Manner Modification Across Modalities:

Insights from Gesture, Sign, and Spoken Language

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Dissertation Defense
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Events and components

Events are central to human cognition and language. [1]

Describing an event involves multiple components.

1) The girl carried the cotton candy
   a) to the fair. (path)
   b) yesterday. (time)
   c) silently. (manner)

Taken from https://www.shutterstock.com

[1] Papafragou 2015; Ünal et al. 2024; ao.

Events and multimodality

Event components can be expressed in different ways.

Taken from https://gifdb.com/images

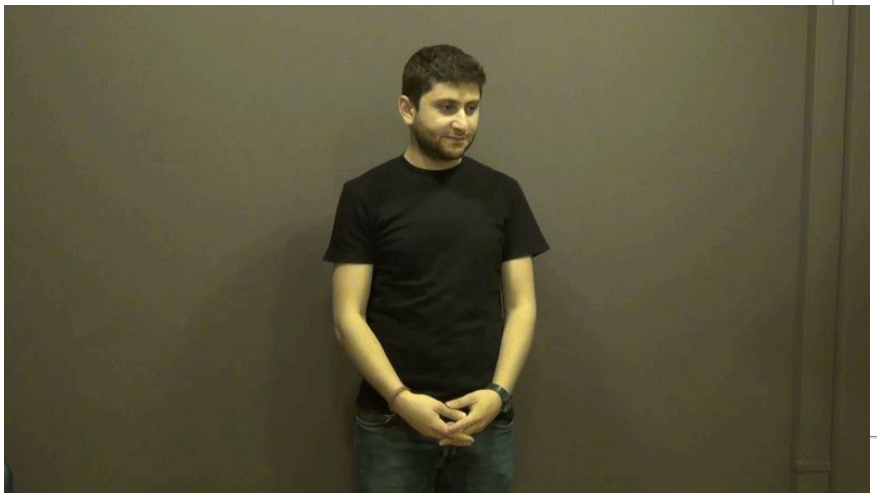
2) The car went ***fast***. — *lexical*

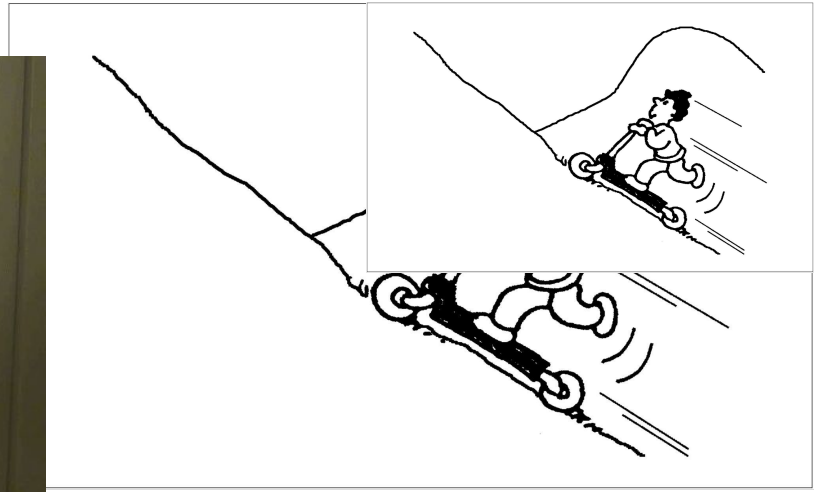
3) The car went ***vroom***.

4) The car went ***like this***. — *gesture* — *depictive/iconic*

Events in sign languages

5) Turkish Sign Language (TİD)





Core questions

Do event-related modifiers contribute uniformly to interpretation?

If not, where do systematic asymmetries arise?

Do these asymmetries persist across modalities ,

or do they depend on the semantic class of the modifier?

Dissertation roadmap

Event representation in a sign language with iconicity (Chapter 2)

- Turkish Sign Language (classifier constructions)

Event components across modalities (Chapter 3)

- English (written language and co-speech gesture)

Event modification in a spoken language with iconicity (Chapter 4)

- Turkish (lexical adverbials and ideophones)

Event Representation in a Sign Language

Classifier constructions in sign languages

Classifier constructions (CL) in sign languages encode information about:

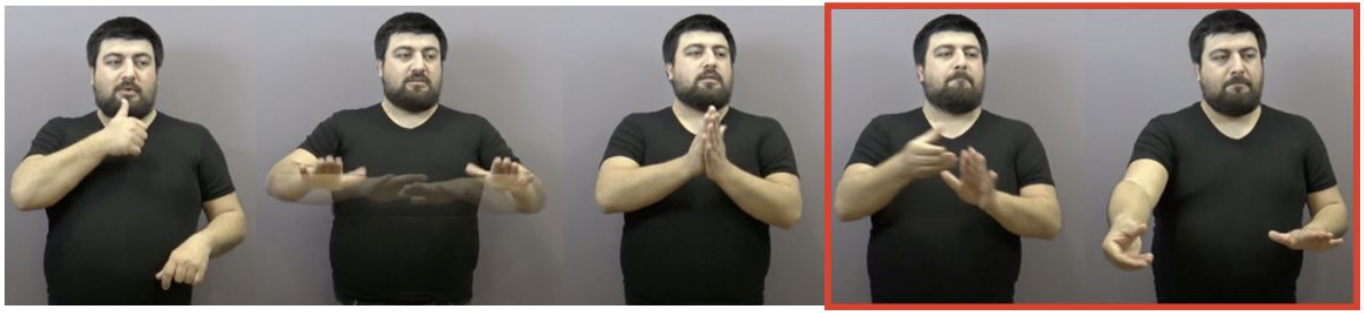
- the physical properties,
- the movement, and/or
- the location of the argument(s)

via a clear iconic mapping. [1]

[1] Davidson 2015; Emmorey and Herzig 2003; Supalla 1986; Schembri 2003; Zucchi 2012; ao.

Classifier constructions in sign languages

6) TİD



H1:	MAN	TABLE	BOOK	$_a$HCL: $_b$
H2:		TABLE	BOOK	

"The man puts the book on the table."

Lexical signs

Signs consist of sublexical elements that are specified in the lexicon.

7) TİD

a. 

“wrong”

b. 

“king”

Lexical signs

These sublexical elements are:

- Handshape
- Location
- Movement
- Palm orientation
- Non-manual markers

Lexical signs vs. classifier constructions

Sublexical elements of lexical signs do not carry inherent meaning:

➢ They function like phonological elements. [1]

Each component of a classifier construction functions not only as a phonological but also as a meaningful element:

➢ yielding a complex internal structure. [2]

8) ASL (From asl-lex.org)

"PENNY"

9) ASL (From lifeprint.com)

"An (upright) entity is moving in this direction"

[1] Brentari et al. 2018.
[2] Schembri 2003; Supalla 1982; ao.

Classifier constructions and argument structure

10) American Sign Language [1]

a.

"The (standing) book fell down on its side."

b.

"S/he took the (standing) book and laid it down on its side."

Alignment between classifier type and argument structure

Clauses with a single internal argument
➔ Whole Entity Classifier (WECL)

Transitive clauses
➔ Handling Classifier (HCL)

Attested across several unrelated sign languages. [2]

[1] Benedicto & Brentari 2004.
[2] Zwitserlood 2003; Benedicto et al. 2007; Kimmelman et al. 2020; Pavlic 2016; ao.

Previous analyses of classifier constructions

Existing formal morphosyntactic analyses:

★ Classifiers as functional heads [1]

★ Agreement [2]

[1] Benedicto & Brentari 2004; ao.
[2] Zwitserlood 2003; ao.

Previous analyses of classifier constructions

Three aspects of existing accounts that I aim to improve based on new data from Turkish Sign Language:

- ➔ They treat classifiers as strictly verbal elements.
- ➔ They predict a single classifier type in transitives (Handling CL - HCL).
- ➔ They have no formal representation of depictive structure.

Classifier constructions in nominal domain

Classifier constructions are not restricted to verbal environments. [1]

11) TİD

"There are babies in the chicken nest."

[1] Bergman & Wallin 2003; Koenders 2024; Kubus 2008 (for TİD); ao.

Two-handed classifier constructions in TİD

Instead of Handling CL (HCL), some transitive structures show the simultaneous use of Body Part CL (BPCL) - Whole Entity CL (WECL). [1]

12) TİD

H1:	CHILD	BOOK	FORWARD.BPCL(✋)
H2:		BOOK	CL:WECL(✊)

"The child kicks the book."

[1] Gökgöz 2024; Sevgi & Gökgöz 2022; ao.

Depiction and structure

Classifier constructions combine linguistic structure with depictive content. [1]

- The handshape component is the conventionalized linguistic unit. [2]
- The movement and location of the hands can closely resemble real-world motion, aligning with gestural patterns. [3]

[1] Emmorey et al. 2002; Emmorey & Herzig 2003; Schembri 2003; Liddell 2003; Wilcox 2004; ao.
[2] Benedicto & Brentari 2004; Davidson 2015; Supalla 1982, 1986; Zwitserlood 2003 ao.
[3] Cogill-Koez 2000; Emmorey & Herzig 2003; Davidson 2015; Liddell 2003, ao.

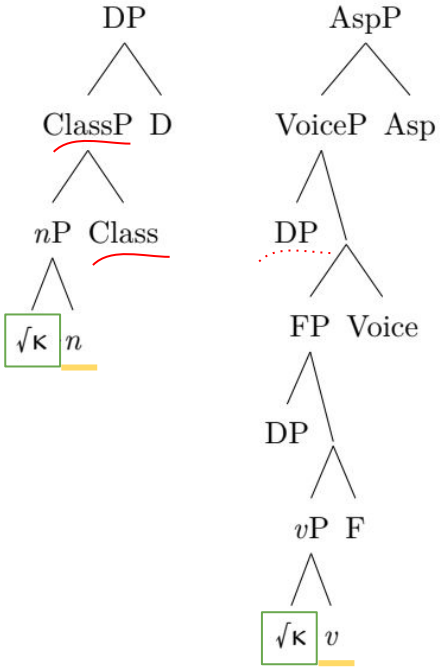
Classifiers in Turkish Sign Language: Proposal

These constructions are built on an underspecified root (√κ) that triggers depictive realization. [1]

This root combines with category-assigning heads (*n*, *v*), resulting in nominal and verbal classifier constructions. [2]

ClassP in the nominal spine introduces referent-based classification features which constrain interpretation and agreement.

Two-handed constructions arise from post-syntactic operations but not due to iconic freedom or articulatory choice. [2]

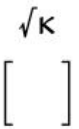


[1] in line with Zwitserlood 2003
[2] Halle & Marantz 1993

One root to build them all

√κ is radically underspecified:

- ➢ no inherent phonology [1]
- ➢ no inherent syntactic category [2]



√κ does not lexically encode meaning.

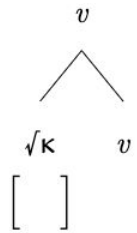
But introduces a requirement:

➔ some part of the structure must be realized depictively.

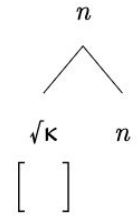
[1] following and refining Zwitserlood 2003
[2] Halle & Marantz 1993; ao.

Acategorial classifier roots in Turkish Sign Language

√κ + v
→ verbal classifier construction
→ licenses eventive path movement

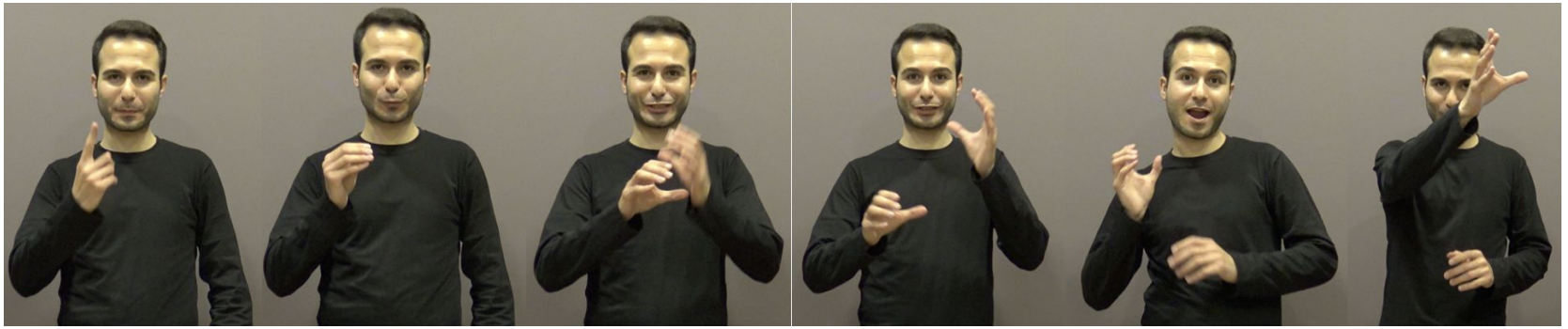


√κ + n
→ nominal classifier construction
→ licenses a depictive movement that maps the spatial contour or surface configuration of the referent



Classifier constructions in verbal domain

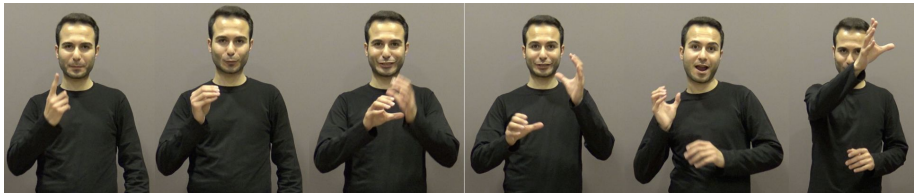
13) TİD



H1: ONE	CHILD	BOTTLE	FORWARD.HCL(🤏)
H2:		BOTTLE	

"The child throws the bottle."

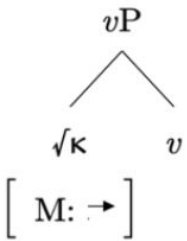
Classifier constructions in verbal domain



H1: ONE CHILD BOTTLE FORWARD.HCL(🤏)

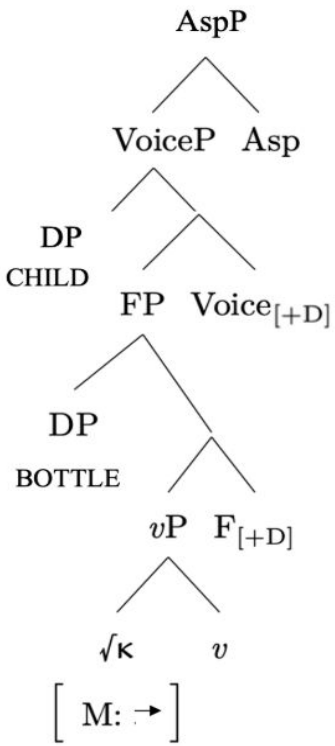
H2: BOTTLE

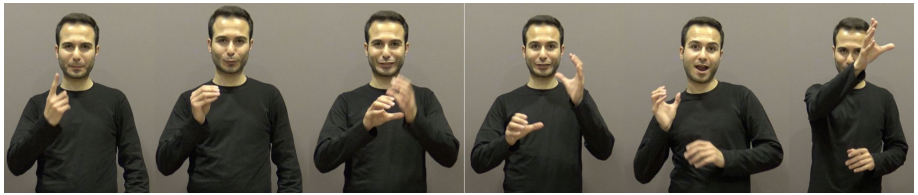
"The child throws the bottle."



Category-assigning heads constrain the depictive content

Classifier constructions in verbal domain





H1: ONE CHILD BOTTLE FORWARD.HCL(🔍)

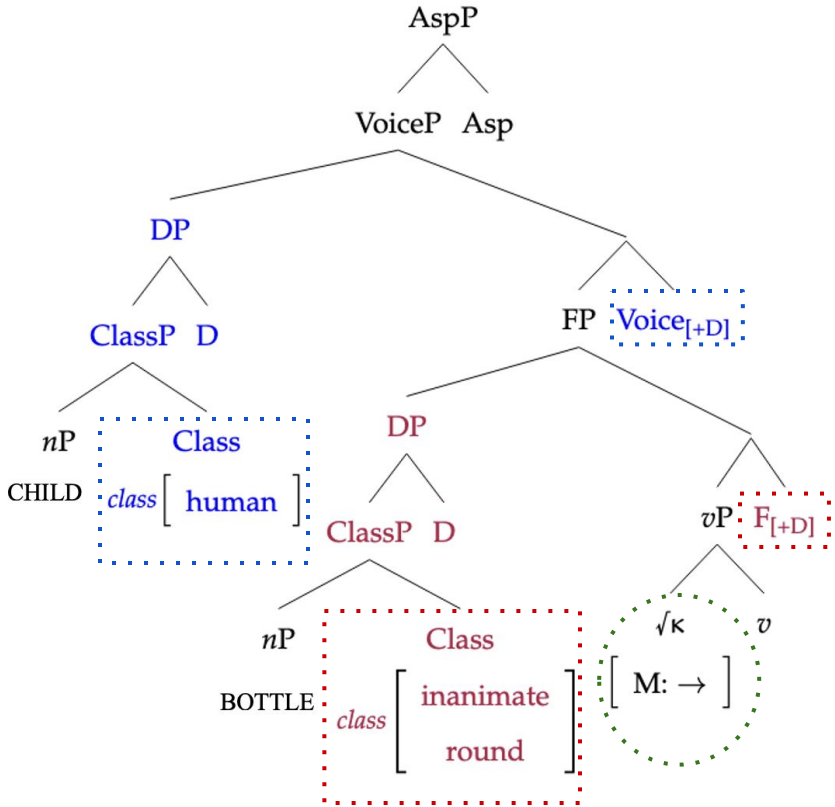
H2: BOTTLE

"The child throws the bottle."

Functional heads introduce the internal and external arguments [1]

[1] Borer 2005; Ahn 2016, 2022; ao.

Classifier constructions in verbal domain



Movement and location information:

as a depiction of the path motion in the event

Handshape information:

through a specifier-head agreement relationship between the functional head and the argument in its specifier position [1]

[1] Following Benedicto & Brentari 2004.

Why handling classifiers?

Dominant hand = primary insertion site

- Argument-introducing heads need to be realized together.

But how?

Building the construction post-syntactically

Morphological merger groups the argument-introducing heads. [1]

Morphological merger of argument-introducing heads:

[[√κ v] [F Voice]]

[1] Bobaljik 2002; Embick & Noyer 2001; Marantz 1989; ao.

Building the construction post-syntactically

Fusion creates a single insertion site for a single exponent. [1]

[[√κ v] [F/Voice]]

H1: FORWARD.HCL:

What about two-handed constructions?

[1] Halle & Marantz 1993; Bobaljik 2017; ao.

Two-handed classifier constructions

14) TİD

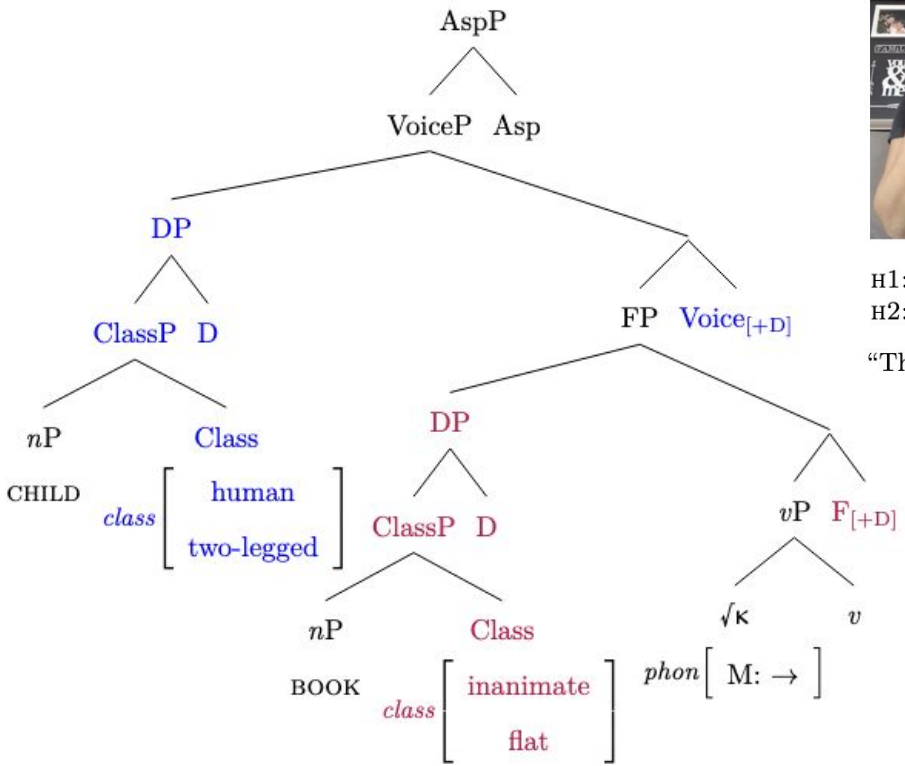
H1:	CHILD	BOOK	FORWARD.BPCL()
H2:		BOOK	CL:WECL()

"The child kicks the book."

Internal argument

External argument

Two-handedness as a morphological repair



H1: CHILD BOOK FORWARD.BPCL(🤌)
H2: BOOK CL:WECL(🤌)

"The child kicks the book."

Two-handedness as a morphological repair

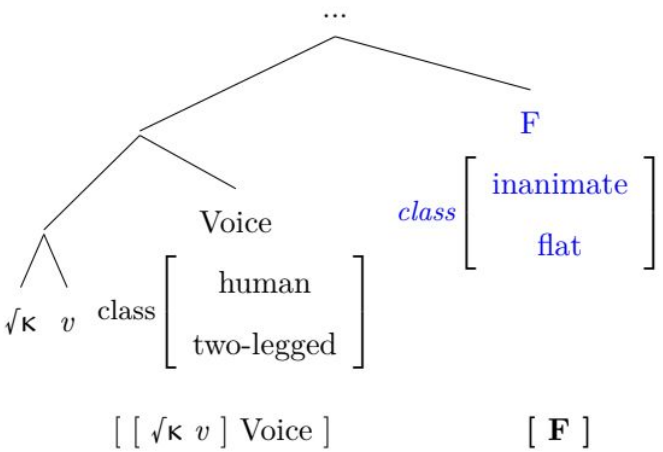
Dominant hand = primary insertion site

- Argument-introducing heads need to be realized together.
- If an exponent with the features of both heads is available:
  - Handling CL (HCL)
- If not, a repair mechanism takes place.

Two-handedness as a morphological repair

- Object-related features are dislocated to a higher node.
- As a result, they are realized on the non-dominant hand simultaneously.

Dislocation of features [1]

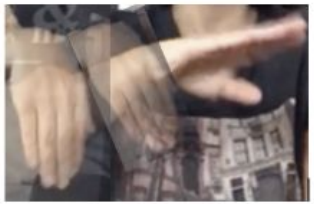


[1] Embick and Noyer 2001; ao.

Two-handedness as a morphological repair

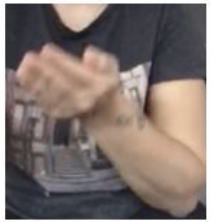
[[√κ v] Voice]

H1: FORWARD.BPCL:



[**F**]

H2: WECL:



What this proposal brings

Integrates depiction into the grammar via the underspecified root ($\sqrt{\kappa}$)

★ *depictive content is licensed within morphosyntax*

Provides a uniform explanation for the distribution across verbal and nominal domains

★ *depictive content is constrained by the syntactic category*

Derives two-handed constructions structurally

★ *they are not due to modality-specific reasons or free iconicity*

Dissertation roadmap

Event representation in a sign language with iconicity (Chapter 2)

- Turkish Sign Language (classifier constructions)

Event components across modalities (Chapter 3)

- English (written language and co-speech gesture)

Event modification in a spoken language with iconicity (Chapter 4)

- Turkish (lexical adverbials and ideophones)

Event Components across Modalities

Path and manner

Path and manner are distinct parts of motion events. [1]

- Path → trajectory of motion
- Manner → how the motion unfolds

15) The bottle floated out.

Path constitutes the core schema of a motion event. [1]

[1] Talmy 1985, 2000.

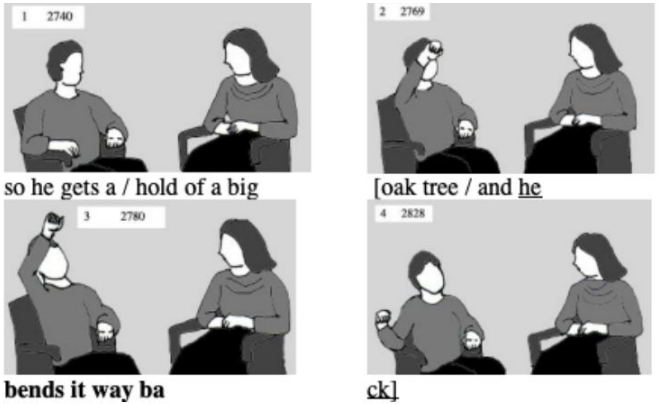
Path and manner

Languages lexicalize these conceptually distinct components differently. [1]

15) The bottle floated out.

16) La botella salió flotando.
The bottle exited floating.

This difference is reflected in gesture production. [2]



Taken from McNeill n.d.

Speech and gesture are tightly coordinated in expressing motion events.

[1] Talmy 1985, 2000.
[2] Kita & Özyürek 2003.

Gesture and negation

Gesture is often degraded or suppressed under negation.

Two existing approaches:

- Scope / projection [1]

  Gestural content may escape negation or remain weakly integrated.

- Depiction vs. description [2]

  Difficulties under negation may reflect depictive content more generally, not gesture alone.

[1] Ebert & Ebert 2016; Schlenker 2018; ao.
[2] Davidson 2023.

Path and manner in written English and co-speech gesture

The path-manner distinction
The relation between speech and gesture
The interaction between gesture and negation

How do path and manner pattern across modalities?

Three acceptability-judgment tasks on written English (2) and co-speech gesture (1)

Same logic, different modalities

Written English task

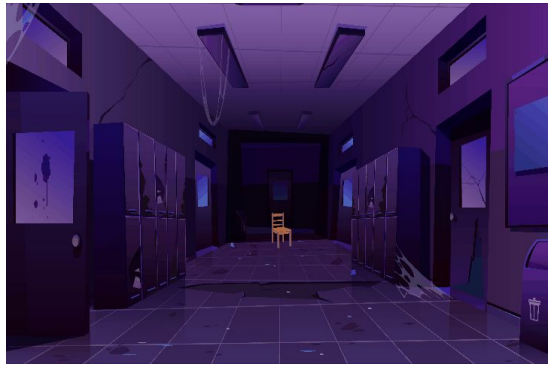
"The chair is not moving in a forward direction in a circular pattern."

150 participants recruited on Prolific

"The chair is not moving in a circular pattern in a forward direction."

120 participants recruited on Prolific

Variables:
Modifier/Gesture Type (Path/Manner/Path+Manner),
Event Type (Path/Manner/Path+Manner),
Polarity (Affirmative/Negative)



Extremely unlikely

Extremely likely

Co-speech gesture task

gesture

"The chair is not moving."

150 participants recruited on Prolific

Path and manner asymmetries

- Written language shows a robust path–manner asymmetry. (Experiment I)
  - Path mismatches are penalized more strongly than manner mismatches.
- This asymmetry is stable across word-order manipulations. (Experiment II)
  - It is not an artifact of sentence-final prominence or linear order.
- A similar asymmetry is present in co-speech gestures in affirmative contexts. (Experiment III)

Language and gesture under negation

- The asymmetry extends to negation in written language, though in a weaker form.
- But this asymmetry is not preserved under negation in the gesture domain. Moreover, gesture effects largely disappear under negation. [1]

[1] In line with previous literature (cf. Davidson 2023; Ebert & Ebert 2016; Schlenker 2018; ao.)

What these findings show

- ★ Semantic class matters:
  - Path and manner provide different interpretive profiles in affirmative contexts across modalities.
- ★ Under negation, this asymmetry is present in written language while gestures do not reliably support the same contrastive interpretation.

Does semantic class of a modifier play a role in this asymmetry?

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Event Modification in a Spoken Language

Event modifiers in Turkish

How do manner and time contribute to meaning in alternative-sensitive contexts?

Turkish as a case study

- Turkish is an SOV language with scrambling.
- Word order is closely associated with information structure
  - Immediate preverbal position is a default focus position [1]

[1] Erguvanlı-Taylan 1984; Kurt & Dinçtopal Deniz 2023.

Turkish as a case study

➢ Negation interacts with focus structure and alternative sets [1]

17) Turkish

a) Ayşe elmayı yemedi.
“It was not the apple that Ayşe ate.”

b) Elmayı Ayşe yemedi.
“It was not Ayşe that ate the apple.”

[1] Fălăuş 2020; ao.

Turkish as a case study

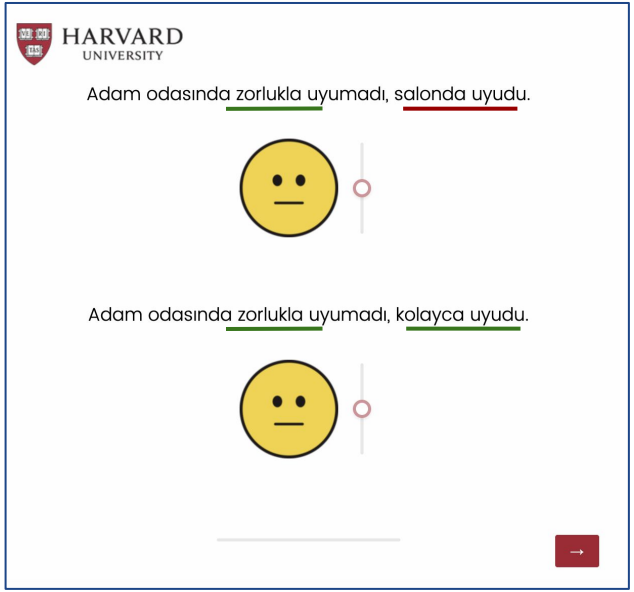
Two acceptability-judgment experiments using a biclausal continuation task in contrastive contexts

A monoclausal acceptability-judgment experiment testing adverbials under negation

Adverbials in alternative-sensitive contexts

Target clause:
Adam odasında zorlukla uyumadı
“The man did not sleep in his room with difficulty,...”

Match continuation	Mismatch continuation
“He slept easily.”	“He slept in the living room.”



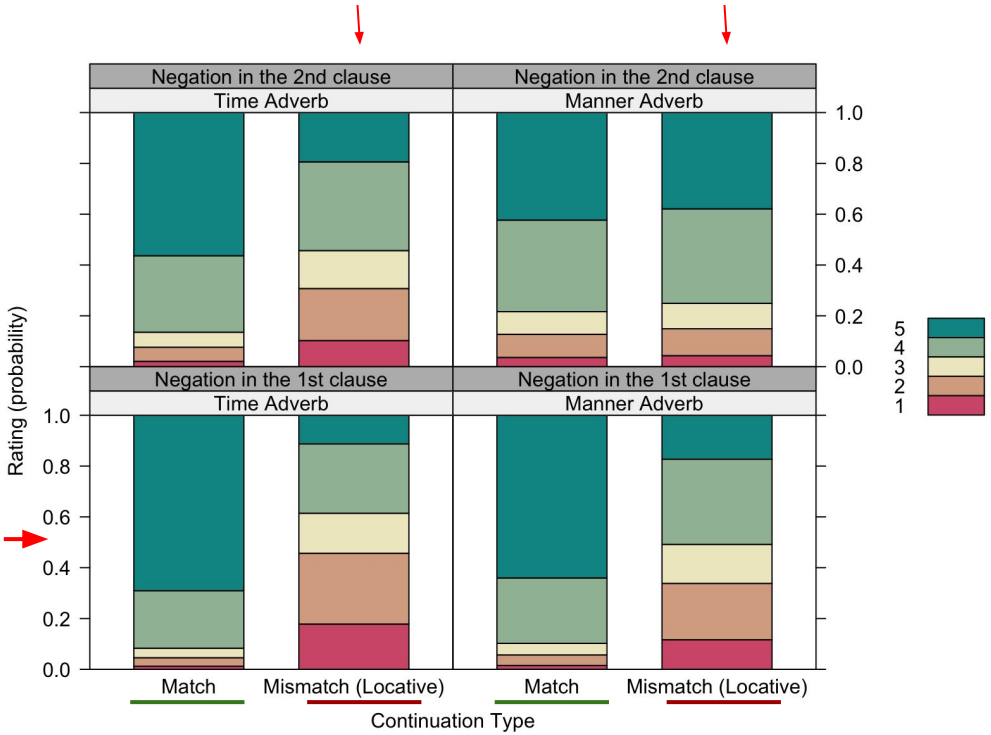
Variables:
Adverb type (Time/Manner),
Continuation type (Match/Mismatch),
Negation Position (First/Second clause)

60 participants recruited on besample

Manner and time do not behave identically

- Time adverbials incur a significantly stronger mismatch penalty than manner adverbials ($p < 0.01$).

Time alternatives impose stricter matching requirements than manner alternatives.



➔ Could word order, and therefore focus, be affecting the results?

Word order and focus

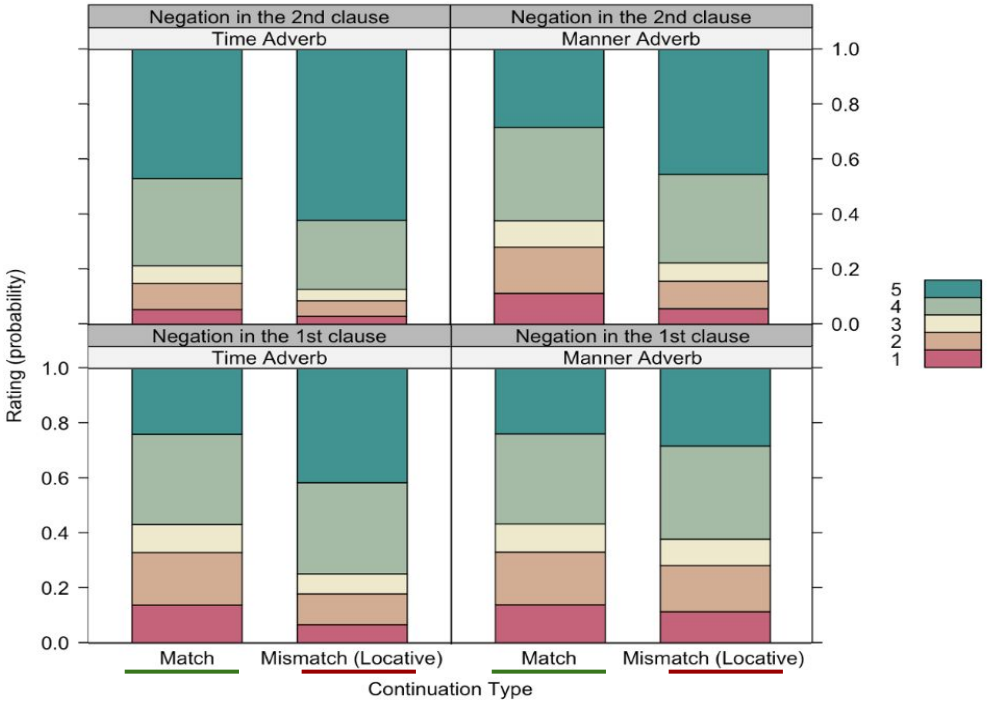
Experiment I	Experiment II
Target adverb immediately preverbal	Target adverb no longer immediately preverbal
“Adam odasında güçlükle uyumadı,...”	“Adam güçlükle odasında uyumadı,...”
“The man did not sleep in his room with difficulty,...”	“The man did not sleep with difficulty in his room,...”

Match continuation	Mismatch continuation
“He slept easily.”	“He slept in the living room.”

60 participants recruited on besample

Focus modulates the pattern but does not eliminate it

- Moving the target adverb changes the strength of mismatch effects.
- But the semantic class contrast remains part of the explanation.



So far in Experiment I and II

Manner and time do not pattern alike in alternative-sensitive contexts.

- Time adverbials show a stronger mismatch penalty.
- Manner adverbials allow more flexible continuations.

Constituent order and focus structure modulate the judgments.

- But the broader asymmetry remains → Semantic class matters.

Do we see the effect of semantic class when the modifier is iconic?

Ideophones to test iconicity in a spoken language

Manner can be expressed through ideophones. [1]

Ideophones

perceptually grounded expressions that iconically depict sensory experiences [2]

18) Turkish [3]
Kuş ***pır pır*** uçtu.
"The bird flew away fluttering."

How do the ideophones behave in alternative-sensitive contexts?

Back to Experiment I and II

[1] Slobin 2006.
[2] Dingemanse 2012, Kita 1997; ao.
[3] Jendraschek 2001.

Ideophones to test iconicity in a spoken language

Adam odasında horul horul uyumadı

“The man did not sleep in his room huffing and puffing,...”

Match continuation	Mismatch continuation
“He slept silently.”	“He slept in the living room.”

- Ideophones did not diverge from manner adverbials with respect to acceptability.

Judgments were influenced primarily by the semantic properties of the adverbial rather than by the depictive or iconic qualities in the given experimental design

Ideophones and negation

Ideophones are typically resistant to negation [1] due to their expressiveness [2]

The degree of morphosyntactic integration conditions compatibility with negation. [3]

- In more independent constructions, ideophones are typically not negated.
- In more integrated constructions, they can occur under negation.

Does morphosyntactic integration systematically predict how ideophones pattern under negation in Turkish?

[1] Barnes et al. 2022; Dingemanse 2017; Newman 1968; Kita 1997; ao.
[2] Kilian-Hatz 2006.
[3] Dingemanse 2017.

Adverbials under negation in simple clauses

Su ocakta ADVERB kaynamadı.
water.NOM stove-LOC ADVERB boil-NEG-PST.3SG
“The water did not boil on the stove ADVERB.”

Variables:
Polarity (Affirmative/Negative)
ADVERB Type

Time Adverb:	hemen	“immediately”
Lexical Manner Adverb:	yavaşça	“slowly”
More integrated ideophone:	fokurdayarak	“bubbling”
Less integrated ideophone:	fokur fokur	“with a bubbling sound”

Adverbials under negation in simple clauses

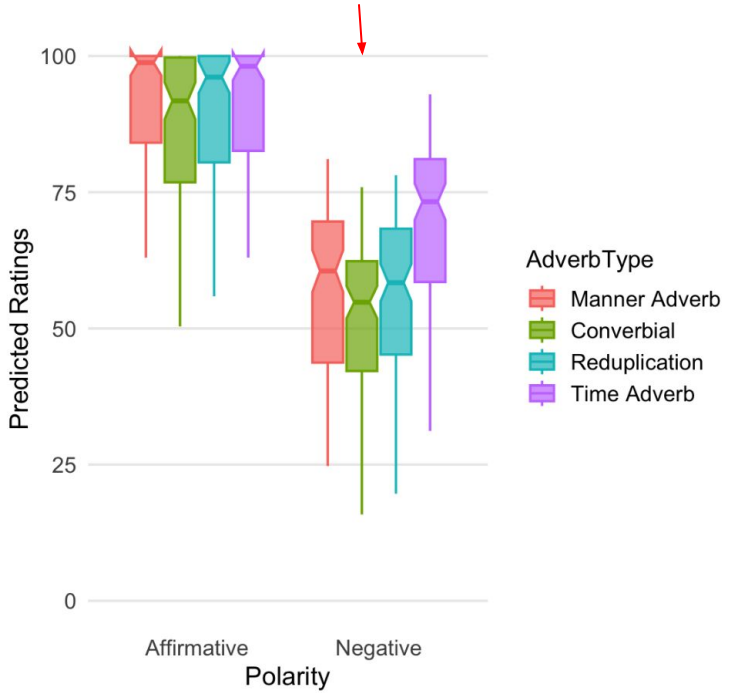
HARVARD UNIVERSITY

Su, ocakta fokur fokur kaynadı.

Hiç doğal değil! Oldukça doğal!

120 participants recruited on besample

Adverbials under negation in simple clauses



- Under negation, manner-related expressions form a semantic class with a distinct profile.
- The relevant distinction is semantic: Time versus Manner

ADVERB

Lexical Manner:	yavaşça	“slowly”
Converbial:	fokurdayarak	“bubbling”
Reduplication:	fokur fokur	“with a bubbling sound”
Time Adverb:	hemen	“immediately”

What these findings show

Manner-related expressions form a semantic class with a distinct profile in negative and contrastive contexts in Turkish.

➔ Reduced acceptability under negation tracks manner.

Event modifiers are not a uniform class

Event modifiers are not interpretively uniform under alternative-sensitive contexts.

This asymmetry is not reducible to:

- Depiction
- Morphosyntax

But to the semantic class → **Manner**

Event modifiers are not a uniform class: Potential approach

Different event modifiers interact with alternatives in different ways.

Time/path	→	More structured, restricted
Manner	→	More flexible, multidimensional

Alternative structure depends on:

- semantic class
- not just focus

Bringing each piece together

Event representation in a sign language with iconicity (Chapter 2)

- ❖ a morphosyntactic account of event representation in TİD classifier constructions
  - ➢ Depiction can be grammatically integrated

Event components across modalities (Chapter 3)

- ❖ a cross-modal comparison of path and manner
  - ➢ Linguistic modifier interpretation differs from that of co-speech gestures under negation

Event modification in a spoken language with iconicity (Chapter 4)

- ❖ a within-language investigation showing the importance of semantic class
  - ➢ Manner as a semantic class differs from other modifiers.

Bringing each piece together

Event-related modifiers vary in interpretation;
manner is a distinct dimension, and
linguistic modifiers in sign and spoken languages differs from co-speech gestures under negation.

My deepest thanks to…

Kathryn Davidson

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Mind Brain Behavior

Meaning & Modality Linguistics Laboratory

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Appendix: More on Properties of Classifier Constructions

11) American Sign Language [1]

a. MONEY BE_LOCATED.CL: 

"The coin is located [on the table]."

b. MONEY BE_LOCATED.CL: 

"The banknote is located [on the table]."

c. MONEY BE_LOCATED.CL: 

"A pile of coins is located [on the table]."

Different classifier handshapes for the same noun depending on the context/referent

[1] Supalla 1982.

Appendix: Acategorial classifier roots in Turkish Sign Language

Independent evidence from noun-verb pairs in lexical sign

8) ASL [1]

“TO-SIT”

“CHAIR”

[1] Abner 2021 [p. 214]

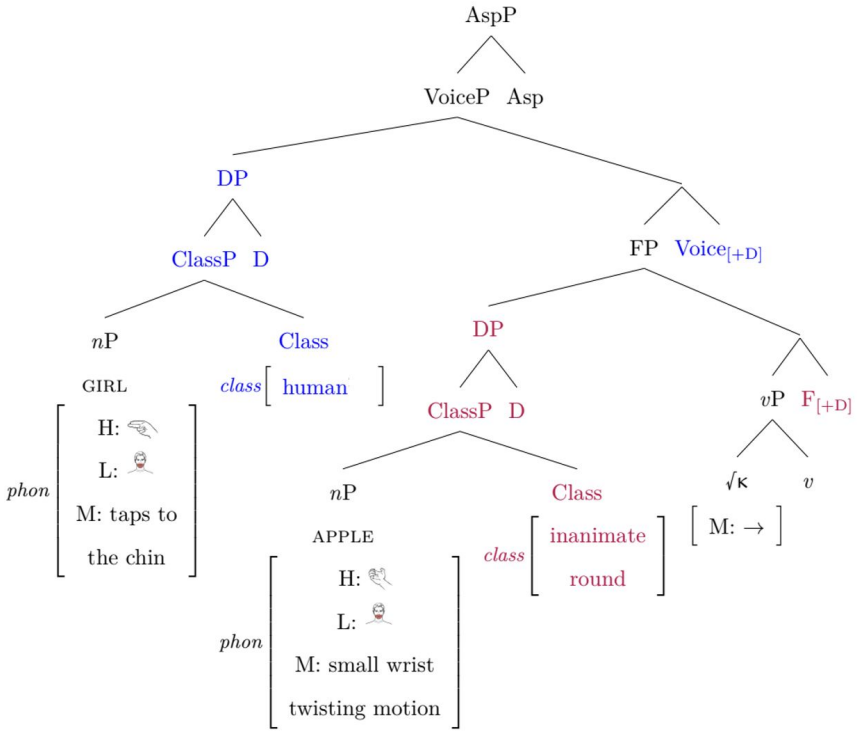
Appendix: Derivations in Chapter 2

I.

Transitive clause with HCL

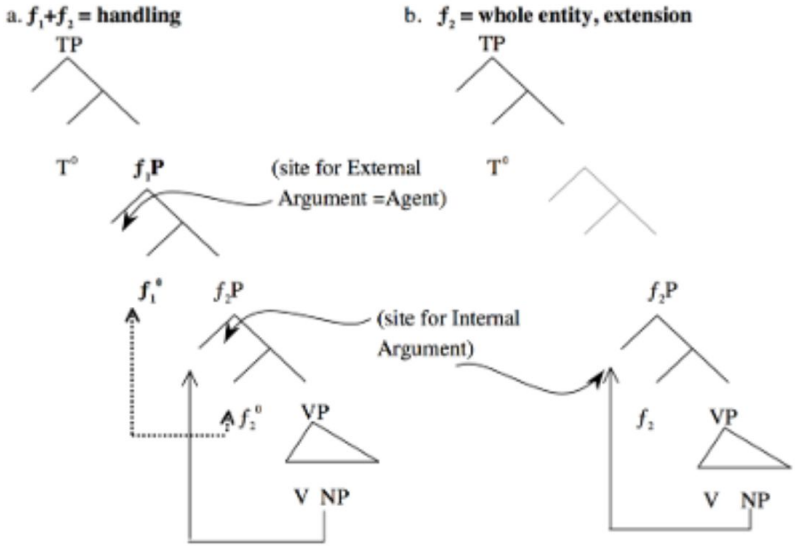
H1: GIRL APPLE FORWARD.HCL(🐓)

"The girl throws the apple."



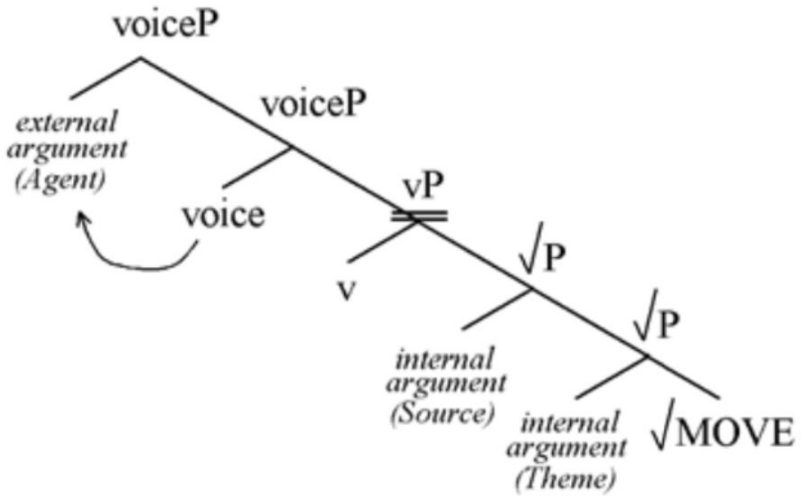
* TİD data comes from 8 native Deaf TİD signers residing in İstanbul (M_{age} = 27.6).

Appendix: Proposal of Benedicto and Brentari (2004) - Chapter 2



Classifier type	Argument encoded	Via
BPCL	AGENT	Higher functional head (*f1*)
WECL	THEME	Lower functional head (*f2*)
HCL	AGENT | THEME	Two functional heads (*f1* and *f2*)

Appendix: Proposal of Zwitserlood (2003) - Chapter 2



Appendix: Derivations in Chapter 2

Transitive clause with HCL

H1: GIRL APPLE FORWARD.HCL(🤜)

"The girl throws the apple."

II. [[[√κ *v*] F] Voice]

III. Morphological merger of argument-introducing heads:

[[√κ v] [F Voice]]

IV. Fusion of argument-introducing heads:

[[√κ v] [F/Voice]]

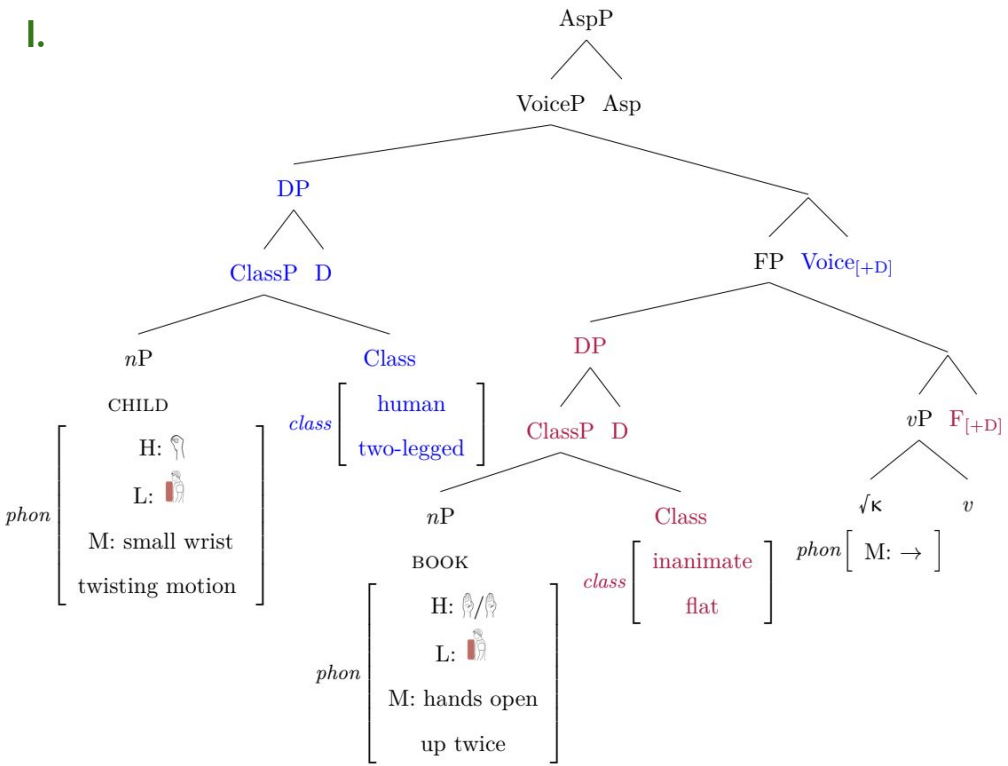
H1: FORWARD.HCL:🤜

Appendix: Derivations in Chapter 2

Transitive clause with BPCL-WECL

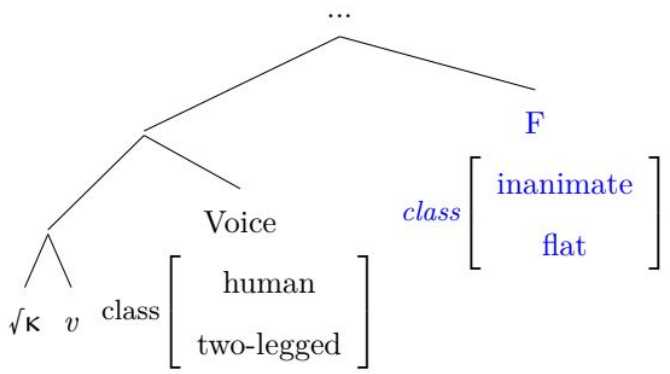
H1: CHILD BOOK FORWARD.BPCL()
H2: BOOK CL:WECL()
"The child kicks the book."

I.



Appendix: Derivations in Chapter 2

IV. Dislocation of features

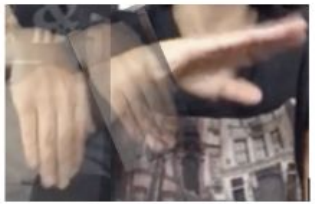


Transitive clause with BPCL-WECL

H1: CHILD BOOK FORWARD.BPCL(🤌)
H2: BOOK CL:WECL(🤌)
"The child kicks the book."

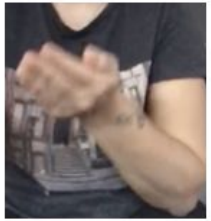
[[√κ v] Voice]

H1: FORWARD.BPCL:🤌



[F]

H2: WECL:🤌

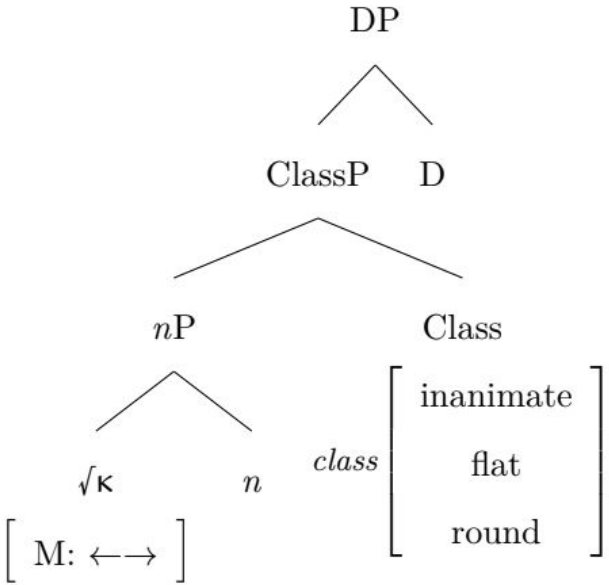


Appendix: Derivations in Chapter 2

Nominal domain

H1:	CHICKEN	CL:	BABY	EXIST	IX
H2:	CHICKEN	CL:			

"There are babies in the chicken nest."

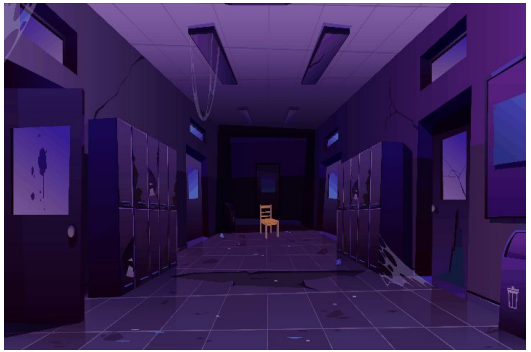


Appendix: Chapter 2

Classifier handshapes attested in Turkish Sign Language

Role	Handshape	Referent	Classifier type
Theme		Long-thin entities; human being	WECL
		Two-legged entities; human beings	WECL[2]
		Honorific human being; bottle; drinks	WECL
		Animals	WECL
		Trees; plural humans	WECL
		Flat entities (e.g. book); vehicles	WECL
		Airplanes	WECL
		Cylindrical entities	WECL
		Small spherical entities	WECL
		Round entities (e.g. apple, ball, etc.)	WECL
		Round flat entities (e.g. plate, CD, etc.)	WECL
		Piles	WECL
Agent		Two-legged entities; humans	BPCL
		Two-legged entities; humans	BPCL
		Limp (e.g. foot, tongue)	BPCL
		Body part (e.g. head)	BPCL
Agent + Theme		Handling of small round objects	HCL
		Handling of round objects (e.g. bottle, apple)	HCL
		Handling of objects (e.g. bag, baggage) and vehicles	HCL
		Handling of flat objects (e.g. book)	HCL

Appendix: Sample GIF Stimuli Used in Experiments 1–3 in Chapter 3



Conflated Event
(Path + Manner)

Path Event

Manner Event

Appendix: Sample Stimuli Used in Experiments 1–3 in Chapter 3

Subject-Verb Pair	Path Information	Manner Information
fall – leaf	in a downward direction	in a circular pattern
float – plank	in a backward direction	in a curving pattern
fly – paper	in an upward direction	in a circular pattern
go – car	in a forward direction	in a zigzagging pattern
move – chair	in a forward direction	in a circular pattern

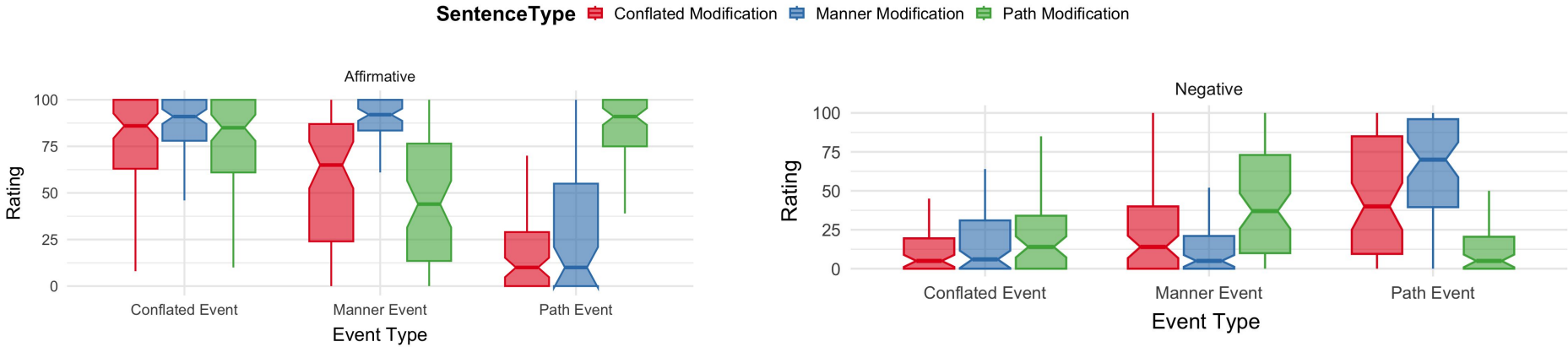
Appendix: Sample stimulus from Experiment I in Chapter 3

The chair is not moving in a forward direction in a circular pattern.

Extremely unlikely

Extremely likely

Appendix: Results of Experiment I in Chapter 3



* A total of 150 participants were recruited via Prolific, with 140 included in the final analysis.

Appendix: Results of glmm for Experiment I in Chapter 3

	Estimate	Standard Error	z value	p value
Intercept	1.08	0.17	6.30	<0.001
Path Modification	-0.05	0.19	-0.27	0.8
Manner Modification	0.32	0.19	1.65	0.1
Path Event	-2.52	0.21	-11.61	<0.001
Manner Event	-0.71	0.23	-3.05	0.002
Path Modification:Path Event	2.77	0.29	9.54	<0.001
Manner Modification:Path Event	0.002	0.30	0.01	0.99
Path Modification:Manner Event	-0.71	0.29	-2.40	0.016
Manner Modification:Manner Event	0.70	0.29	2.36	0.018

Results of beta regression model with a logit link for affirmative polarity

Results of beta regression model with a logit link for affirmative polarity

	Estimate	Standard Error	z value	p value
Intercept	-1.02	0.17	-5.93	<0.001
Path Modification	0.17	0.22	0.76	0.4
Manner Modification	-0.08	0.22	-0.36	0.7
Path Event	0.69	0.23	3.01	0.003
Manner Event	0.26	0.22	1.18	0.2
Path Modification:Path Event	-0.98	0.32	-3.05	0.002
Manner Modification:Path Event	1.10	0.32	3.34	<0.001
Path Modification:Manner Event	0.15	0.30	0.50	0.6
Manner Modification:Manner Event	-0.42	0.30	-1.42	0.15

Appendix: Results of glmm for Experiment II in Chapter 3

Coefficients	Estimate	Standard Error	z value	p value
Intercept	0.81	0.18	4.51	<0.001
Path Modification	-0.11	0.22	-0.50	0.6
Manner Modification	0.28	0.21	1.29	0.2
Path Event	-2.19	0.23	-9.40	<0.001
Manner Event	-0.59	0.26	-2.24	0.02
Path Modification:Path Event	2.87	0.32	8.76	<0.001
Manner Modification:Path Event	0.05	0.33	0.16	0.8
Path Modification:Manner Event	-0.31	0.33	-0.93	0.3
Manner Modification:Manner Event	0.98	0.32	3.00	<0.01

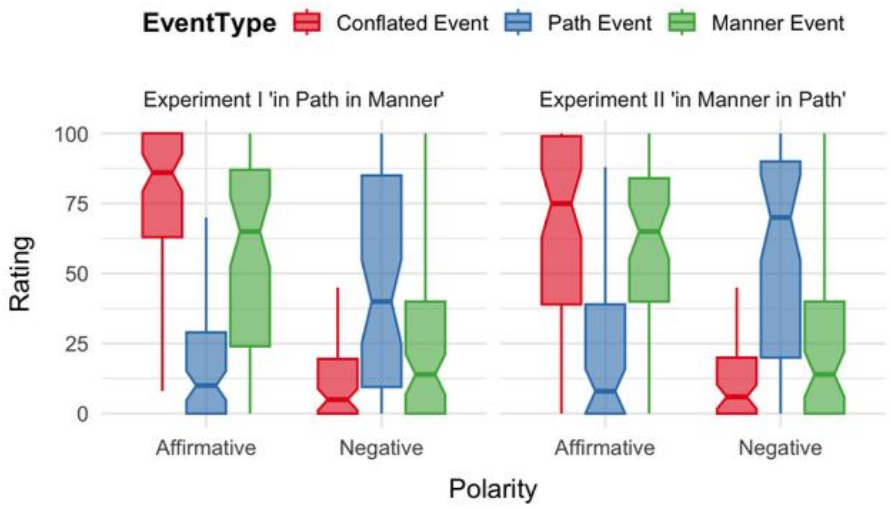
Results of beta regression model with a logit link for affirmative polarity

Results of beta regression model with a logit link for negative polarity

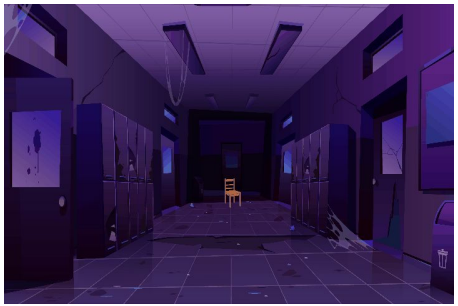
Coefficients	Estimate	Standard Error	z value	p value
Intercept	-1.23	0.18	-6.51	<0.001
Path Modification	0.34	0.23	1.42	0.2
Manner Modification	0.05	0.25	0.20	0.8
Path Event	1.51	0.25	6.03	<0.001
Manner Event	0.32	0.25	1.28	0.2
Path Modification:Path Event	-1.98	0.34	-5.69	<0.001
Manner Modification:Path Event	0.39	0.35	1.11	0.3
Path Modification:Manner Event	0.65	0.33	1.97	0.04
Manner Modification:Manner Event	-0.49	0.33	-1.46	0.1

* A total of 120 participants were recruited via Prolific, with 114 included in the final analysis.

Appendix: Comparison of the results of Experiment I and II in Chapter 3



Appendix: Sample stimulus from Experiment III in Chapter 3



Extremely unlikely

Extremely likely

Appendix: Results of glmm for Experiment III in Chapter 3

	Estimate	Standard Error	z value	p value
Intercept	1.72	0.15	11.90	<0.001
Path Gesture	-0.09	0.06	-1.49	0.13
Manner Gesture	0.30	0.07	4.32	<0.001
Path Event	-0.09	0.06	-1.45	0.14
Manner Event	0.03	0.10	0.26	0.8
Path Gesture:Path Event	0.29	0.09	2.95	<0.01
Manner Gesture:Path Event	-0.0002	0.11	-0.002	1
Path Gesture:Manner Event	-0.24	0.09	-2.70	<0.01
Manner Gesture:Manner Event	-0.01	0.09	-0.96	0.9

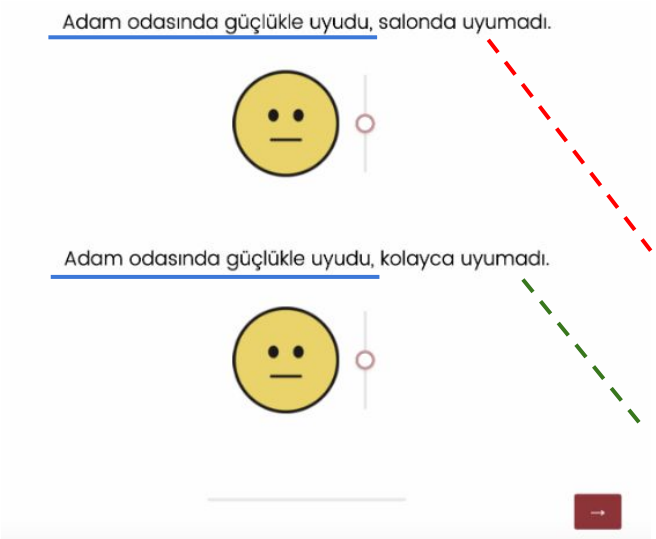
Results of beta regression model with a logit link for
negative polarity

Results of beta regression model with a logit link for
affirmative polarity

	Estimate	Standard Error	z value	p value
Intercept	-1.88	0.08	-21.80	<0.001
Path Gesture	-0.11	0.06	-1.66	0.1
Manner Gesture	-0.02	0.06	-0.29	0.8
Path Event	-0.09	0.06	-1.42	0.15
Manner Event	0.06	0.07	0.88	0.4
Path Gesture:Path Event	0.01	0.09	0.12	0.9
Manner Gesture:Path Event	-0.002	0.09	-0.03	0.9
Path Gesture:Manner Event	0.09	0.09	1.03	0.3
Manner Gesture:Manner Event	-0.07	0.09	-0.76	0.4

* A total of 150 participants were recruited via Prolific, with 142 included in the final analysis.

Appendix: Sample Stimulus of Experiment I in Chapter 4



Target adverbial = Manner
Negation = In the second clause

The man slept in his room with difficulty, ….

Mismatch Condition
"..., (he) did not sleep in the living room."

Match Condition
"..., (he) did not sleep easily."

Appendix: Stimulus Used in Experiment I in Chapter 4

	First Clause	Continuation with *Target* Adverbial	Continuation with Locative Adverbial
Negation in continuation	Adam odasında ***horul horul*** uyudu	sessizce uyumadı	salonda uyumadı
	The man slept in his room ***huffing and puffing***	he did not sleep silently	he did not sleep in the living room
	Adam odasında ***güçlükle*** uyudu	kolayca uyumadı	salonda uyumadı
	The man slept in his room ***with difficulty***	he did not sleep easily	he did not sleep in the living room
	Adam odasında ***sabah*** uyudu	gece uyumadı	salonda uyumadı
	The man slept in his room ***in the morning***	he did not sleep at night	he did not sleep in the living room
	At arabası toprak yolda ***tıngır tıngır*** ilerledi	sessizce ilerlemedi	asfalt yolda ilerlemedi
	The horse cart moved on the earth road ***rattling***	it did not move silently	it did not move on the paved road
	At arabası toprak yolda ***hızla*** ilerledi	yavaşça ilerlemedi	asfalt yolda ilerlemedi
	The horse cart moved on the earth road ***fast***	it did not move slowly	it did not move on the paved road
	At arabası toprak yolda ***akşam vakti*** ilerledi	gündüz ilerlemedi	asfalt yolda ilerlemedi
	The horse cart moved on the earth road ***in the evening***	it did not move in the daytime	it did not move on the paved road
	Su ocakta ***fokur fokur*** kaynadı	sessizce kaynamadı	sobada kaynamadı
	The water boiled on the stove ***bubbling***	it did not boil silently	it did not boil on the burner
	Su ocakta ***çabucak*** kaynadı	yavaşça kaynamadı	sobada kaynamadı
	The water boiled on the stove ***quickly***	it did not boil slowly	it did not boil on the burner
	Su ocakta ***biraz önce*** kaynadı	şimdi kaynamadı	sobada kaynamadı
	The water boiled on the stove ***a little while ago***	it did not boil now	it did not boil on the burner
	Oğlan okulda ***zırıl zırıl*** ağladı	sessizce ağlamadı	evde ağlamadı
	The boy cried in the school ***sobbing***	he did not cry silently	he did not cry at home
	Oğlan okulda ***sessizce*** ağladı	yüksek sesle ağlamadı	evde ağlamadı
	The boy cried in the school ***silently***	he did not cry loudly	he did not cry at home
	Oğlan okulda ***dün*** ağladı	bugün ağlamadı	evde ağlamadı
	The boy cried in the school ***yesterday***	he did not cry today	he did not cry at home
	Öğrenci sınıfta ***fısır fısır*** konuştu	yüksek sesle konuşmadı	kantinde konuşmadı
	The student talked in the classroom ***murmuring***	she did not talk loudly	she did not talk in the cafeteria
	Öğrenci sınıfta ***sessizce*** konuştu	yüksek sesle konuşmadı	kantinde konuşmadı
	The student talked in the classroom ***silently***	she did not talk loudly	she did not talk in the cafeteria
	Öğrenci sınıfta ***dersten önce*** konuştu	ders sırasında konuşmadı	kantinde konuşmadı
	The student talked in the classroom ***before the lecture***	she did not talk during the lecture	she did not talk in the cafeteria
	Tekne denizin ortasında ***cayır cayır*** yandı	hafifçe yanmadı	limanda yanmadı
	The boat burned in the middle of the sea ***fiercely***	it did not burn lightly	it did not burn in the port
	Tekne denizin ortasında ***aniden*** yandı	yavaşça yanmadı	limanda yanmadı
	The boat burned in the middle of the sea ***suddenly***	it did not burn slowly	it did not burn in the port
	Tekne denizin ortasında ***iki gün önce*** yandı	dün yanmadı	limanda yanmadı
	The boat burned in the middle of the sea ***two days ago***	it did not burn yesterday	it did not burn in the port

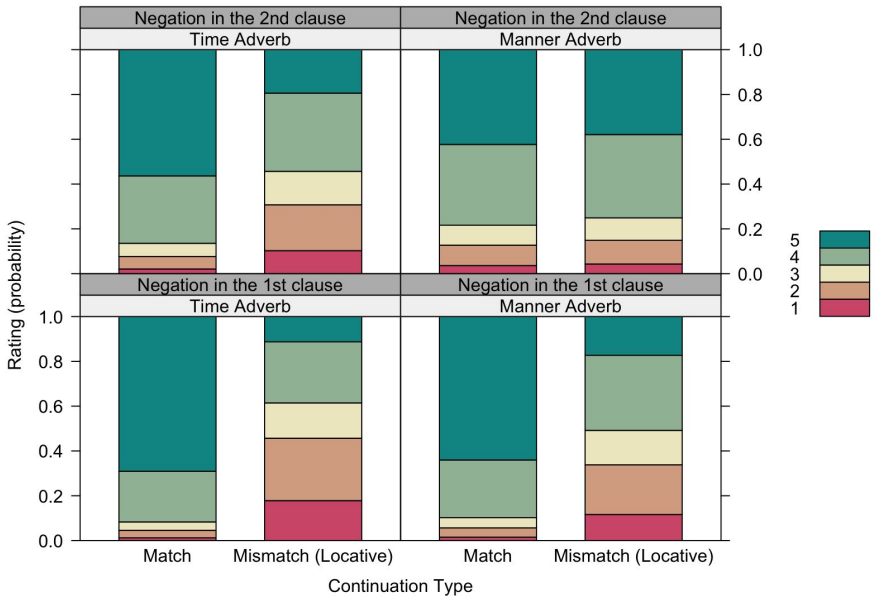
Appendix: Results of clmm for Experiment I in Chapter 4

Results of ordinal mixed-effects model, cumulative link mixed model (clmm)
Time vs. Manner vs. **Ideophone**

Coefficients	Estimate	Standard Error	z value	p value
Continuation Type	0.60	0.08	7.23	<0.001
AdverbType1	-0.14	0.11	-1.20	0.23
AdverbType2	0.07	0.12	0.60	0.55
Negation Position	0.09	0.08	1.14	0.25
Continuation Type:AdverbType1	0.47	0.11	4.12	<0.001
Continuation Type:AdverbType2	-0.05	0.11	-0.45	0.65
Continuation Type:Negation Position	-0.37	0.08	-4.5	<0.001
AdverbType1:Negation Position	-0.07	0.11	-0.58	0.55
AdverbType2:Negation Position	-0.01	0.11	-0.08	0.93
Continuation Type:AdverbType1:Negation Position	0.09	0.11	0.84	0.4
Continuation Type:AdverbType2:Negation Position	-0.08	0.11	-0.73	0.46

* A total of 60 participants were recruited via besample, with 50 included in the final analysis.

Appendix: Results of clmm for Experiment I in Chapter 4



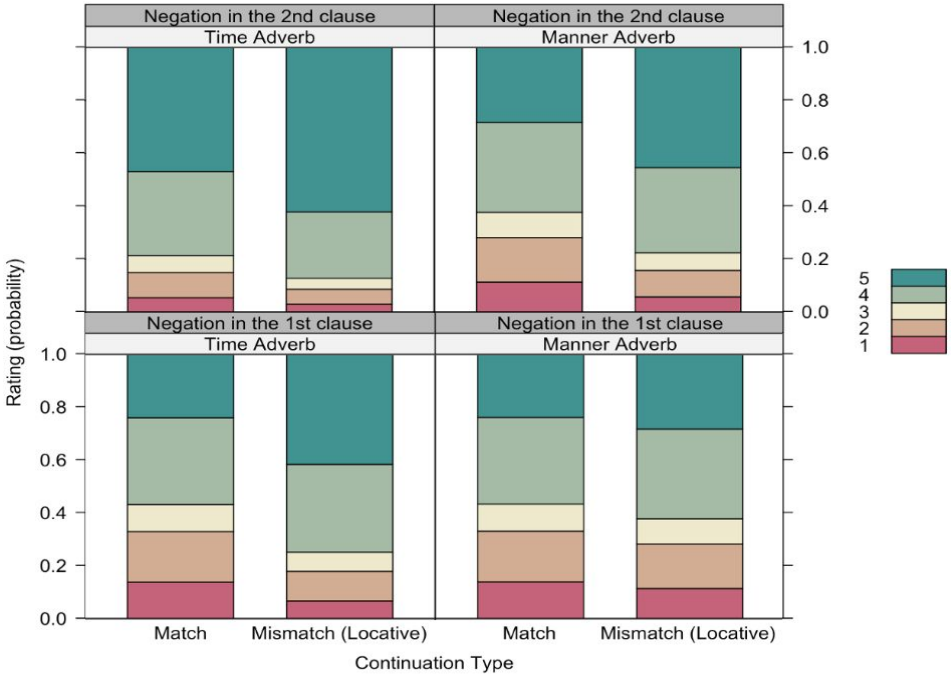
Appendix: Results of clmm for Experiment II in Chapter 4

Results of ordinal mixed-effects model, cumulative link mixed model (clmm)
Time vs. Manner vs. **Ideophone**

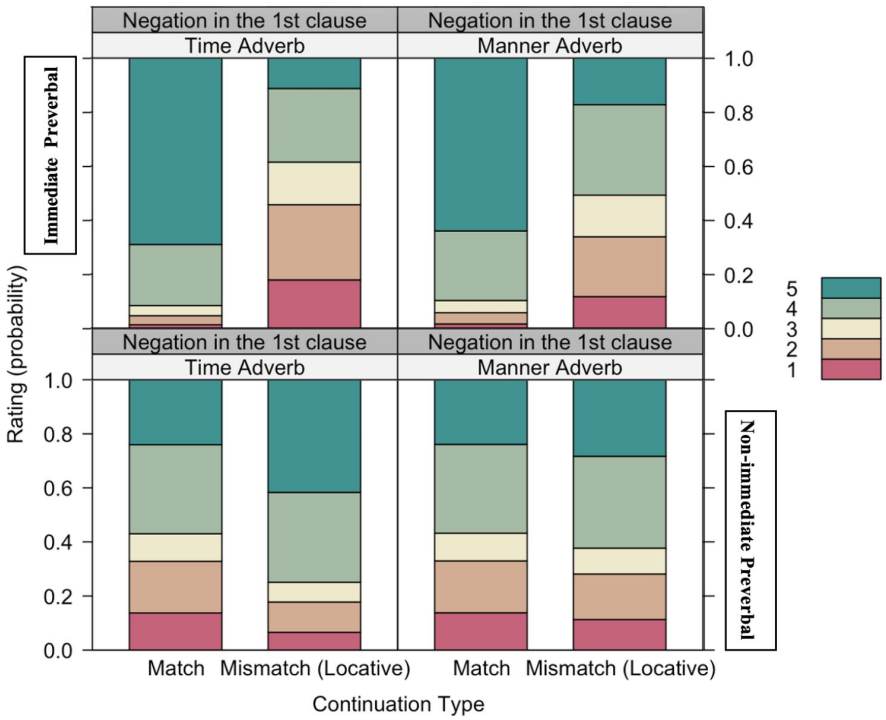
Coefficients	Estimate	Standard Error	z value	p value
Continuation Type	0.44	0.08	5.44	<0.001
AdverbType1	-0.38	0.12	-3.17	<0.01
AdverbType2	0.19	0.11	1.66	0.1
Negation Position	-0.31	0.08	-3.87	<0.001
Continuation Type:AdverbType1	-0.05	0.12	-0.40	0.69
Continuation Type:AdverbType2	-0.17	0.11	-1.51	0.13
Continuation Type:Negation Position	0.11	0.08	1.3	0.18
AdverbType1:Negation Position	-0.18	0.12	-1.57	0.12
AdverbType2:Negation Position	0.05	0.11	0.48	0.63
Continuation Type:AdverbType1:Negation Position	-0.15	0.12	-1.26	0.21
Continuation Type:AdverbType2:Negation Position	0.04	0.11	0.34	0.73

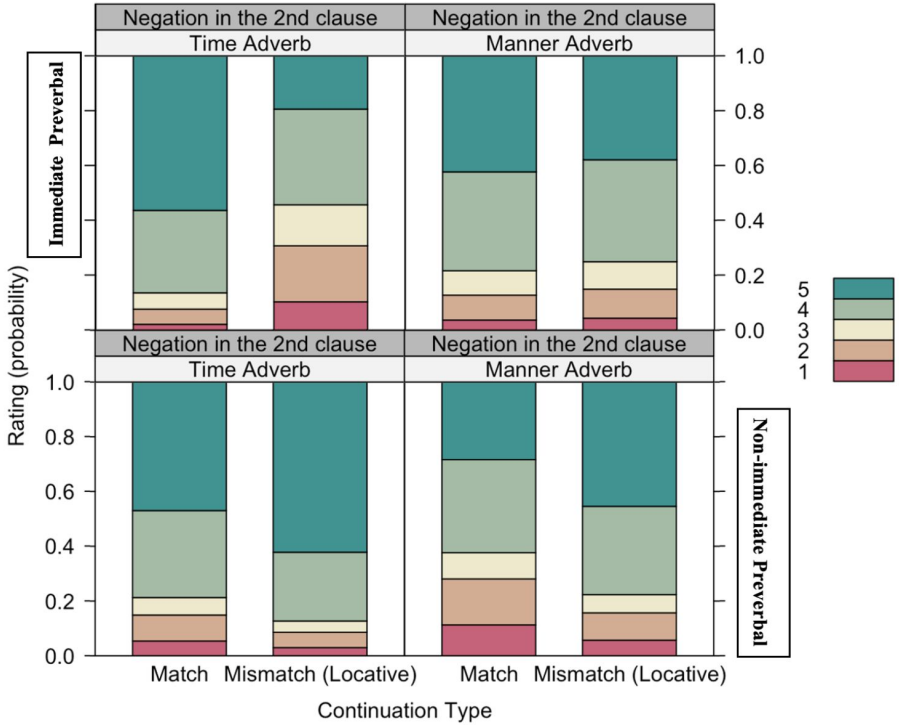
* A total of 60 participants were recruited via besample, with 49 included in the final analysis.

Appendix: Results of clmm for Experiment II in Chapter 4



Appendix: Comparison of results of Experiment I and II in Chapter 4





Appendix: Conditions in Experiment III in Chapter 4

	Polarity	Condition
Iconic roots	Affirmative	Reduplication
	Negative	Converbial
		Lexical manner adverbial
		Lexical time adverbial
Non-iconic roots	Affirmative	Reduplication
	Negative	Converbial
		Lexical manner adverbial
		Lexical time adverbial

Appendix: Sample sentences used in Experiment III in Chapter 4

a. Iconic roots

The child drank/did not drink the milk in the morning/with a gurgling sound/gurgling/slowly.

Conditions	Subject	Object/Adjunct	Adverb	Verb
Lexical Time	Çocuk	sütü	sabah	içti (Affirmative)
Reduplication			lıkır lıkır	iç**me**di (Negative)
Converbial			lıkırdatarak	
Lexical Manner			yavaşça	

b. Non-iconic roots

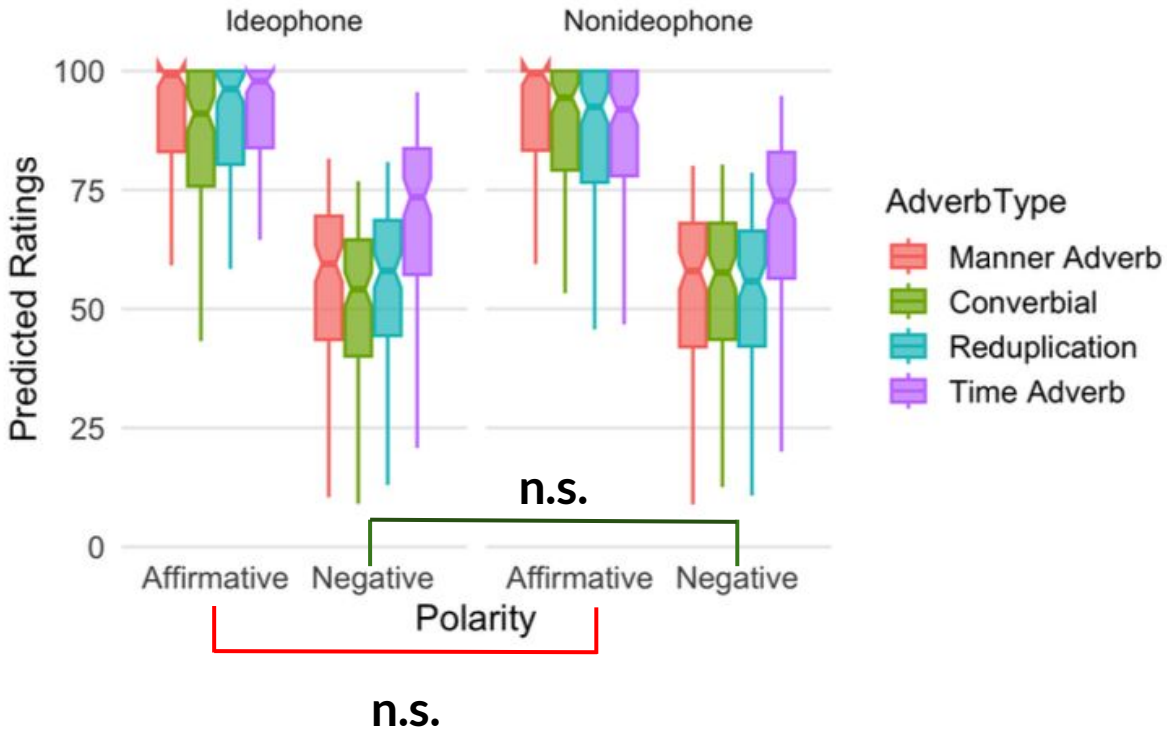
The girl came/did not come to the school at seven o'clock/by running/running/fast.

Conditions	Subject	Object/Adjunct	Adverb	Verb
Lexical Time	Kız	okula	saat yedide	geldi (Affirmative)
Reduplication			koşa koşa	gel**me**di (Negative)
Converbial			koşarak	
Lexical Manner			hızlıca	

Appendix: Sentences used in Experiment III in Chapter 4

	Subject	Arg/Adjunct	Target				Verb	
			Converbial	Reduplication	Manner Adverbial	Time Adverbial	Affirmative	Negative
Iconic roots (Ideophones)	Çocuk	sütü	lıkırdatarak	lıkır lıkır	yavaşça	sabah	içti	içmedi
	child	*milk*	*gurgling*	*gurgling*	*slowly*	*morning*	drink	drink-NOT
	Görevli	balkonu	foşurdatarak	foşur foşur	iyice	dün sabah	yıkadı	yıkamadı
	officer	*balcony*	*splashing*	*splashing*	*well*	*yesterday morning*	wash	wash-NOT
	Adam	odasında	horuldayarak	horul horul	zorlukla	bütün gün	uyudu	uyumadı
	man	*his room*	*huffing*	*huffing*	*with difficulty*	*all day*	sleep	sleep-NOT
	Öğrenci	sınıfta	fısırdayarak	fısır fısır	sessizce	ders boyunca	konuştu	konuşmadı
	student	*class*	*murmuring*	*murmuring*	*silently*	*during the lecture*	talk	talk-NOT
	At arabası	toprak yolda	tıngıdayarak	tıngır tıngır	hızla	tüm gün	ilerledi	ilerlemedi
	horse cart	*on earth road*	*rattling*	*rattling*	*fast*	*all day*	move	move-NOT
	Oğlan	evde	zırıldayarak	zırıl zırıl	sessizce	tüm gün	ağladı	ağlamadı
	boy	*home*	*bawling*	*bawling*	*silently*	*all day*	cry	cry-NOT
	Su	ocakta	fokurdayarak	fokur fokur	hızlıca	tüm gece	kaynadı	kaynamadı
	water	*stove*	*bubbling*	*bubbling*	*fast*	*all night*	boil	boil-NOT
	Hemşire	hastanın esprisine	kıkırdayarak	kıkır kıkır	sessizce	bütün gün	güldü	gülmedi
	nurse	*joke by the patient*	*by giggling*	*giggling*	*silently*	*all day*	laugh	laugh-NOT
Verbal roots (Nonideophones)	Sarhoş	ağaçtan	yuvarlanarak	yuvarlana yuvarlana	aniden	dün gece	düştü	düşmedi
	drunk (one)	*tree*	*rolling*	*rollling*	*suddenly*	*last night*	fall	fall-NOT
	Kadın	dükkana	yürüyerek	yürüye yürüye	zorla	akşam	gitti	gitmedi
	woman	*store*	*walking*	*walking*	*with difficulty*	*evening*	go	go-NOT
	Postacı	evin merdivenlerini	dolanarak	dolana dolana	güçlükle	bu sabah	çıktı	çıkmadı
	postman	*stairs of the house*	*winding*	*winding*	*with difficulty*	*this morning*	ascend	ascend-NOT
	Hasta	koridorda	sekerek	seke seke	dikkatlice	bütün gün	yürüdü	yürümedi
	patient	*hall*	*hobbling*	*hobbling*	*carefully*	*all day*	walk	walk-NOT
	Kuş	gökyüzünde	dönerek	döne döne	keyifle	tüm gün	uçtu	uçmadı
	bird	*sky*	*coiling*	*coiling*	*joyfully*	*all day*	fly	fly-NOT
	Atlet	bitiş çizgisine	zıplayarak	zıplaya zıplaya	zorlukla	vaktinde	ulaştı	ulaşmadı
	athlete	*finish line*	*jumping*	*jumping*	*with difficulty*	*on time*	arrive	arrive-NOT
	Kız	okula	koşarak	koşa koşa	hızlıca	saat yedide	geldi	gelmedi
	girl	*school*	*running*	*running*	*fast*	*seven o'clock*	come	come-NOT
	İşçi	binaya	aksayarak	aksaya aksaya	saat onda	yavaşça	girdi	girmedi
	worker	*building*	*limping*	*limping*	*morning*	*ten o'clock*	enter	enter-NOT

Appendix: Results of Experiment III in Chapter 4



Time adverbial differs from the other modifiertypes in negative polarity in each group ($p<0.01$).

* A total of 120 participants were recruited via besample, with 114 included in the final analysis.

Appendix: Results of Experiment III in Chapter 4

Results of the linear mixed-effects model targeting the ideophone group

Coefficients	Estimate	Standard Error	z value	p value
Intercept	95.83	3.09	30.92	<0.001
AdverbType_Converbial	-7.22	3.12	-2.30	<0.05
AdverbType_Reduplication	-3.59	3.13	-1.14	0.25
AdverbType_Time Adverb	-0.96	3.13	-0.30	0.76
Polarity_Negative	-39.16	3.13	-12.50	<0.001
AdverbType_Converbial:Polarity_Negative	2.05	4.43	0.46	0.64
AdverbType_Reduplication:Polarity_Negative	2.23	4.43	0.50	0.6
AdverbType_Time Adverb:Polarity_Negative	14.43	4.43	3.25	<0.01

Appendix: Pairwise comparison of the variables in Experiment III in Chapter 4

Analysis of ideophone group only

Pairs	Estimate	p value
Affirmative Polarity		
Manner Adverb - Converbial	7.22	0.09
Manner Adverb - Reduplication	3.59	0.65
Converbial - Reduplication	-3.62	0.65
Manner Adverb - Time Adverb	0.96	0.99
Converbial - Time Adverb	-6.25	0.19
Reduplication - Time Adverb	-2.63	0.83
Negative Polarity		
Manner Adverb - Converbial	5.16	0.35
Manner Adverb - Reduplication	1.35	0.97
Converbial - Reduplication	-3.80	0.61
Manner Adverb - Time Adverb	-13.47	<0.001
Converbial - Time Adverb	-18.64	<0.001
Reduplication - Time Adverb	-14.83	<0.001

Appendix: Results of Experiment III in Chapter 4 (including non-ideophones)

Coefficients	Estimate	Standard Error	z value	p value
Intercept	95.86	3.01	31.83	<0.001
AdverbType_Converbial	-7.29	3.20	-2.27	<0.05
AdverbType_Reduplication	-3.62	3.20	-1.12	0.25
AdverbType_Time Adverb	-1.00	3.20	-0.31	0.75
Type_NonIdeophone	0.28	3.20	0.08	0.93
Polarity_Negative	-39.14	3.20	-12.21	<0.001
AdverbType_Converbial:Type_NonIdeophone	3.07	4.53	-0.89	0.49
AdverbType_Reduplication:Type_NonIdeophone	-4.03	4.53	-0.89	0.37
AdverbType_Time Adverb:Type_NonIdeophone	-6.17	4.53	-1.36	0.17
AdverbType_Converbial:Polarity_Negative	2.20	4.53	0.48	0.62
AdverbType_Reduplication:Polarity_Negative	2.19	4.53	0.48	0.62
AdverbType_Time Adverb:Polarity_Negative	14.26	4.53	3.14	<0.01
Type_NonIdeophone:Polarity_Negative	-1.79	4.53	-0.39	0.69
AdverbType_Converbial:Type_NonIdeophone:Polarity_Negative	1.94	6.40	0.30	0.76
AdverbType_Reduplication:Type_NonIdeophone:Polarity_Negative	3.33	6.40	0.52	0.60
AdverbType_Time:Type_NonIdeophone:Polarity_Negative	6.92	6.40	1.08	0.28