

‘I sometimes still get my tenses wrong’:

**Insights from studies on the interaction between lexical
and grammatical aspect**

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Tense-aspect asymmetry in SLA contexts

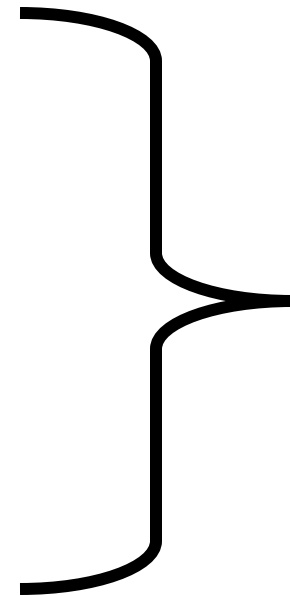
- Second language learners often switch tenses in ‘non-native’ ways, as illustrated in the following example from Bardovi-Harlig (2000).
- The police left the man and caught the women. *The man **wants** go to the prison because he **is** very poor and he **sleep** on the street every day. After that he went to the restaurant and took food for eating. (Learner E4)*

Interaction between lexical and grammatical aspect

- An interesting question is whether there is some **regular pattern** to these ‘non-native’ shifts in tenses. If the answer is yes, the next question is **why**.
- In this paper, we examine two major strands of research with convergent findings, namely, **language acquisition research** and **language processing studies**.
- Both strands of studies reveal biases in the relationships between **tense-aspect marking** and **verb type** —the former referred to as ‘**grammatical aspect**’ and the latter as ‘**lexical aspect**’.

Temporal reference

- What happened?
- **When did it happen?**
- Where did it happen?
- Who were involved?
- How/why did it happen?



Elements of
narratives

An event is necessarily located in time.

Temporal reference markers

We locate time in a number of ways.

- Using adverbs of time:
- Using adverbs of sequence:
- Using tense markers:
- **Using aspect markers:**
- **Types of aspect:**
 - Lexical aspect
 - Grammatical aspect

*Once upon a time,
last week, this morning*

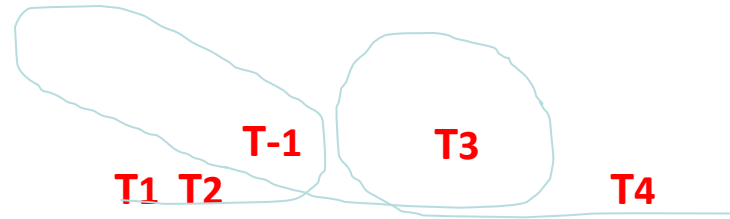
First, then, lastly

-ed, -s, will/shall

-ed, have V-en, be V-ing

The primary function
of aspect markers is
not temporal
location.

Temporal frames in English



Temporal frames (TF) in English narratives:

- **Establish** TF
- **Maintain** TF
- **Switch** TF

- **Switch** TF

- **Re-establish** TF

- *Last week* my nephew came home all excited.
- He rushed into the house brimming with news.
- He had just lost his first front tooth.
- And he had pulled it out himself!
- His mouth was now wide open, and indeed his left upper tooth was gone, and the gum was still bleeding slightly.
- “Wow, Adrian, you are such a brave boy!” I could see he was very proud of himself, and he had every reason to be proud of course.
- I *then* accompanied him to the bathroom to get some gauze to clean up his slightly bleeding gum.

Andersen (1990)

Temporal frames (TF) in Mandarin narratives

Lexical aspect can provide **implicit** temporal information

Grammatical aspect provides **explicit** temporal information

- **Establish** TF ~ temporal adverbs
- **Maintain** TF ~ **bare verbs**, **aspect markers**
- **Switch** TF ~ temporal adverbs, **perfect aspect**
- **Re-establish** TF ~ temporal adverbs

Aspectual system

Imposes a **bounded vs. unbounded perspective** to an event or situation

Lexical aspect
(situation aspect)

Grammatical aspect
(viewpoint aspect)

Perfectiv

e

e.g. He *made* a cake.

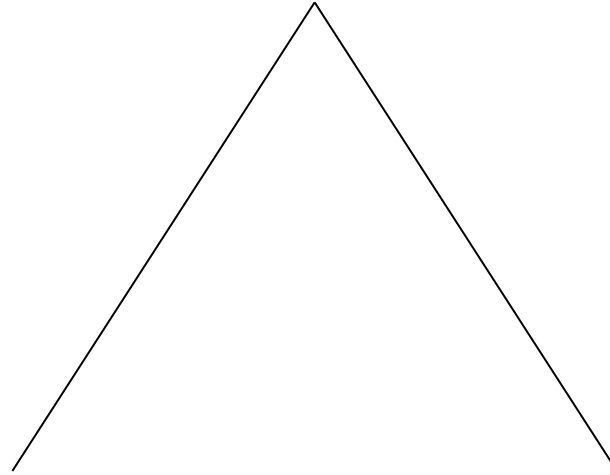
Imperfectiv

e

e.g. He *is making* a cake.

He *was making* a cake.

Aspectual system



Lexical aspect
(situation aspect)

Grammatical aspect
(viewpoint aspect)

e.g. He *climbed* up the roof.

e.g. He *climbed* among the rocks.



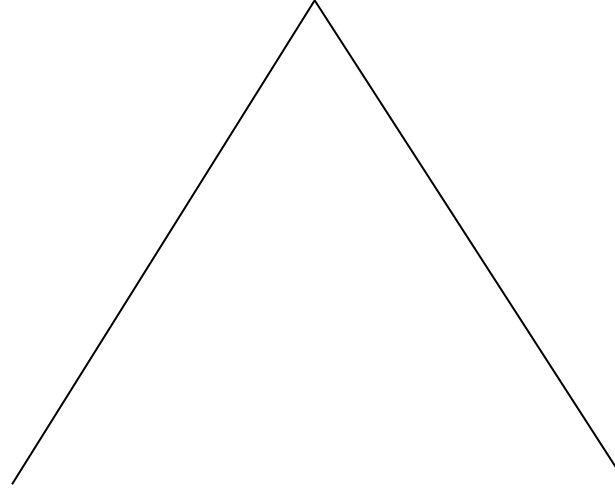
Aspectual system



Lexical aspect
(situation aspect)

e.g. He *climbed* up the roof.

e.g. He *climbed* among the rocks.



Grammatical aspect
(viewpoint aspect)

Lexical Aspect

- state



- activity



- accomplishment



- achievement



- *Once upon a time, there lived an old woman deep in the forest of Wushu.*
- *One day, the woman was gathering wood some distance from her cottage.*
- *When she was done gathering, she bundled the wood together, and headed home.*
- *On the way home, she tripped and fell.*

Situation types (lexical aspect) and their temporal properties

(Smith 1991)

	Dynamic	Durative	Telic	Examples
State	-	+	-	<i>know, love</i>
Activity	+	+	-	<i>play, talk</i>
Accomplishment	+	+	+	<i>run a mile</i>
Achievement	+	-	+	<i>break, drop</i>
Semelfactive	+	+	+	<i>cough, skip</i>

iterative

Research on tense-aspect acquisition

- **‘Defective Tense’ Hypothesis**
 - Children at first cannot handle tense, which involves temporal reference relative to speaker time.
 - Children’s cognitive development initially focus on the ‘here and now’.

Research on tense-aspect acquisition

- **‘Aspect First’ Hypothesis**
 - Children first attend to aspect.
 - They pay attention to **change of state**, and initially use *-ed* to mark completion (hence perfective aspect) rather than past temporal reference.

Research on tense-aspect acquisition

- **Acquisition of aspect in Chinese**

- Children first attend to aspect (perfective *le*) before modals (Erbaugh 1982).
- They also pay attention to **change of state**, and tend to acquire perfective aspect earlier than imperfective aspect.
- Mandarin-speaking children first acquire **perfective *le*** (Erbaugh 1982; Li 1990; Liu 2009), then **progressive *zai*** and **durative *zhe*** before they acquire **experiential *guo*** (Lin 1986).

Children's initial *le* is also used to mark completion rather than past temporal reference.

- There is an asymmetry in the acquisition of perfective vs. imperfective aspect marking.
- Erbaugh (1982) examined data from children aged 2-3; children in Li's (1990) data ranged from 3;11 to 6;4, and those in Liu's (2009) from 1;9.10 to 2;2.7.

Aspect Hypothesis

(Shirai 1991; Andersen & Shirai 1996)

1. Learners first use past marking on achievement and accomplishment verbs, eventually extending use to activities and statives.

Past marking: **ACH and ACC** > ACT > STA

2. In languages that encode the perfective/imperfective distinction, imperfective past appears later than perfective past, and imperfective past marking begins with statives, extending next to activities, then to accomplishments, and finally to achievements.

Aspect Hypothesis

(Shirai 1991; Andersen & Shirai 1996)

3. In languages that have progressive aspect, progressive marking begins with activities, then extends to accomplishments and accomplishments, and finally to achievements.

Progressive marking:

ACT > ACC and ACH > *STA

4. Progressive markings are not incorrectly overextended to statives.

rarely

Adult language learners sometimes make these 'errors'.

- The police *left* the man and *caught* the women.

The man *wants* go to the prison because he *is* very poor
and he *sleep* on the street every day. After that
he *went to the restaurant* and *took food* for eating.

[Learner E4, Bardovi-Harlig 2000]

Why do language learners make these 'errors'?

- The police **left** the man and **caught** the women.
(ACHIEVEMENT, past) (ACHIEVEMENT, past)

The man **wants** go to the prison because he **is** very poor
(STATE, present) (STATE, present)

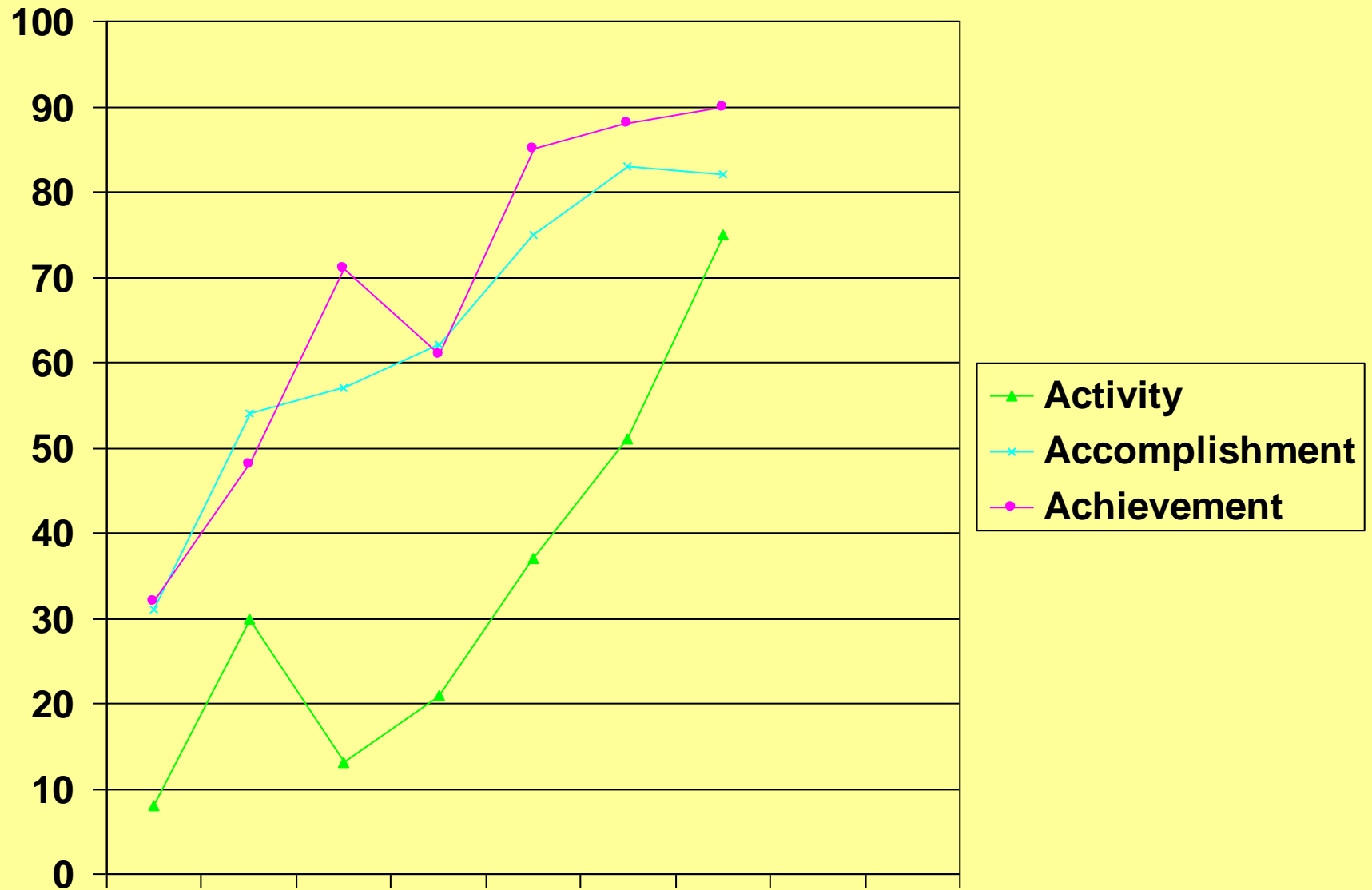
and he **sleep** on the street every day. After that
(ACTIVITY, base form)

he **went to the restaurant** and **took food** for eating.
(ACCOMPLISHMENT, past) (ACCOMPLISHMENT, past)

Table 1. Distribution of tense-aspect morphology within aspectual categories in written narratives by learners of English in 7 proficiency groups (Bardovi-Harlig 1998)

Group	Form	States		Activities		Accomplishments		Achievements	
		%	(n)	%	(n)	%	(n)	%	(n)
Group 10-30 N=5	Past	11	(3)	9	(2)	31	(10)	32	(24)
	Prog	0	(0)	30	(7)	6	(2)	3	(2)
	Pres	67	(18)	4	(1)	3	(1)	1	(1)
	Base/Other	22	(6)	56	(13)	59	(19)	63	(47)
Group 40 N=3	Past	20	(4)	30	(7)	55	(12)	48	(25)
	Prog	0	(0)	9	(2)	0	(0)	0	(0)
	Pres	50	(10)	4	(1)	0	(0)	0	(0)
	Base/Other	30	(6)	56	(13)	46	(10)	52	(27)
Group 50 N=3	Past	52	(11)	13	(3)	58	(15)	71	(43)
	Prog	0	(0)	33	(8)	4	(1)	2	(1)
	Pres	19	(4)	4	(1)	4	(1)	0	(0)
	Base/Other	29	(6)	50	(12)	35	(9)	28	(17)
Group 60 N=4	Past	79	(22)	21	(3)	63	(12)	61	(44)
	Prog	0	(0)	43	(6)	5	(1)	0	(0)
	Pres	14	(4)	0	(0)	0	(0)	0	(0)
	Base/Other	7	(2)	36	(5)	31	(6)	39	(28)
Group 70 N=9	Past	63	(30)	37	(25)	74	(29)	85	(160)
	Prog	2	(1)	37	(25)	0	(0)	0	(0)
	Pres	25	(12)	0	(0)	0	(0)	0	(0)
	Base/Other	10	(5)	27	(18)	26	(10)	15	(29)
Group 80 N=7	Past	71	(36)	51	(18)	83	(34)	88	(104)
	Prog	2	(1)	34	(12)	5	(2)	3	(3)
	Pres	22	(11)	0	(0)	10	(4)	0	(0)
	Base/Other	6	(3)	14	(5)	2	(1)	10	(11)
Group 90 N=6	Past	90	(28)	75	(27)	82	(22)	90	(87)
	Prog	0	(0)	25	(9)	4	(1)	2	(2)
	Pres	10	(3)	0	(0)	11	(3)	0	(0)
	Base/Other	0	(0)	0	(0)	4	(1)	8	(8)

Comparison of within-category analysis of the distribution of simple past in **written** narratives by learners of English (Bardovi-Harlig 1998)



Comparison of within-category analysis of the distribution of simple past in **oral** narratives by learners of English (Bardovi-Harlig 1998)

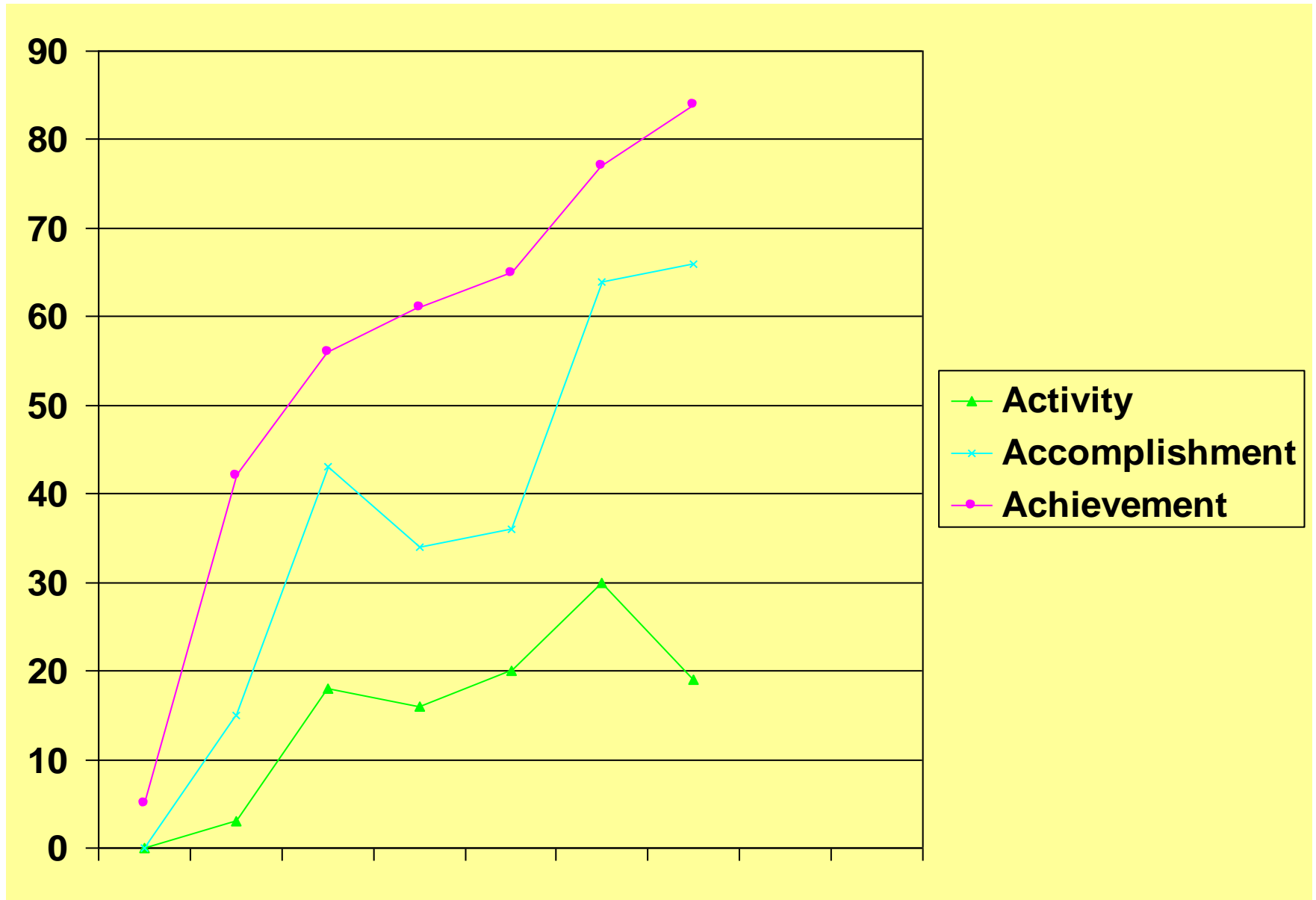


Table 3. Across-category analysis of the distribution of tense-aspect morphology in written narratives by learners of English in 7 proficiency groups (Bardovi-Harlig 2002) “What percent of past tense marking occurs on X?” where X could be States, Activities, Accomplishments or Achievements.

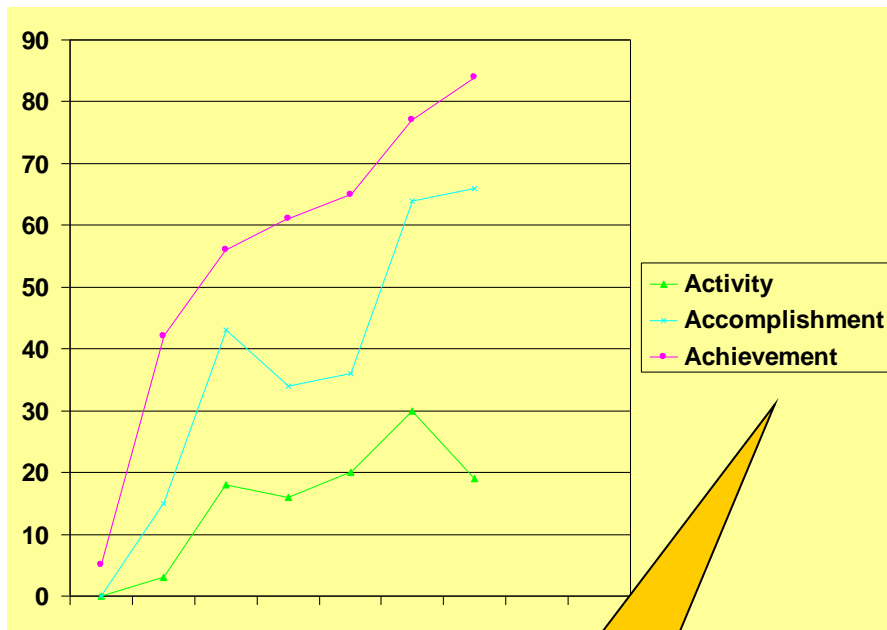
Group	Form	States	Activities	Accomplishments	Achievements	Total	Total
		%	%	%	%	%	(n)
Group 10-30 N=5	Past	8	5	26	62	100	(39)
	Prog	0	64	18	18	100	(11)
	Pres	86	5	5	5	100	(21)
	Base	6	17	26	51	100	(69)
Group 40 N=3	Past	8	15	25	52	100	(48)
	Prog	0	100	0	0	100	(2)
	Pres	91	9	0	0	100	(11)
	Base	8	24	18	49	100	(49)
Group 50 N=3	Past	15	4	21	60	100	(72)
	Prog	0	80	10	10	100	(10)
	Pres	67	17	17	0	100	(6)
	Base	13	28	20	40	100	(40)
Group 60 N=4	Past	27	4	15	54	100	(81)
	Prog	0	86	14	0	100	(7)
	Pres	100	0	0	0	100	(4)
	Base	6	15	15	65	100	(34)
Group 70 N=9	Past	12	10	12	66	100	(244)
	Prog	4	96	0	0	100	(26)
	Pres	100	0	0	0	100	(12)
	Base	10	28	20	42	100	(50)
Group 80 N=7	Past	19	9	18	54	100	(192)
	Prog	6	67	11	17	100	(18)
	Pres	73	0	27	0	100	(15)
	Base	18	24	6	53	100	(17)
Group 90 N=6	Past	17	16	13	53	100	(164)
	Prog	0	75	8	17	100	(12)
	Pres	50	0	50	0	100	(6)
	Base	0	0	50	50	100	(2)

Sample of an across-category analysis of the distribution of tense-aspect morphology in **written** narratives

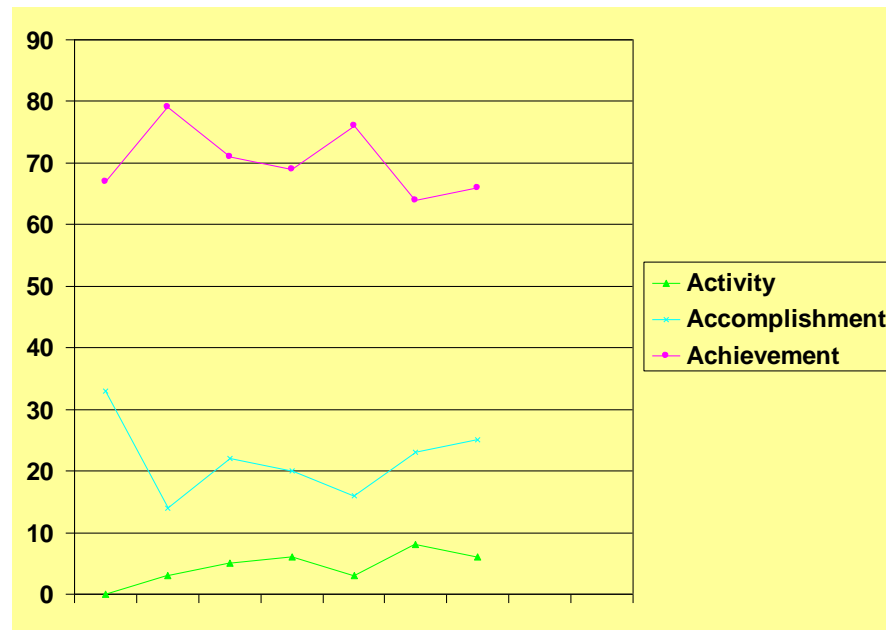
Group	Form	States	Activities	Accomplishments	Achievements	Total	Total
		%	%	%	%	%	(n)
Group 10-30 N=5	Past	8	5	26	62	100	(39)
	Prog	0	64	18	18	100	(11)
	Pres	86	5	5	5	100	(21)
	Base	6	17	26	51	100	(69)

Comparison of within-category and across-category analyses of the distribution of **simple past** in **oral** narratives by learners of English (Bardovi-Harlig 2000)

within-category analysis



across-category analysis



Past marking is acquired earlier on **achievement** verbs.

Recall the predictions of the Aspect Hypothesis.

Past marking is acquired in the following sequence:

ACH > ACC > ACT > STA

Findings from acquisition studies

- L1 acquisition studies reveal that children acquiring English tend to use past marking (*-ed* and irregular past forms) on achievement and accomplishment verbs first, then activity verbs, and finally state verbs.

PAST MARKING: **Achievement & Accomplishment** > Activity > State

e.g. Shirai & Andersen (1995); Andersen & Shirai (1996)

- A similar tendency has also been observed in L2 acquisition.

e.g. Bardovi-Harlig (1998, 2000)

- These studies further show that progressive marking (*be + -ing*) follows a different sequence of development across verb types: the progressive form tends to first appear on activity verbs, then accomplishment and achievement verbs, and rarely ever on stative verbs.

PROGRESSIVE MARKING: **Activity** > Achievement & Accomplishment > */? State

Aspectual asymmetry in processing and acquisition

- These differences in accuracy and rate of acquisition in both L1 and L2 emerge as a result of biases/asymmetries in the strengths of combination between **grammatical aspect** (perfective/past vs. imperfective/progressive marking) and **lexical aspect** (verb type: ACH, ACC, ACT, ST, ...).
- Similar biases or asymmetrical effects in the interaction between grammatical aspect and lexical aspect have also been observed in other languages.

e.g. Japanese, Chinese, and Spanish

(see for example Li & Shirai 2000; Salaberry & Shirai 2002)

There's asymmetry in the acquisition of aspect marking—**past is acquired earlier on ACH (and ACC) verbs.**

And progressive is acquired earlier on ACT verbs.

Is there a cognitive basis for the observed aspectual asymmetry in language acquisition?

Can this bias be empirically tested?

Magliano & Schleich (2000)

Comprehension / Memory recall task

- Participants were asked to read English passages and to then decide if target verb phrases (either perfective or imperfective) appeared in those narratives.

Magliano & Schleich (2000)

Participants read narrative sentences
(perfective or imperfective)

Introduction

Aspect sentences

Post-aspect sentences

Conclusion

Critical question



Respond to yes-no question
(judgment on the basis of whether the event was ongoing or completed)

Magliano & Schleich (2000)

Step1: Participants read narrative sentences (perfective or imperfective)

Jack's wife Betty was expecting a baby, and boy was he excited.
He was planning to be her coach when she gave birth.
He went to all the Lamaze classes.
Every night, Jack made Betty practice her breathing.
Finally, the big night was here.

Betty was delivering their first child.

OR

Betty delivered their first child.

Jack fainted dead on the spot.
The video recorder went crashing on the ground.

Jack recorded about 10 seconds of the birth of their child.
He was never more embarrassed in his life.

Step 2: Respond to yes-no question

(judgment on the basis of whether the event was ongoing or completed)

Has the baby been born yet?

Comprehension / Memory recall task

- Participants were asked to read English passages and to then decide if target verb phrases (*either perfective or imperfective*) appeared in those narratives.

Results

- Participants responded significantly **faster to imperfective** verb phrases than to perfective ones.

Conclusion

- **Faster recognition time for imperfective verbs** was attributed to their **slower decay rate**, *which allows for longer activation and retention in working memory.*

Verbs with **imperfective** markers
are more likely to be perceived as **ongoing**
in the subsequent context.

They were **walking** to school.



**Often perceived as
still walking.**

Walk-ing

T₁

T₂

T₃

Verbs with **perfective** markers
are more likely to be perceived as **completed**
in the subsequent context.

They **walked** to school.



**Often perceived as
completed.**

Walk-ed

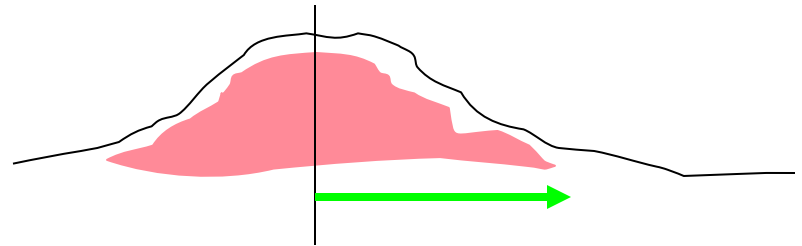
T_1

T_2

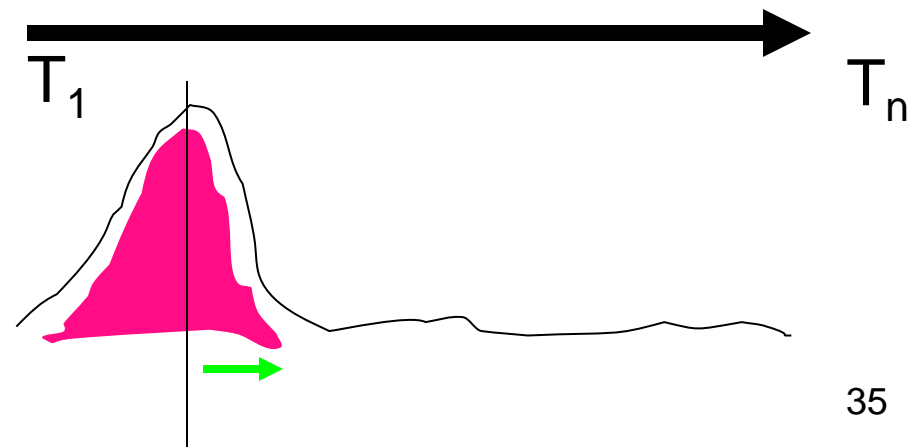
T_3

Memory of verbs with **imperfective** marking
decay at a slower rate.

She *was writing* a letter.



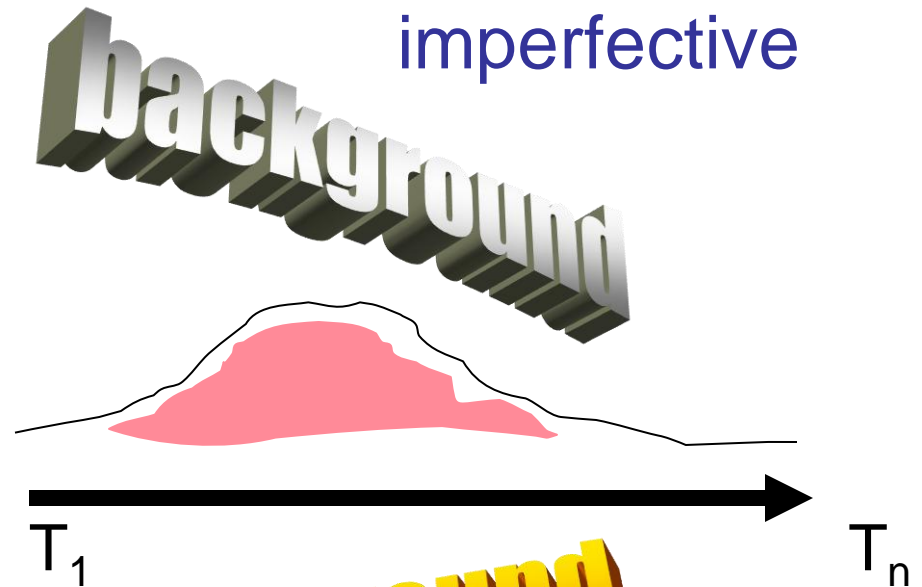
She *wrote* a letter.



There is a strong correlation between **aspectual asymmetries** and **discourse grounding functions**.

(Hopper 1979)

She **was writing** a letter.



She **wrote** a letter

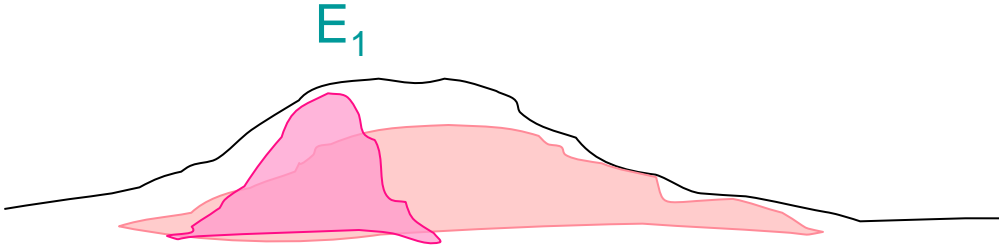


Discourse implications:

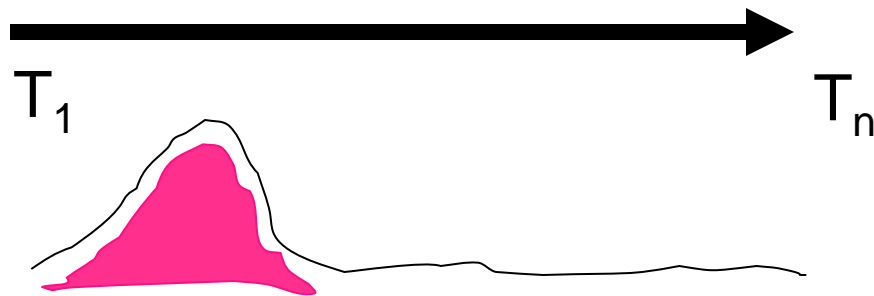
Imperfective verbs ~ slower decay rate ~ background situation

Perfective verbs ~ faster decay rate ~ foregrounded events

While she *was writing* a letter, $E_1 \dots, E_2 \dots, E_3 \dots$



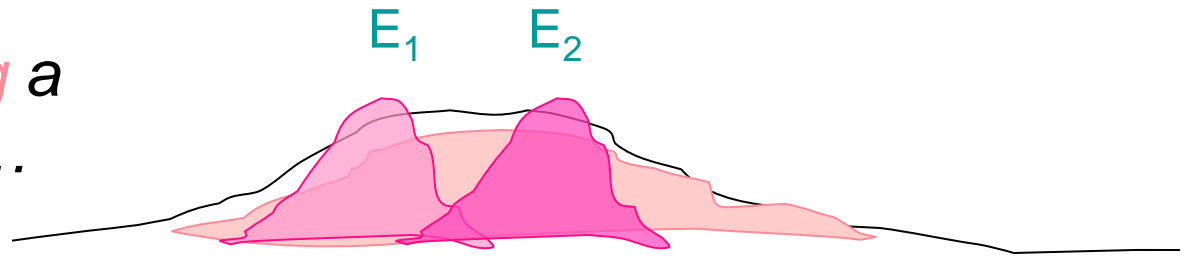
She *wrote* a letter.



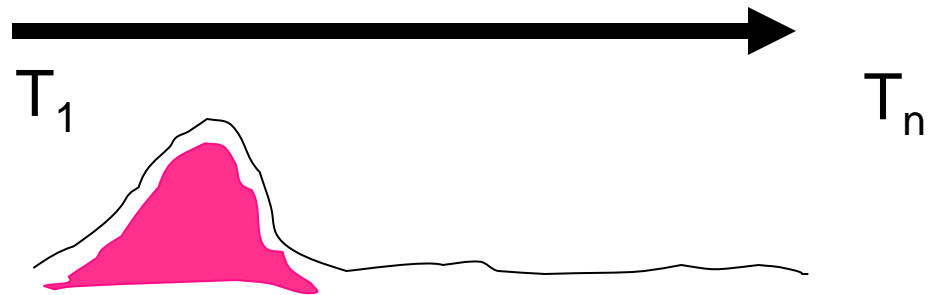
Imperfective verbs ~ slower decay rate ~ background situation

Perfective verbs ~ faster decay rate ~ foregrounded events

While she *was writing* a letter, E_1 ..., E_2 ..., E_3 ...

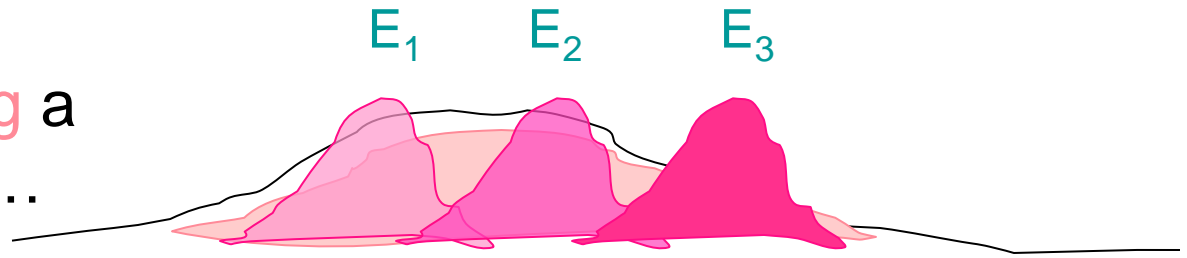


She *wrote* a letter.

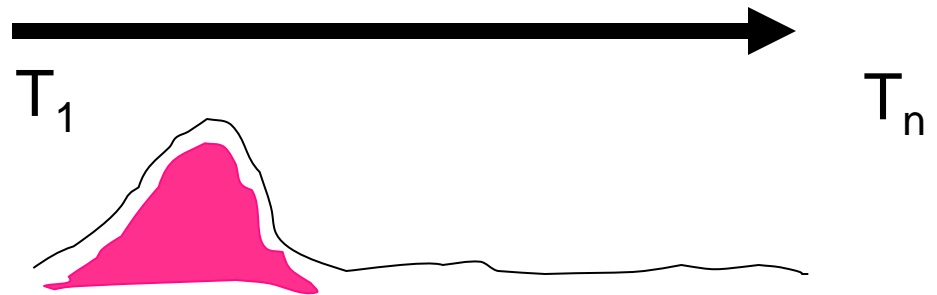


Imperfective verbs ~ slower decay rate ~ background situation
Perfective verbs ~ faster decay rate ~ foregrounded events

While she **was writing** a letter, $E_1 \dots, E_2 \dots, E_3 \dots$



She **wrote** a letter.

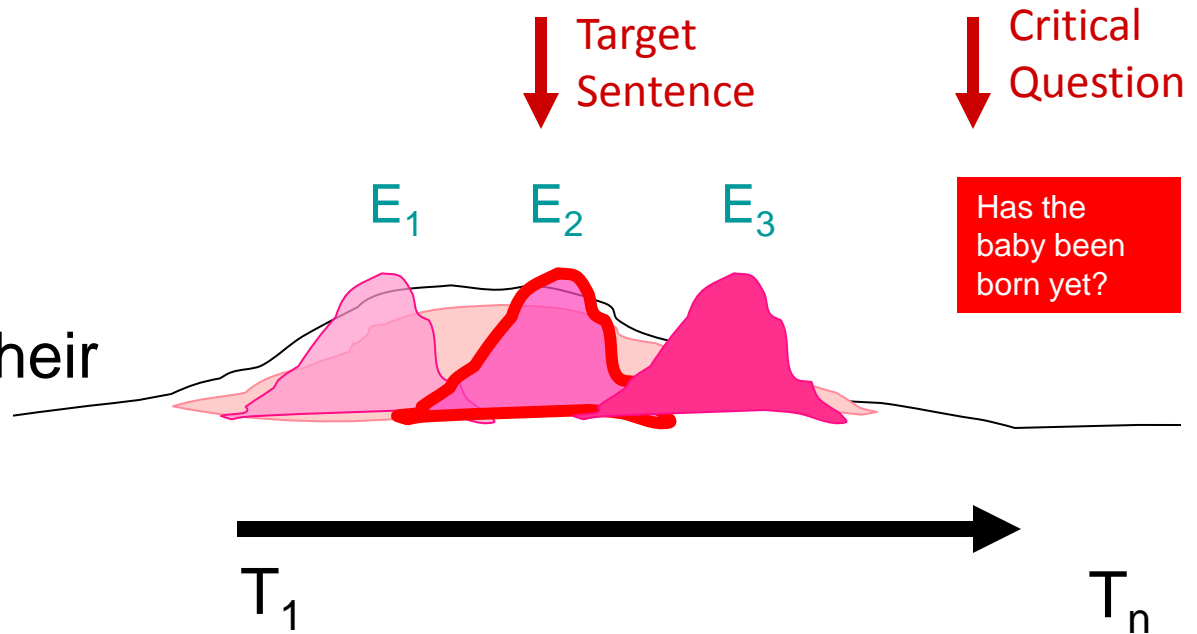


Imperfective verbs ~ slower decay rate ~ background situation

Perfective verbs ~ faster decay rate ~ foregrounded events

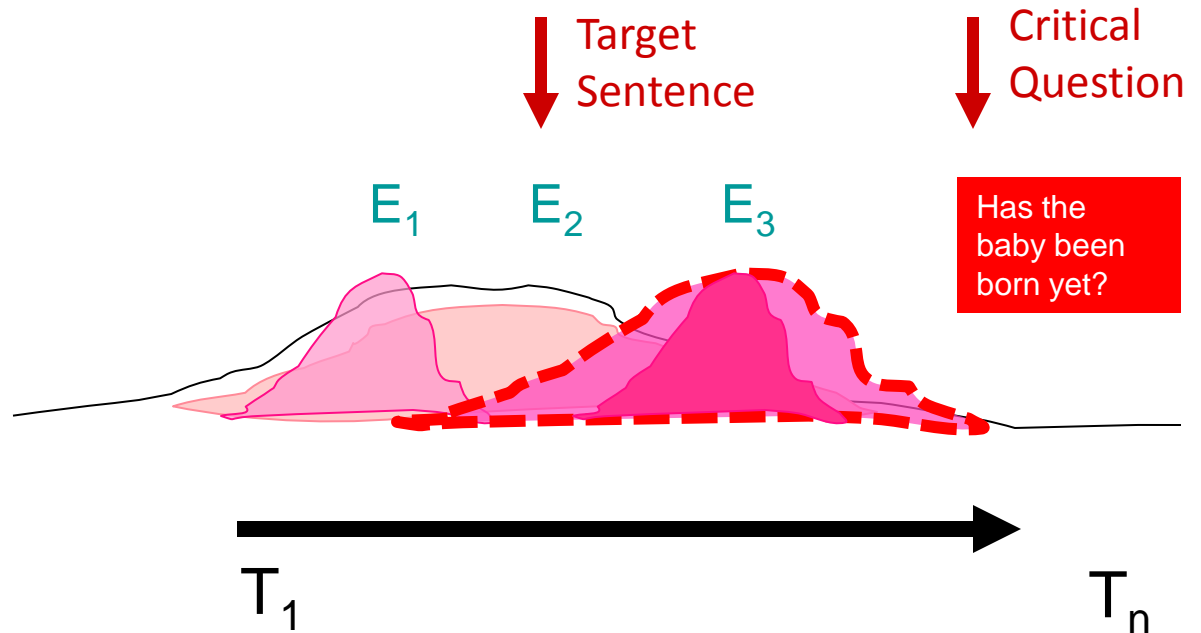
$E_1 \dots, E_2 \dots, E_3 \dots$

Betty **had delivered** their first child.



Imperfective verbs ~ slower decay rate ~ background situation
Perfective verbs ~ faster decay rate ~ foregrounded events

$E_1 \dots, E_2 \dots, E_3 \dots$
Betty **was delivering**
their first child.



Sentence completion task

- Participants were asked to complete sentence fragments containing either perfective or imperfective verb phrases

vs. *The cow had grazed* _____
The cow was grazing _____

vs. *The fire had burned* _____
The fire was burning _____

Strong association between **imperfective aspect and locations**
and perfective aspect with patients
(Ferretti, Kutas & McRae 2007)

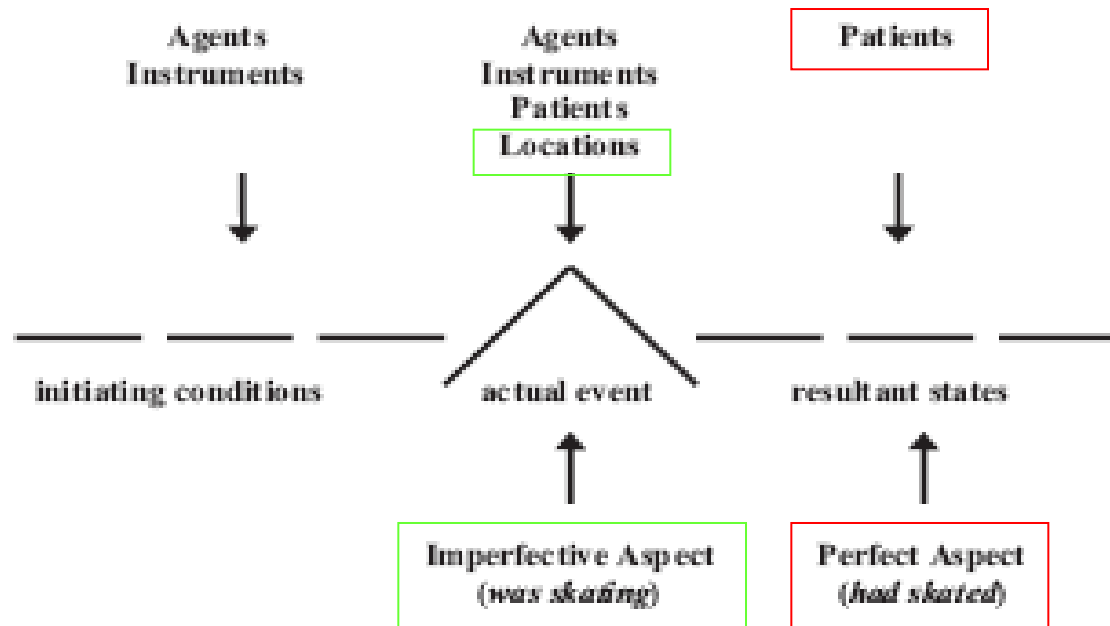


Figure 1. Verb aspect, thematic roles, and their general relationship with the temporal and causal structure of events.

Feretti, Kutas & McRae (2007)

**Perfective
aspect**

Highlights
patient
affectedness,
etc.

• *The fire had burned*

the house

• *The fire was burning*

**Imperfective
aspect**

in the house

**Locative
prepositional
phrases**— highlighting
attention to the internal
contour of the event

Strong association between imperfective aspect and locations

and perfective aspect with patients
(Ferretti, Kutas & McRae 2007)

Table 2

Percentage of Verb Phrase Preferences for Verbs Marked With Imperfective and Perfect Aspect in Experiment 2

Phrase type	Imperfective		Perfect		Difference
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	
Preposition (other)	13	2	14	2	-1
Preposition (locative)	37	3	28	3	9
Noun	38	4	43	4	-5
Adverb	9	1	12	1	-3
Conjunction	2	0.4	3	0.5	-1



Sentence completion task

- Participants were asked to complete sentence fragments containing either perfective or imperfective verb phrases
- *The cow had grazed* _____ vs. *The cow was grazing* _____
- *The fire had burned* _____ vs. *The fire was burning* _____

Results

- Participants produced **more locative prepositional phrases** (e.g. *The fire was burning in the kitchen*) for **imperfective** sentence fragments.
- For **perfective** sentence fragments, participants tended to produce **noun phrases that identify affected patients** (e.g. *The fire had burned the house*).

Conclusion

- Participants appear to be sensitive to event knowledge—that is, they tend to associate ongoing events (marked by imperfective aspect) with locative prepositional phrases, and completed events (marked by perfective aspect) with noun phrases denoting affected entities.

Comprehension task using ERP measures

- Participants were asked to read perfective and imperfective sentence fragments with typical vs. atypical locations.
- Typical location: *cook in the kitchen*
- Atypical location: *cook in the museum*



**Perfective
aspect**

- *cooked* in the kitchen
- *cooked* in the museum

Typical location

Atypical location

- *was cooking* in the kitchen
- *was cooking* in the museum



**Imperfective
aspect**

Electrode caps for ERP experiments



ERP experiment—testing for possible semantic violations



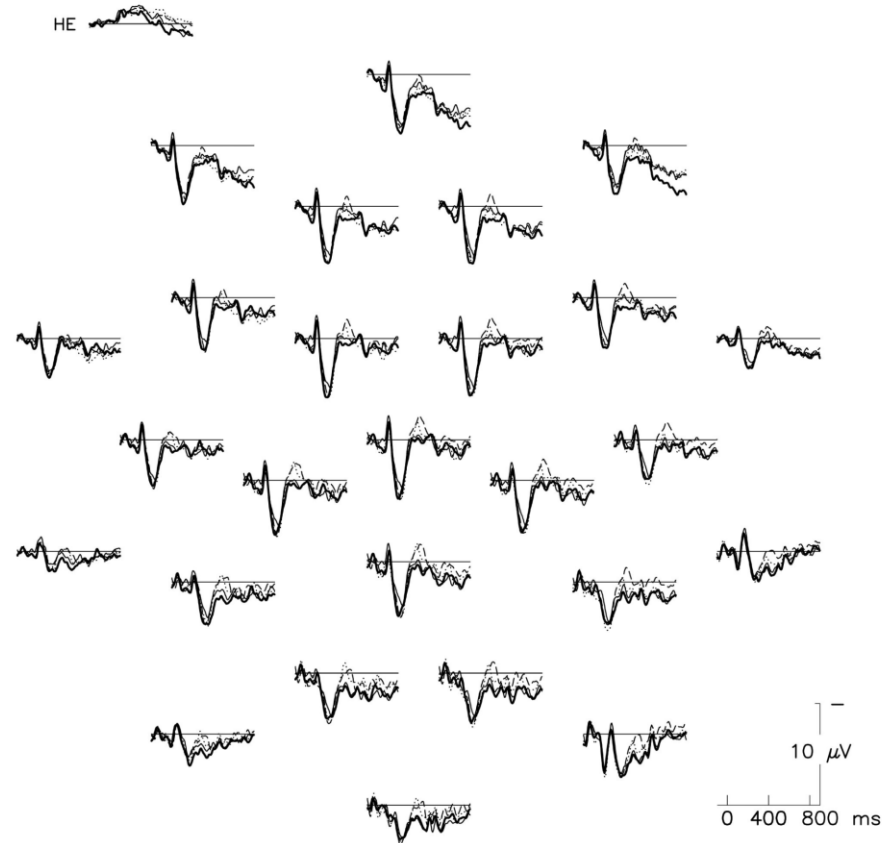
Cook**ed** in the museum

Cook**ing** in the museum

Cook**ed** in the kitchen

Cook**ing** in the kitchen

Figure 2. Experiment 3 grand averages (n = 28) for the 4 experimental conditions at all 26 electrode sites.

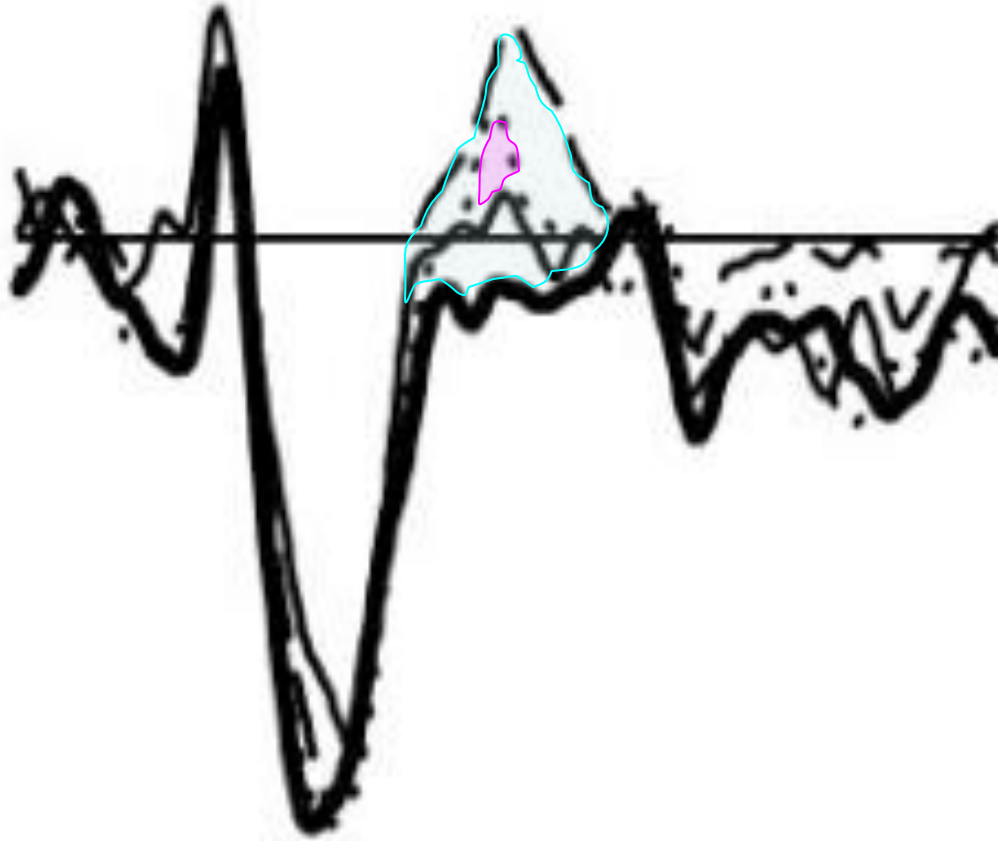


- high probability location, imperfective aspect
- low probability location, imperfective aspect
- High probability location, perfect aspect
- Low probability location, perfect aspect

N400 measures semantic violations



- high probability location, imperfective aspect
- low probability location, imperfective aspect
- High probability location, perfect aspect
- Low probability location, perfect aspect



Significant difference in N400 readings between high and low probability location for **imperfective** aspect



Non-significant difference for **perfective** aspect

Feretti, Kutas & McRae (2007)

**Perfective
aspect**

- *cooked* in the kitchen
- *cooked* in the museum

No significant
N400 amplitude

Typical location

Atypical location

- *was cooking* in the kitchen
- *was cooking* in the museum

**Imperfective
aspect**

**Significant N400
amplitude—**
highlighting attention
to internal details of
the event, e.g. location
of ongoing action

Feretti, Kutas & McRae (2007)

Comprehension task using ERP measures

Results

- **Atypical locations elicited a higher N400 amplitude than typical locations for events denoted by verbs marked with imperfective aspect** (e.g. *was cooking*).
- For verbs marked with perfective aspect (e.g. *had cooked*), no significant difference was found.

Conclusion

- **Participants are more sensitive to subtle differences in locative interpretations when processing imperfective sentences**, but not perfective ones.
- This is consistent with our understanding that imperfective sentences highlight the internal and unbounded view of an event (inclusive of its locative details), while perfective sentences highlight instead an external and bounded view that pays more attention to result or patient affectedness than to locus of action.

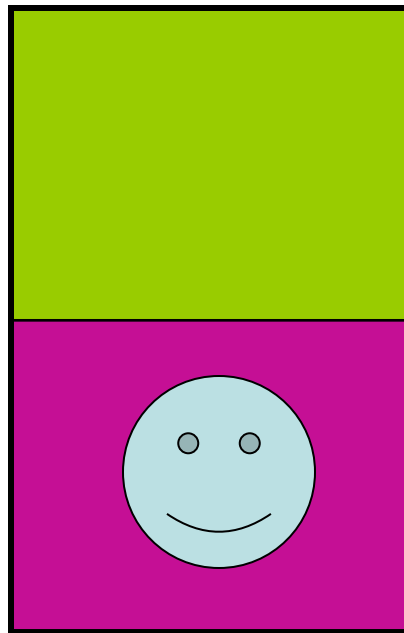
Sentence-picture matching task

- Participants were asked to listen to sentences (either perfective or imperfective) and then match them to ongoing or completed pictures.

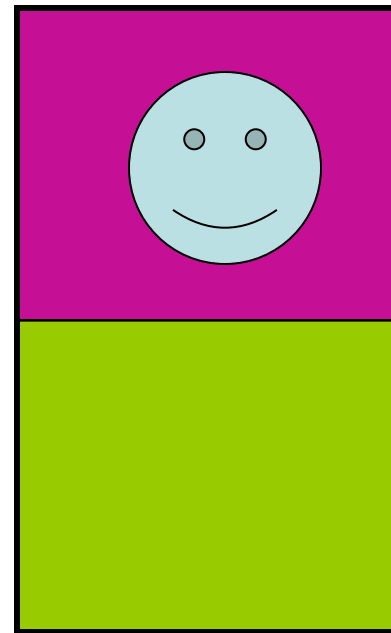
Predicted aspectual asymmetry:

Perfective sentences are faster with ACC verbs;
Imperfective sentences are faster with ACT verbs.

Accomplishment



Activity





Imperfective

e.g. ?English *-ing*
Cantonese *gan2*

Perfective

e.g. ?English *-ed*
Cantonese *zo2*

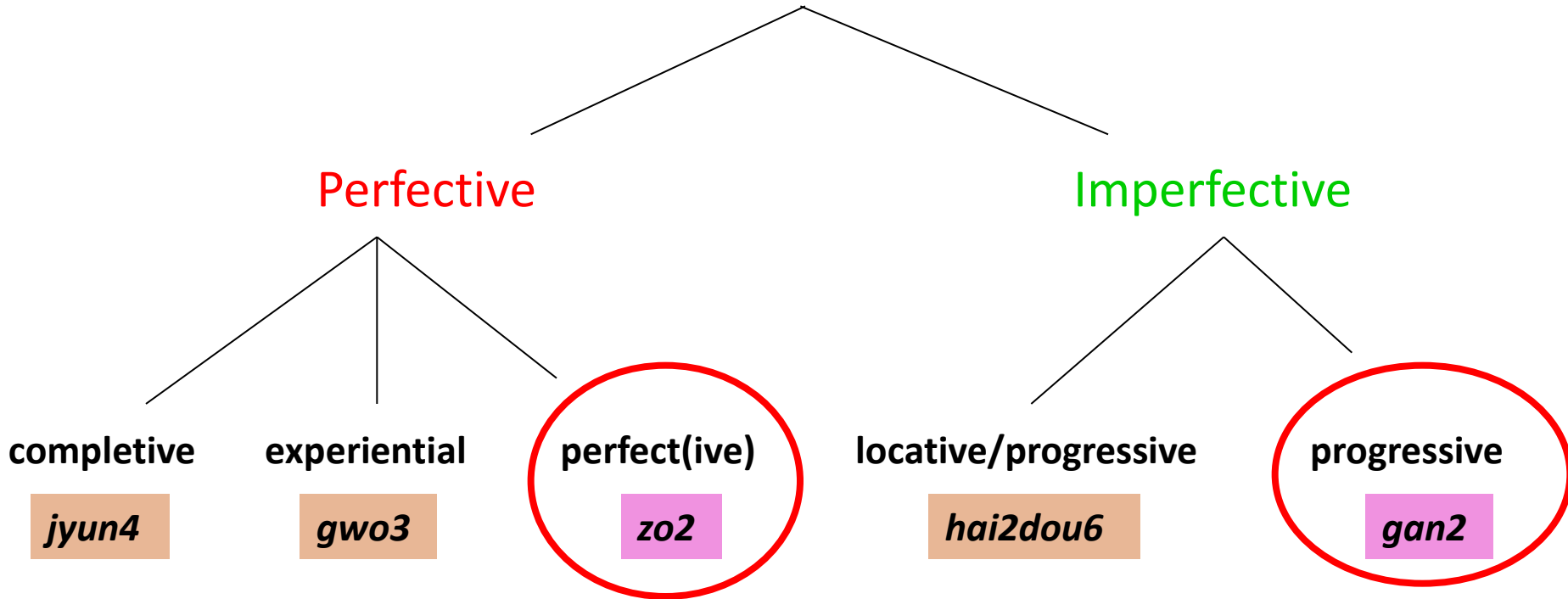
Predicted interaction effects: grammatical aspect and lexical aspect

	Accomplishment	Activity
Imperfective		
Perfective		

Sentence matched with Ongoing Picture

Sentence matched with Completed Picture

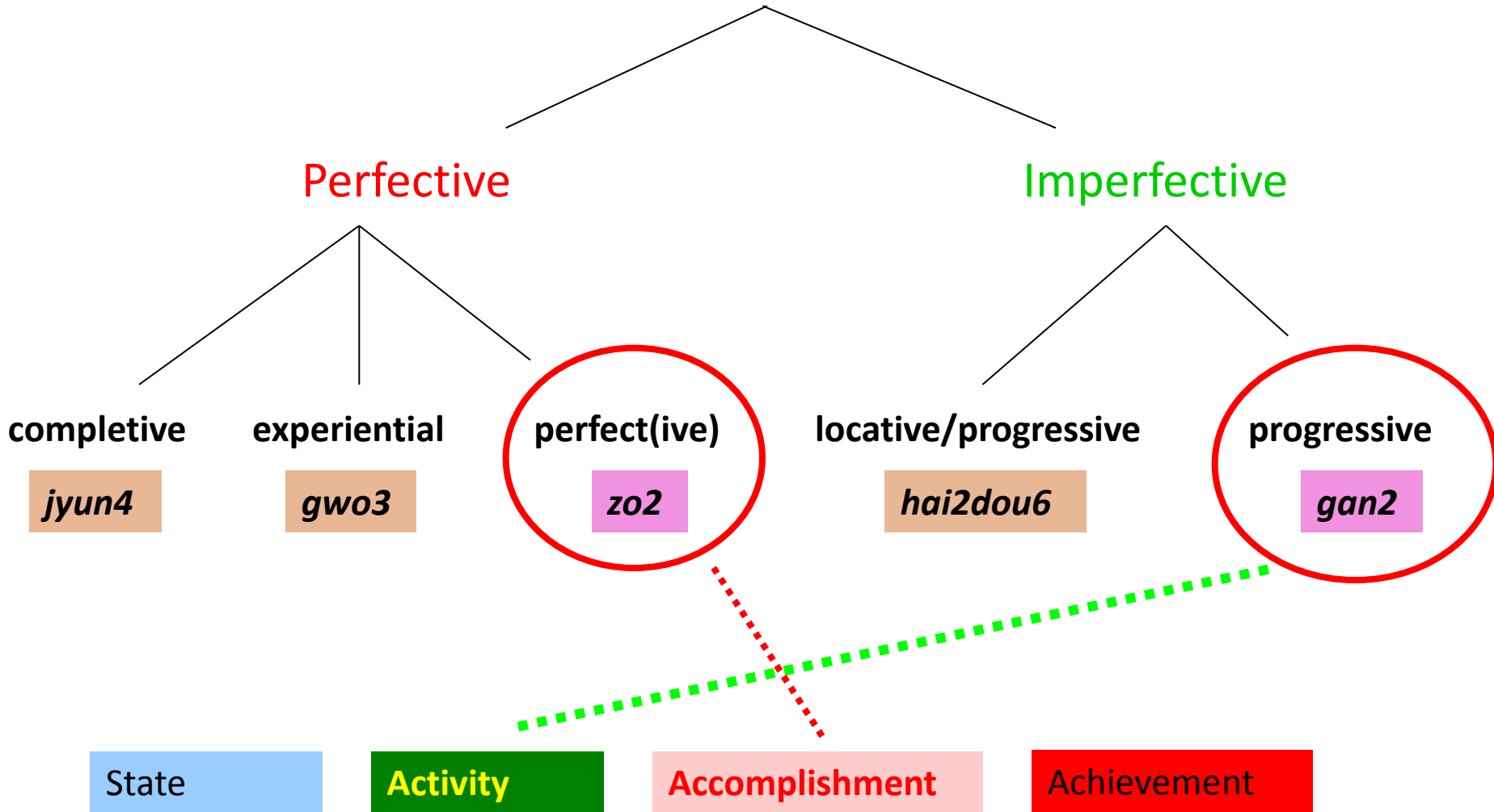
Cantonese aspectual system



Why choose
Cantonese,
not English?

English *-ed* and *be + -ing*
show conflation between
aspect and tense

Cantonese aspectual system



Predicted interaction between lexical aspect (verb type) and grammatical

Lexical aspect in Cantonese

(1) Accomplishment (ACC): [+dynamic] [+durative] **[+telic]**

寫封信

se2 fung1 seon3

write CL letter

'write a letter'

(2) Activity (ACT): [+dynamic] [+durative] **[-telic]**

聽音樂

teng1 jam1ngok6

listen music

'listen to music'

Lexical and grammatical aspect in Cantonese

(1) Accomplishment (ACC): [+dynamic] [+durative] **[+telic]**

個男仔寫緊封信
go3 naam4zai2 se2-gan2 fung1 seon3
CL boy write-IMPF CL letter
'The boy is writing a letter'

個男仔寫佐封信
go3 naam4zai2 se2-zo2 fung1 seon3
CL boy write-PERF CL letter
'The boy has written a letter'



(2) Activity (ACT): [+dynamic] [+durative] **[-telic]**

個男仔聽緊音樂
go3 naam4zai2 teng1-gan2 jam1ngok6
CL boy listen-IMPF music
'The boy is listening to (some) music'



個男仔聽佐音樂
go3 naam4zai2 teng1-zo2 jam1ngok6
CL boy listen-PERF music
'The boy has listened to some music'

Reaction Time Study



Procedure

A. Presentation of either a perfective or imperfective sentence (auditory form):

個男仔彈緊琴

go3 naam4zai2 taan4gan2 kam4

CL boy play-IMPF piano

'The boy is playing the piano.'



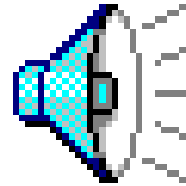
B. Presentation of a pair of pictures depicting ongoing versus completed events:



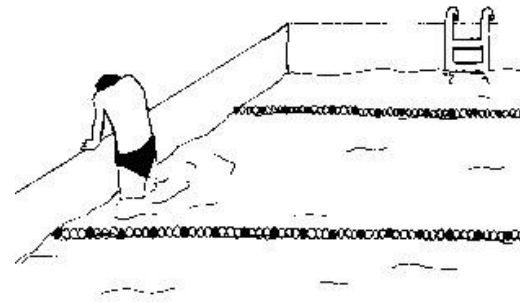
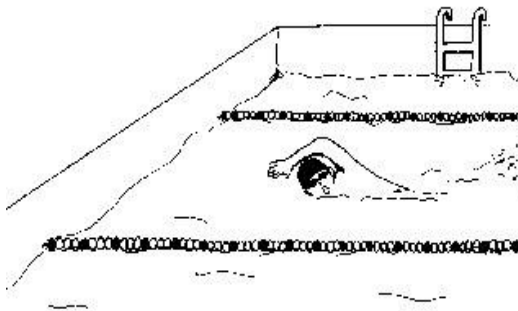
C. Decision of which picture matches the utterance by pressing a corresponding key on the computer keyboard.

Sentence-and-picture matching task

Participants hear a **perfective** or **imperfective** utterance.



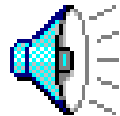
then



Sentence-and-picture matching task

ACTIVITY VERBS

Participants hear a perfective utterance on the screen

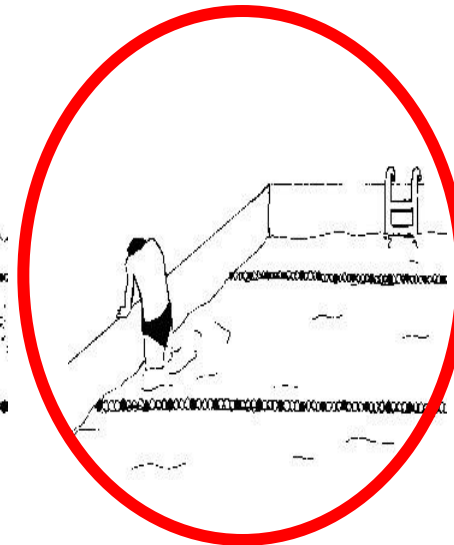
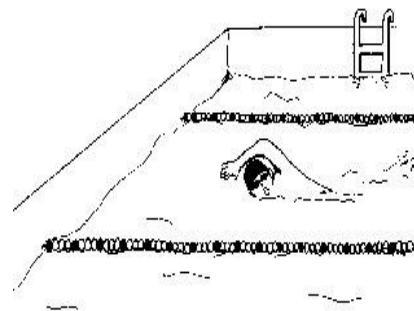


then

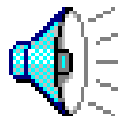
個男仔游佐水

Go3 laam4zai2 jau4 zo2 sei2

'The boy has finished swimming.'



Participants hear an imperfective utterance on the screen



then

個男仔游緊水

Go3 laam4zai2 jau4 gan2 sei2

'The boy is swimming.'

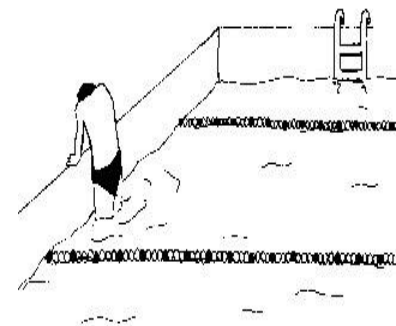
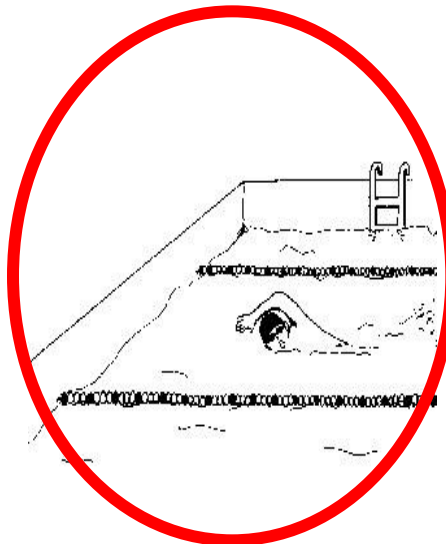


Table 5. Mean Accuracy Rates (in Percentages) for Matched Perfectives and Matched Imperfectives in a Sentence-Picture Matching Task

Type of analysis	Grammatical aspect	Lexical aspect (verb type)			
		Activity		Accomplishment	
		M	SD	M	SD
Subject analysis	Perfective	96.1	8.4	97.8	5.6
	Imperfective	98.2	3.9	93.5	8.3
Item analysis	Perfective	96.1	3.5	97.8	3.0
	Imperfective	98.2	3.4	93.3	5.4

Note. Perfective facilitation for accomplishments and imperfective facilitation for activities (for both subject and item analyses) $p < .05$

Table 6. Mean Reaction Times (in Milliseconds) for Matched Perfectives and Matched Imperfectives in a Sentence-Picture Matching Task

Type of analysis	Grammatical aspect	Lexical aspect (verb type)			
		Activity		Accomplishment	
		M	SD	M	SD
Subject analysis	Perfective	1086	198	1037	193
	Imperfective	980	172	1076	210
Item analysis	Perfective	1084	118	1036	89
	Imperfective	988	145	1089	100

Note. Interaction effect between lexical and grammatical aspect (for both subject and item analyses) $p < .001$

Sentence-picture matching task

Results

- Participants matched **ongoing** pictures significantly **faster for activity verbs with imperfective aspect**.
- Participants matched **completed** pictures significantly **faster for accomplishment verbs with perfective aspect**.

Conclusion

- *Grammatical aspect interacts with lexical aspect during sentence processing.*

Findings

- Lexical aspect (i.e., verb type) interacts with grammatical aspect in the course of language processing.
 - Participants respond to **progressive *gan2*** more accurately and faster for **activity** verbs compared to accomplishment verbs.
 - They respond to **perfective *zo2*** more accurately and faster for **accomplishment** verbs.
- This suggests that certain combinations of verb type and grammatical aspect produce stronger neural activations and are processed as well as acquired faster.
- In terms of language production, **the weak/strong combinations of verb type and grammatical aspect** help explain why certain ‘past tense errors’ persist longer than others.

Some 'errors' that take much longer to fix.

- The police *left* the man and *caught* the women.

The man *wants* go to the prison because he *is* very poor

and he *sleep* on the street every day. After that

he *went to the restaurant* and *took food* for eating.

Interpreting the results in terms of Barsalou's (1999) perceptual theory of knowledge

- Perceptual input (including linguistic input, such as aspectual information) contributes to the formation of situation models.
- Each perceptual input activates a configuration of neurons and leaves a trace of these neuronal activations, which is encoded in memory as a perceptual symbol.
- Perceptual symbols interact with each other, particularly in associative areas of the brain, and can give rise to complex cognitive processes.
- Manipulations of perceptual symbols can support hierarchical representations of knowledge, giving rise to symbolic-style logical thinking and inferential thought.
- Not only can perceptual symbols contribute to the formation of situation models in bottom-up fashion, they also can do so in top-down fashion.
- Top-down processing happens, for example, when perceptual symbols influence the interpretation of new incoming perceptual input.

Interaction of lexical and grammatical input

- Within this framework of perceptual symbols, a sentence will activate a dynamic series of neural configurations that give rise to a situation model of the concept represented by the sentence, including the temporal information conveyed by its verb type (e.g., activity or accomplishment).
- The additional presence of a grammatical aspect marker (e.g., progressive imperfective *gan2* or perfective *zo2* in Cantonese) also activates its own neural activation configuration, which will interact with the neural configuration of the verb type (i.e., lexical aspect).
- Together, they produce a nuanced temporal characterization of the situation being described in the sentence.
- Neural activations that reinforce each other are processed more rapidly—hence, the aspectual facilitations observed for imperfective–activity combinations and perfective–accomplishment combinations in this study.

Degree of grammaticalization of lexical and grammatical input

- Within the perceptual symbol framework, frequent co-activations of neural configurations also give rise to stronger connectivity (Hebbian style), which, in turn, also facilitates processing speed.
- More important, as was suggested in Barsalou (1999), frequent associations can give rise to symbols that can serve as attention-tuning devices.
- They contribute to top-down processing, particularly in associative areas in the brain.
- Of the two types of aspect examined in this study, grammatical aspect markers (perfective and imperfective) serve the more symbolic function, each tuning attention in working memory on certain temporal profiles of the situation depicted by the verb types (whether activity or accomplishment).

Emergence of symbolic (or grammatical) markers

- Viewed from a language evolution perspective, the more symbolic status of grammatical aspect markers emerges from a diachronic process of grammaticalization (e.g. Bybee, Perkins, & Pagliuca, 1994; Hopper & Traugott, 2003), whereby certain verbs with high-frequency usage become bleached of much of their original lexical meaning (in large part, due to metonymic and metaphorical extension), retaining mostly some core temporal features such as *ongoingness* (imperfective) or *boundedness/completedness* (perfective).
- As these verbs become semantically light, they begin to be attached to other verbs to highlight certain temporal characteristics of the situation. In time, these light verbs evolve into dedicated grammatical aspect markers, with the top-down symbolic function of attuning attention in working memory to certain temporal interpretations (e.g., ongoing focus or endpoint focus).

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