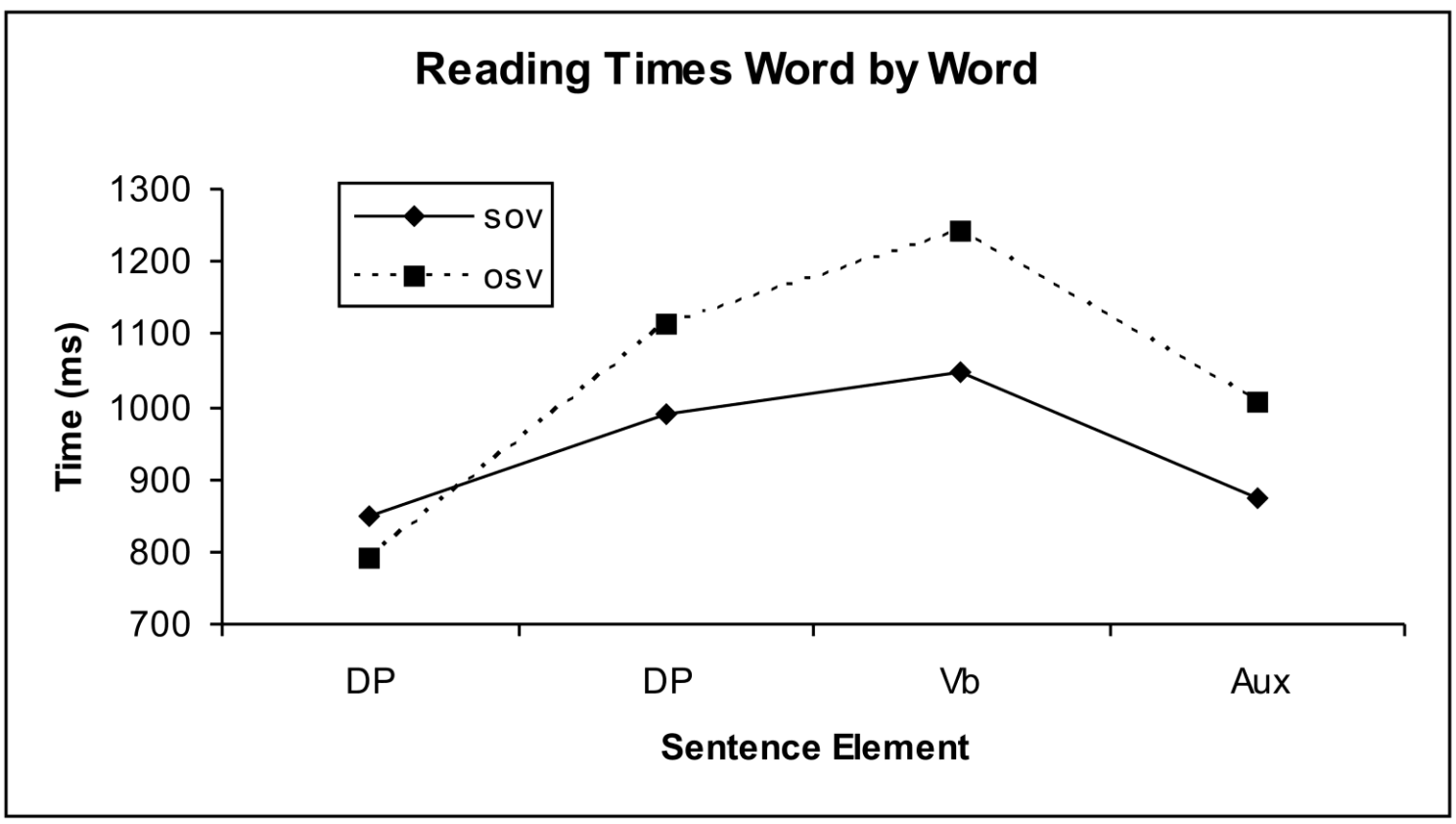
EMAITZAK: Akatsak

Objektu-Subjektu-Aditz baldintzak akats gehiago eragin zituen



EMAITZAK: Hitzez hitz

S irakurri ondoren O irakurtzea errazagoa da O-ren ondoren S irakurtzea baino.



Anbiguotasuna

Anbiguotasuna

EMAKUME**AK** GIZON**AK** IKUSI DITU

Portaerazko 2. esperimentua: Materialak

SOA Otsoek ardiak jan dituzte.

OSA Ardiak otsoek jan dituzte.

Experiment 2

Canonical SOV
8a. Emakume-ek gizon-ak ikusi dituzte
Women-the(S) men-the(O) seen have(V)
'The women have seen the men'

Non-Canonical OSV
8b. Gizon-ak emakume-ek ikusi dituzte
Men-the(O) women-the(S) seen have(V)
'The women have seen the men'

Fully ambiguous
8c. Gizon-ak emakume-ak ikusi ditu
Man-the(S/O) woman-the(S/O) seen has(V)
'The man has seen the women' or 'The woman has seen the men'

Portaerazko emaitzak

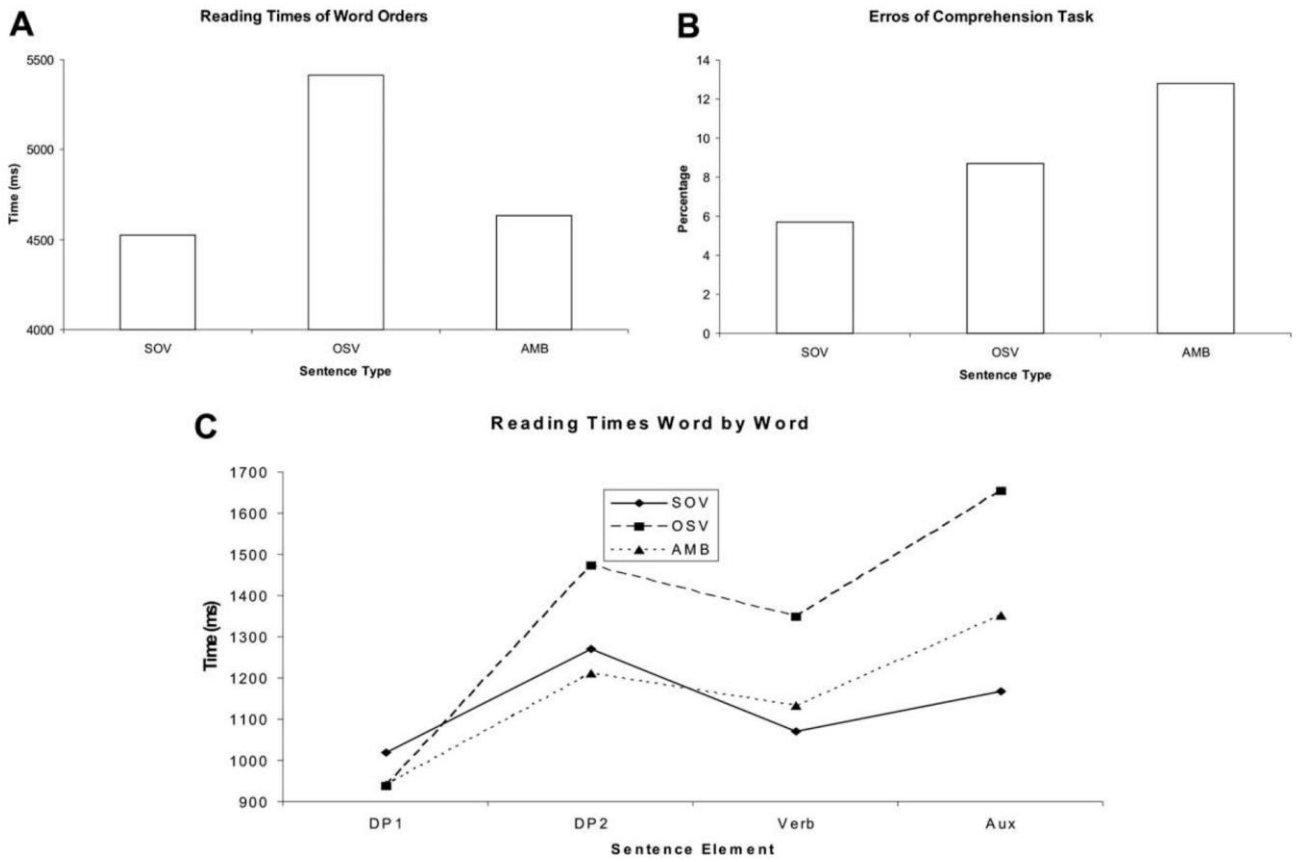


Fig. 2. Results from self-paced reading Experiment 2. (A) Mean reading times to whole sentences in both experimental conditions (SOV = Subject–Object–Verb word order; OSV = Object–Subject–Verb word order; AMB = fully ambiguous sequences). As in the first experiment, the OSV condition required longer reading times. (B) Error rate in the comprehension task. (C) Comparison of SOV, OSV and AMB conditions word-by-word. The *y*-axis features reaction times in milliseconds; in *x*-axis the different constituents of each sentence are depicted (DP = Determiner Phrase; Vb = Verb; Aux = Auxiliary verb). The DPs are the subject and the object of the transitive verb.

1

HITZ HURRENKERA

SOA Otsoak ardia jan du.

OSA Ardia otsoak jan du.

~~SAO Otsoak jan du ardia.~~

~~OAS Ardia jan du otsoak.~~

Erdocia et al. (2009)

HITZ HURRENKERA

SOA Otsoek ardiak jan dituzte.

OSA Ardiak otsoek jan dituzte.

~~SAO Otsoak jan du ardia.~~

~~OAS Ardia jan du otsoak.~~

Erdocia et al. (2009)

HITZ HURRENKERA

SOA Otsoek ardiak jan dituzte.

OSA Ardia otsoak jan du.

~~SAO Otsoak jan du ardia.~~

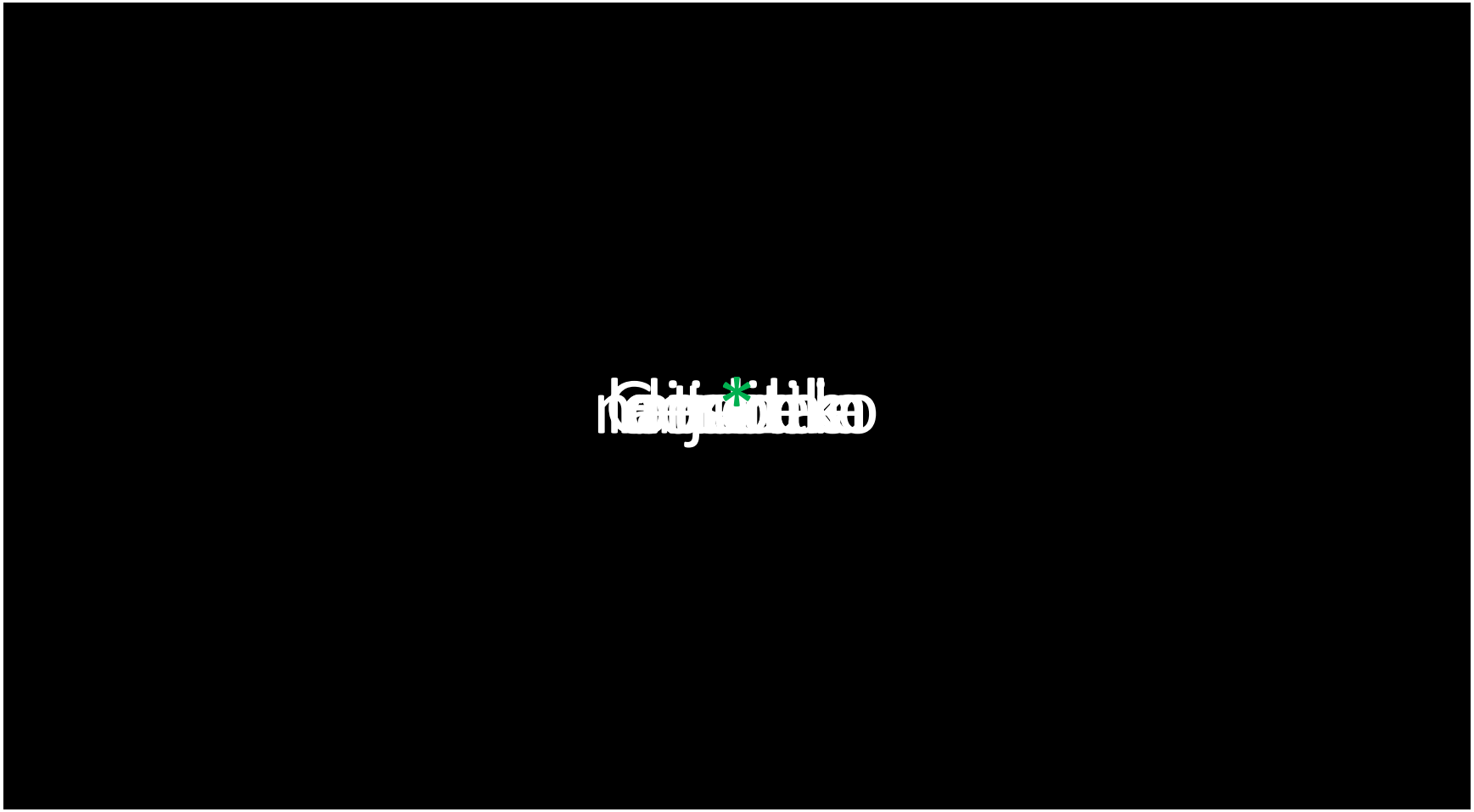
~~OAS Ardia jan du otsoak.~~

Erdocia et al. (2009)

SOV vs. OSV: ERP Materialak

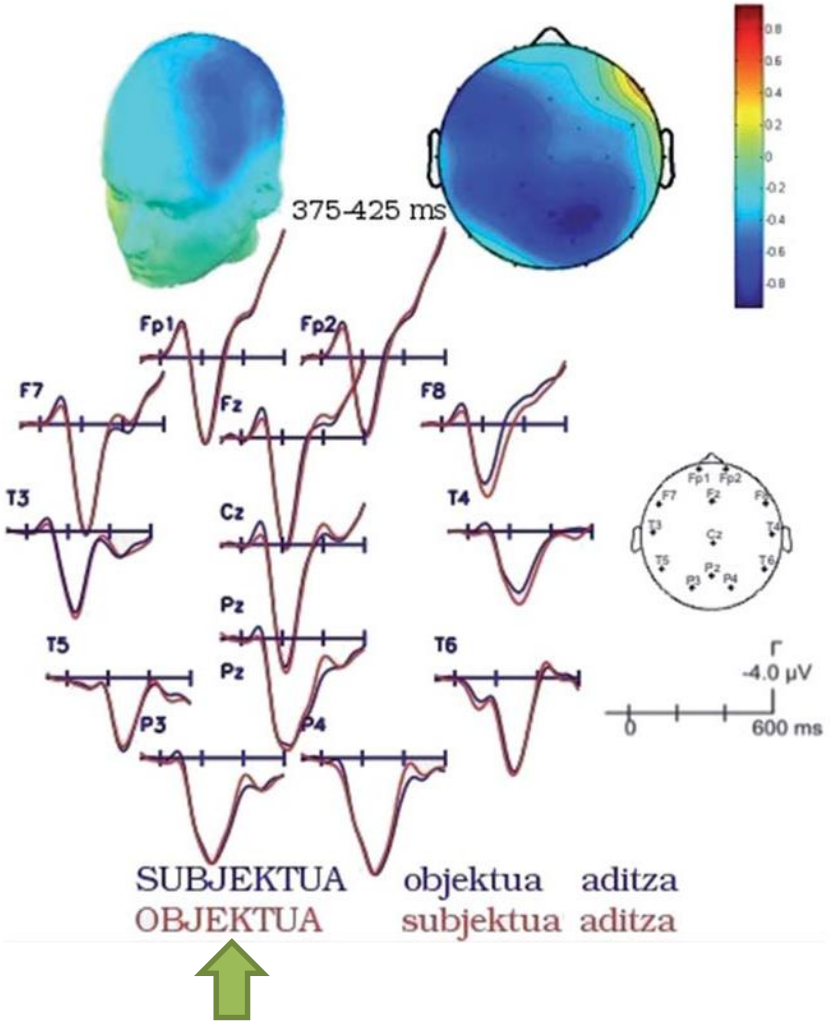
Experiment 3	Canonical SOV	Non-Canonical OSV
Unambiguous	9a. Otso-ek ardi-ak jan dituzte Wolf-the(S) sheep-the(O) eat have(V) *'The wolves have eaten the sheep'*	9b. Ardi-a otso-ak jan du Sheep-the(O) wolf-the(S) eat has(V) *'The wolf has eaten the sheep'*
Temporally ambiguous	9c. Otso-ak ardi-ak jan ditu Wolf-the(S/O)sheep-the(S/O) eat has(V) *'The wolf has eaten the sheep'*	9d. Ardi-ak otso-ak jan ditu Sheep-the(S/O) wolf-the(S/O) eat has(V) *'The wolf has eaten the sheep'*

- OTSO*AK* ARDI*AK* JAN DITU
- ARDI*AK* OTSO*AK* JAN DITU



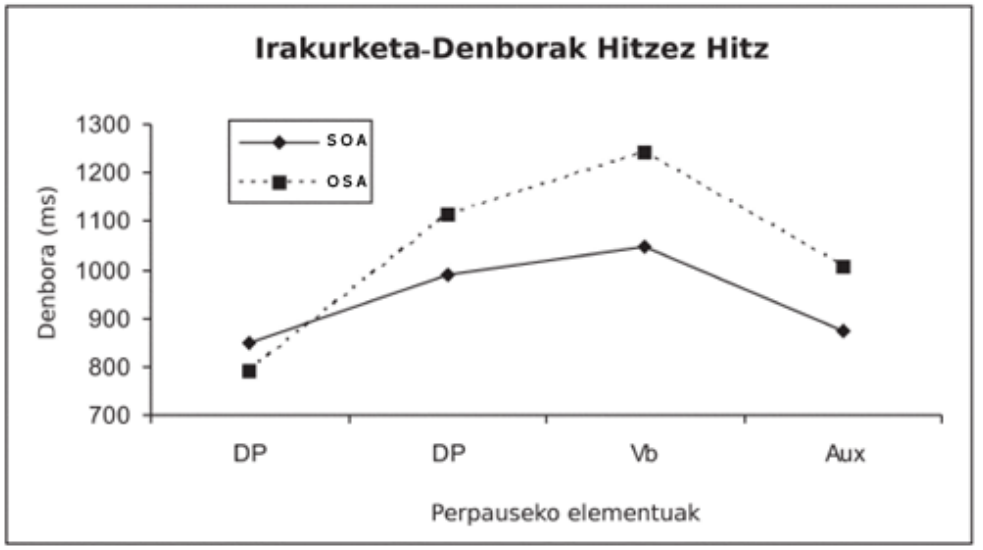
otsoek ardiak jan dituzte

Emaitzak DP1



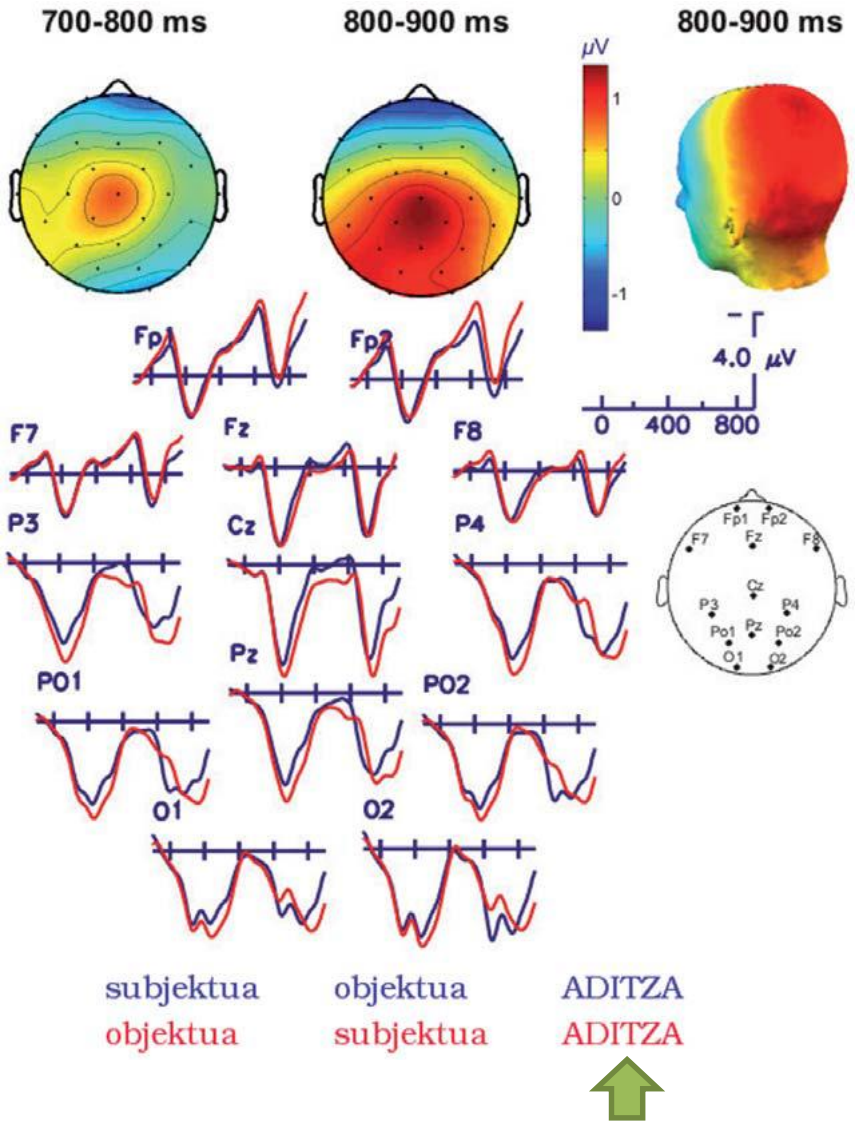
Otsoek ardiak jan dituzte. (SOA)

Ardia otsoak jan du. (OSA)



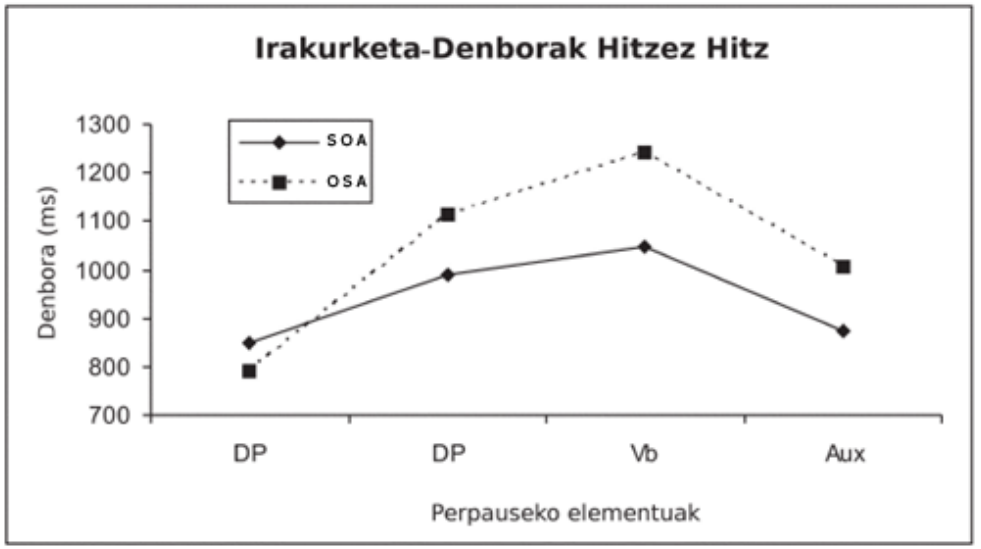
Erdocia et al. (2009)

Emaitzak: Aditza



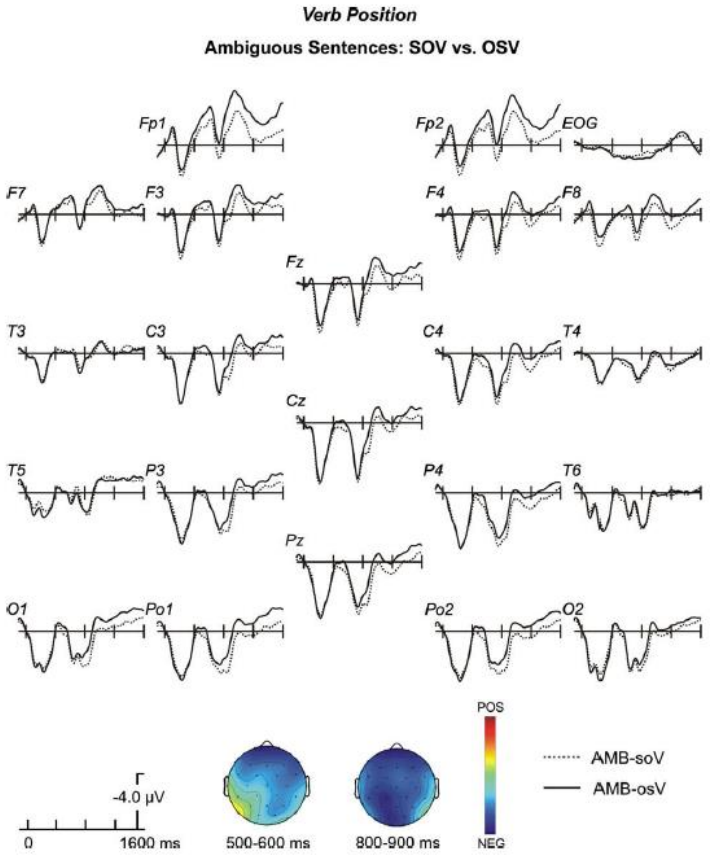
Otsoek ardiak jan dituzte. (SOA)

Ardia otsoak jan du. (OSA)



Erdocia et al. (2009)

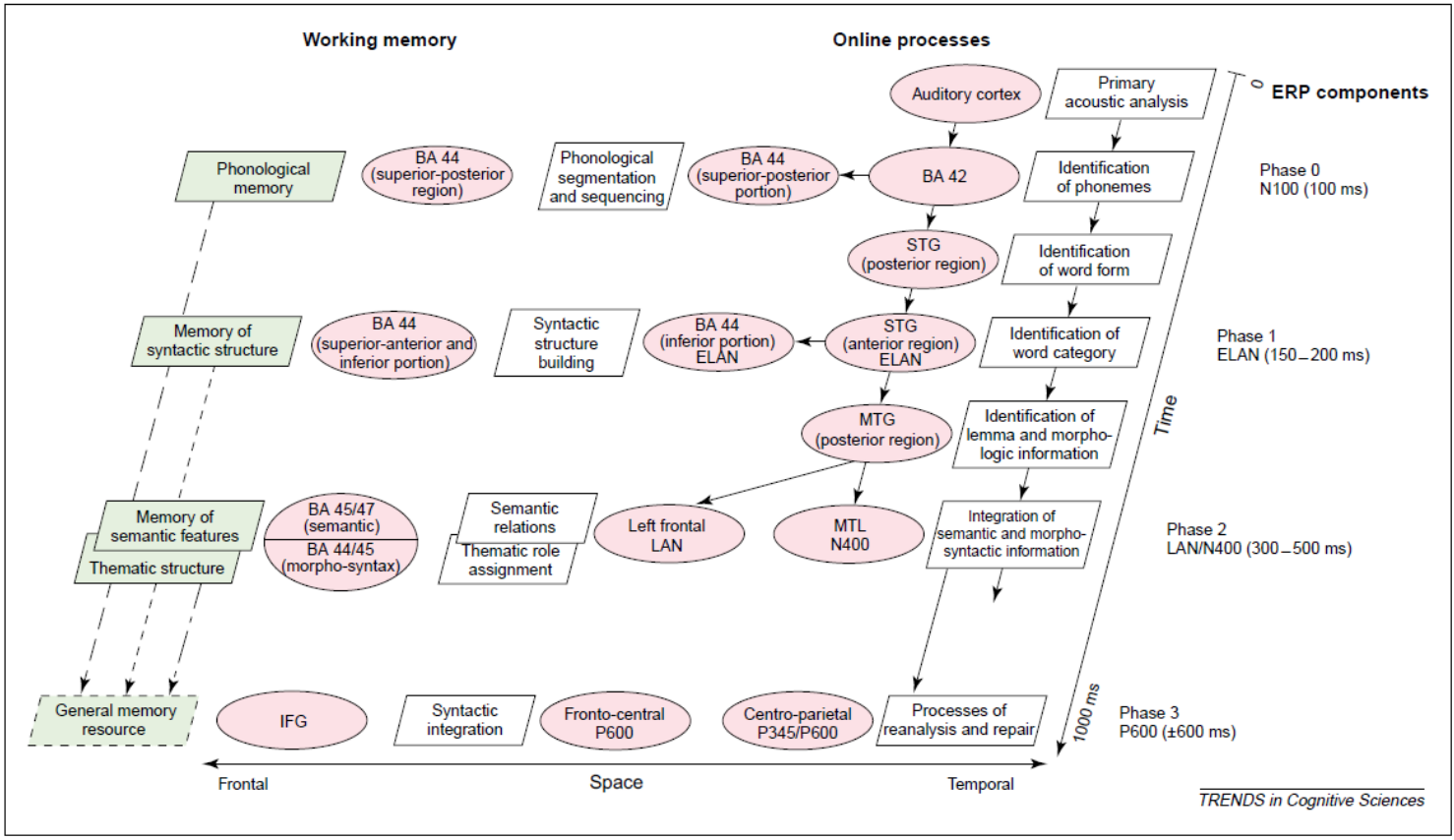
Temporally ambiguous (Aditza)



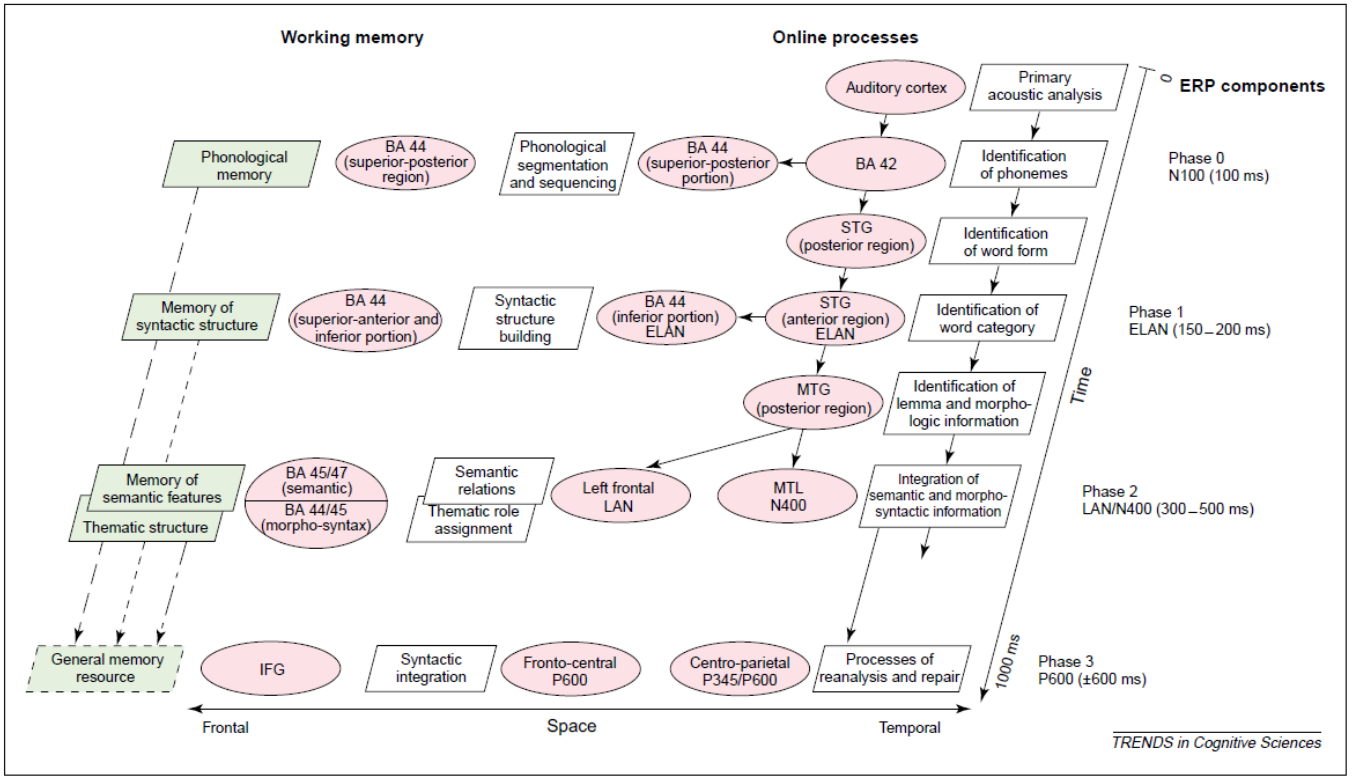
Towards a neural basis of auditory sentence processing

Friederici (2002)

Fig. 1. Neurocognitive model of auditory sentence processing. The boxes represent the functional processes, the ellipses the underlying neural correlate identified either by fMRI, PET or ERPs. The neuroanatomical specification (indicated by text in square brackets) is based on either fMRI or PET data. The ERP components specified in their temporal structure (left-hand side) are assigned to their neural correlate by the function rather than the localization of their generator. This holds true for the ERP components of phase 2 and -3 as late components are hard to localize. The different distributions of the P600 and their functional nature are discussed in Ref. [53]. The neural correlate of the ELAN, however, has been verified by dipole localization [54]. Abbreviations: BA, Brodmann's area; ELAN, early left-anterior negativity; ERP, event-related brain potential; fMRI, functional magnetic resonance imaging; IFG, inferior frontal gyrus; MTG, middle temporal gyrus; MTL, middle temporal lobe; PET, positron imaging tomography; STG, superior temporal gyrus.



Friederici (2002)



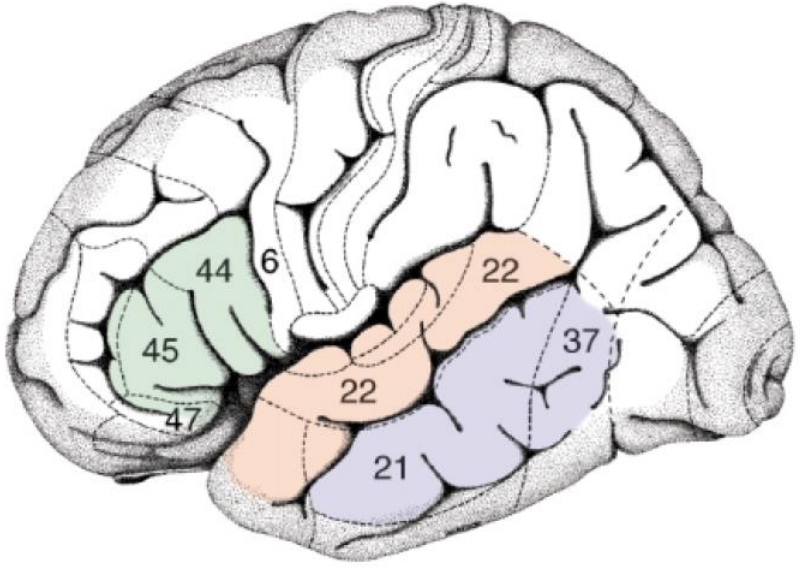


Fig. 2. Brodmann areas (BA) in the left hemisphere. The inferior frontal gyrus (IFG) is shown in green, the superior temporal gyrus (STG) in red and the middle temporal gyrus (MTG) in blue. (Adapted from Ref. [55].)

eADM

The Extended Argument Dependency Model: A Neurocognitive Approach to Sentence Comprehension Across Languages

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Real-time language comprehension is a principal cognitive ability and thereby relates to central properties of the human cognitive architecture. Yet how do the presumably universal cognitive and neural substrates of language processing relate to the astounding diversity of human languages (over 5,000)? The authors present a neurocognitive model of online comprehension, the extended argument dependency model (eADM), that accounts for cross-linguistic unity and diversity in the processing of core constituents (verbs and arguments). The eADM postulates that core constituent processing proceeds in three hierarchically organized phases: (1) constituent structure building without relational interpretation, (2) argument role assignment via a restricted set of cross-linguistically motivated information types (e.g., case, animacy), and (3) completion of argument interpretation using information from further domains (e.g., discourse context, plausibility). This basic architecture is assumed to be universal, with cross-linguistic variation deriving primarily from the information types applied in Phase 2 of comprehension. This conception can derive the appearance of similar neurophysiological and neuroanatomical processing correlates in seemingly disparate structures in different languages and, conversely, of cross-linguistic differences in the processing of similar sentence structures.

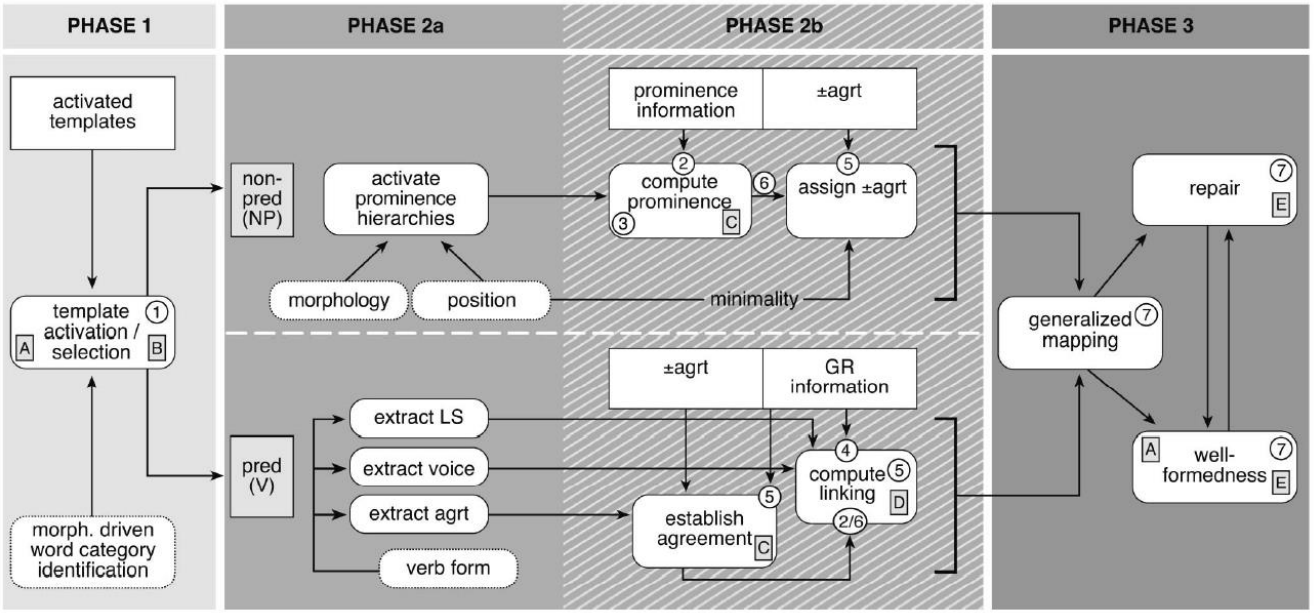

Table 1

Summary of the Extended Argument Depency Model's Neurophysiological Correlates

Processing step	ERP component	Language	Example
Phase 1			
Template activation/selection	Early left-anterior negativity	English, German, Dutch	4, 5
Phase 2			
Compute prominence (mismatch with previous prominence information)	N400	English, German, Russian	6, 7, 8
Compute prominence (mismatch with template)	Scrambling negativity	German	9
Assign ± Agrt	LAN	English, Finnish	11, 12
Establish Agreement (mismatch with GR information)	LAN	English, Dutch, Italian	13
Compute linking (GR mismatch)	Early positivity (P345)	German, Dutch, English	15, 16, 17, 18
Compute linking (agreement mismatch)	N400/P600	German	14, 19, 20
Compute linking (hierarchy mismatch)	LAN	German	21
Phase 3			
Generalized mapping	Late positivity	Dutch, English, German	22, 23, 24
Well-formedness/repair	Late positivity	English, German	25, Footnote 9

Note. ERP = event-related brain potential; LAN = left-anterior negativity; agrt = agreement; GR = generalized semantic roles.

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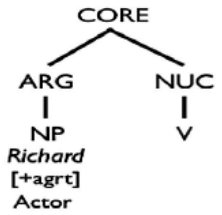
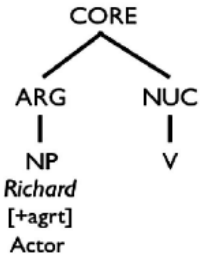
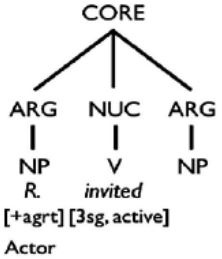
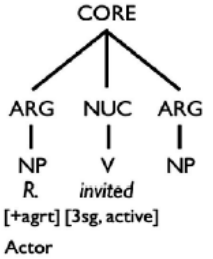
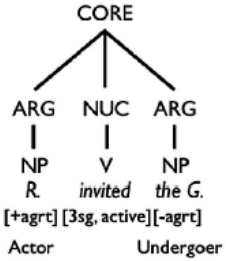
	input representation	phase 1	phase 2	phase 3	output representation
Richard		• NP recognised • 1-arg template activated	• GR / prominence information activated via position (phase 2a) → Actor assigned (Compute Prominence, 2b) → [+agrt] assigned via Actor role (2b)	• Local well-formedness checked	
Richard invited		• V recognised • 1-arg template kept active	• Agreement, voice, logical structure extracted (phase 2a) • Agreement matched against input (Establish Agreement, 2b) → Linking computed (GRs checked) using agreement, voice, LS (Compute Linking, 2b)	• 2-arg template selected on account of subcat. inf (Gen. Mapping) • Local well-formedness checked	
Richard invited the gardener		• NP recognised • 2-arg template kept active	• GR / prominence information activated via position (phase 2a) → Undergoer assigned (Compute Prominence, 2b) → [-agrt] assigned via prominence and previous agreement inf (2b) → linking completed	• Global well-formedness checked	

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