

***hái*: a Mandarin Chinese additive particle**

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1 Introduction

1.1 Research question

- The goal of this paper is to account for various uses of Mandarin Chinese particle *hái*:
 - How to account for each use of *hái*?
 - To what extent could we have a unified account for *hái*?
- The data of *hái*:
 - Comparative use; temporal use; marginality use; *hái-shì*, etc.
 - Additive use, *hái-yǒu*.

1.2 Previous studies on Chinese *hái* and German *noch*

1.2.1 German *noch* is similar to Chinese *hái*

- German *noch* has also these uses:
 - Comparative use (König 1977, Umbach 2009b, etc.)
 - Temporal use (Löbner 1989, König 1991, Krifka 2000)
 - Marginality use (König 1977, Krifka 2000, Ippolito 2007, Umbach 2009a, Umbach 2009b)
 - Additive use (Ippolito 2007, Umbach 2009a, Umbach 2012, etc.)

1.2.2 The study of German *noch*

- In the studies of German *noch*, the marginality reading of *hái* is in general considered to be an extension of the temporal reading (König 1977, Krifka 2000, Umbach 2009a, Umbach 2009b, etc.)
 - According to this view, the difference between the marginality reading and the temporal reading is the scale: in the temporal reading, the scale of time is involved; in the marginality reading, some other scale is involved.

- In general, I agree with this view, but there is a subtlety not captured in this view: the further inference of a temporal reading and the further inference of a marginality reading could be different – the temporal reading usually implies that the current state is similar to a previous state, but the marginality reading usually implies that the current state is a marginal case.
 - [Krifka 2000](#)'s study of the temporal use of *noch* aimed to give a unified account for the aspectual use of *schon* (\approx English *already*) and *noch*.
 - [Krifka 2000](#) proposed that in both the uses of *schon* and *noch*,
 - (i) these particles presupposes the existence of a contextually salient mapping function which monotonically aligns the scale of time and the scale of a certain state (e.g., the raining state, the age of Lydia, etc.)
 - and (ii) these particles restrict the contextually salient alternative set.
 - (iii) The effect of using *noch* is to bring the inference that things develop more slowly than expected.
 - (1) Lydia ist noch drei Monaten alt.
 Lydia be.3SG.PRS NOCH three month old.
 'Lydia is 3 months old.'
 (i) The use of *noch* requires that there is a mapping function between the time scale and the age of Lydia;
 - (ii) The use of *noch* restricts the set of Lydia's age as {3 months, 4 months, etc.}
 - (iii) *3 months* is asserted, not any larger age (i.e., *3 months* is the minimal element in the scale of age), which leads to the inference that Lydia's growth is less than expected.
 - [Krifka 2000](#)'s analysis does not really capture the meaning of *noch*: in the case 'it is still raining', the sentence does not mean that the rain is longer than expected. Even for the case 'Lydia is *noch* three months old', the sentence suggests that Lydia might grow up, not that Lydia grows more slowly than expected.
 - (2) Es regnet noch.
 3SG rain.3SG.PRS NOCH
 'It's still raining.'
 - However, [Krifka 2000](#)'s analysis is enlightening in suggesting that two scales are involved in the interpretation of temporal *noch*. However, since this analysis does not correctly capture the meaning / inference of the sentences, presumably, the contribution of *noch* is not restricting the scale of raining state or Lydia's age.
- [Umbach 2009b](#) claimed that the comparative use of *noch* is an extension of the additive use of *noch*, because in both cases, the use of *noch* relies on the discourse order. As the example shows, the use of *noch* in the second sentence relies on a previous comparison of height.
 - (3) Berta ist größer als Adam; Chris ist noch größer als Berta.
 Berta be.3SG.PRS taller than Adam Chris be.3SG.PRS NOCH taller than Berta
 'Berta is taller than Adam; Chris is taller even than Berta.'

- This analysis is problematic:
First, the utterance of the first sentence is not necessary in the use of comparative *noch*, which makes the ‘discourse order’ view problematic.
Second, this ‘discourse order’ view could not account for the position of *Berta*, *Adam*, *Chris* in these sentences.
- Moreover, the interpretation and the word order of Chinese comparative *hái*-sentences suggest that [Umbach 2009b](#)’s analysis could not be applied to Chinese data.
- Different from [Umbach](#)’s previous studies, which claimed that there is a unified account for various uses of German *noch*, [Umbach 2012](#) suggested that the additive use of *noch* is different from other uses of *noch*. In this study, [Umbach 2012](#) claimed that *noch* is similar to *auch* (*also*) in presupposing the existence of a similar event, but only *noch* is sensitive to the discourse order.
 - (4) a. Otto hat **noch** ein BIER getrunken.
Otto have.3SG.PRS NOCH a beer drink.PST.PTCP
‘Otto also drank [a Beer]_F.’
 - b. Otto hat **auch** ein BIER getrunken.
Otto have.3SG.PRS also a beer drink.PST.PTCP
‘Otto also drank [a Beer]_F.’
 - c. **[[4a]] = [[4b]]**:
Assertion: Otto drank a Beer.
Presupposition: In addition to beer, Otto drank something else.
- I agree with [Umbach 2012](#)’s conclusion that the additive use of *noch* / *hái* is different from other uses, and I will provide evidence from Chinese data to argue for this point. (But other than the conclusion, my analysis of the additive use is different from [Umbach 2012](#)’s.)

1.2.3 [Liu 2000](#)’s analysis of *hái*

- Based on [Fillmore et al. 1988](#), [Kay 1990](#)’s scalar model, [Liu 2000](#) proposed that all uses of *hái* have a basic meaning: it is persistent and it evokes a relation between two propositions and *hái* is associated with the stronger proposition.
- An example of the scalar model:
Suppose there are two scales – a set of people ordered according to their proficiency in Russian, and a set of Russian exams ordered according to its difficulty;
The point-wise composition of the elements of these two scales could generate a scalar space;
The proposition ‘John passed the exam of Level *K*’ entails (i.e., is stronger than) ‘*X* passed the exam of Level *K*’ – *X* is ranked higher than John in the proficiency scale and *K*’ is ranked lower than *K* in the difficulty scale.
- Although [Liu 2000](#) mentioned the scalar model to define the meaning of a ‘stronger proposition’, [Liu 2000](#)’s analysis is in general informal: the scales involved in each use of *hái* are not specified.

- However, the claim that *hái*'s basic meaning is the persistence and *hái* is associated with the stronger proposition is insightful. Krifka 2000 suggested that the use of *noch* has a requirement for the scales (although I disagree with Krifka 2000 on what the requirement is), and presumably, the persistence shown in the use of *hái* could be taken as a requirement for the two scales.

1.3 Main proposal

- Following Umbach 2012, I make a distinction between the additive use of *hái* and other uses of *hái*.
- For all the other uses of *hái* – comparative *hái*, temporal *hái*, marginality *hái*, *hái-shì*, based on Krifka 2000's view of mapping two scales and Liu 2000's view of *hái*'s persistent meaning, I propose that
 - the use of *hái* requires two scales monotonically aligned by a mapping function f , i.e., the existence of $Alt(x_0)$ and $Alt(f(x_0))$ (of course the ordinary semantic value of x_0 and $f(x_0)$ are given in the *hái*-sentence);
 - *hái* further requires that in the *hái*-sentence, in the scale $Alt(x_0)$, there is an item $x' < x_0$ such that $f(x')$ entails $f(x_0)$. – Essentially this is what 'persistence' means: while there is a change on the scale $Alt(x_0)$, the change on the scale $Alt(f(x_0))$ is not great.
 - Since all these uses of *hái* involve two scales, I call these uses 'two-dimensional use of *hái*'.
- For the additive use of *hái*, following Umbach 2012, I also claim that the additive use is based on the discourse order. Moreover, following Liu 2000, I claim that there is a persistence shown in the *hái*-sentence.
 - Since the additive use of *hái* is based on the discourse order, the additive use of *hái* requires the utterance of a precedent sentence.
 - Since *hái* brings a persistent meaning, the use of *hái* requires that
 - (i) either there is a similarity between the precedent sentence and the *hái*-sentence,
 - (ii) or the *hái*-sentence strengthens the meaning of the precedent sentence.

1.4 Outline

- § 2 presents the details of the analysis of two-dimensional *hái*.
- § 3 presents the details of the analysis of additive *hái*.
- § 4 briefly explores the possibility of the existence of a unified account for all the uses of *hái*.
- § 5 contains the concluding remarks.

2 Two-dimensional *hái*

2.1 Three examples

- (5) Temporal use of *hái*:

hái zài xià yǔ.

HAI at fall rain

‘It is still raining.’

Assertion: it is raining (currently).

Presupposition: it has been raining for a while.

- (6) Comparative use of *hái*:

John bǐ Bill **hái** gāo.

John compared.to/than Bill HAI tall(er)

‘John is taller even than Bill.’

Assertion: John is taller than Bill.

Presupposition: Bill is taller than average people.

- (7) Marginality use of *hái*:

Lake Michigan **hái** zài US jìng nèi.

Lake Michigan HAI at US territory inside

‘Lake Michigan is still in US.’

Assertion: Lake Michigan is in US.

Presupposition: Lake Michigan is a marginal case in being in US.

- The common points involved in these uses of *hái*:
 - In the *hái*-sentence, there is a reference point (e.g., the reference time, *Bill*, *Lake Michigan*), and this reference point is of a high value in its scale;
 - The property that holds for this reference point holds also for a lower-valued point in the scale of the reference point.

2.2 A detailed analysis of two cases

- (8) a. sì diǎn **hái** zài xià dà yǔ.
four o'clock HAI at fall big rain
Typical temporal reading: ‘It’s still raining heavily at 4pm.’

- b. liù diǎn **hái** zài xià yǔ.
six o'clock HAI at fall rain
Marginality reading: ‘It’s still raining at 6pm.’

- c. **hái** zài xià yǔ.
HAI at fall rain
‘It’s still raining.’:
ambiguous between a typical temporal reading and a marginality reading

$$f(x) = \begin{cases} \dots \\ \text{John is taller (by 7'')} & x = \text{average people} \\ \dots \\ \text{John is taller (by 3'')} & x = \text{Bill} \\ \dots \end{cases}$$

- The two dimensions involved here: the people to which John is compared to (these people are ordered by their height from shorter ones to higher ones) and the result of the comparison.
 - Notice that when the difference is specified, evidently, if the reference point person goes higher and higher on the scale of height, the difference becomes smaller and smaller and the state that John is the taller one is closer and closer to the turning point
 - at the turning point, the difference becomes 0.

- The existence of two alternative sets.
In some cases, the prosody provides evidence:

(10) John [bǐ BILL] hái [gāo SĀN CÙN].
John compared.to/than Bill HAI tall(er) three inch
'John is taller even than Bill by 3 inches.'

- The distribution of *hái* and *shèn-zhì* (*even*) and *réng-rán* (*still*):

(11) John shèn-zhì bǐ BILL hái gāo SĀN CÙN.
John even compared.to/than Bill HAI tall(er) three inch
'John is taller even than Bill by 3 inches.'

(12) hái réng-rán zài xià yǔ.
HAI still at fall rain
'It's still raining.'

- *shèn-zhì* literally means *to such a point*; *réng-rán* literally means *following that*.
- When *hái* is used, these particles could be optionally inserted; when such particles as *shèn-zhì* / *réng-rán* are used, the use of *hái* could become optional.
- Presumably, there is a division of work and a cooperation between these particles and *hái*: while *hái* marks or builds a two-dimensional persistent discourse structure in a global way, bringing special requirements to the two scales, those particles as *shèn-zhì* / *réng-rán* help to maintain 'persistent' discourse structures in a local way, restricting the ordinary semantic value of the focused part to satisfy the further requirement of an overt / covert *hái*.

2.3 The use of *hái-shì*

- Here is an example of a *hái-shì*-sentence:

(13) wǒ hái shì hē chá (hǎo).
1SG HAI FOC drink tea good
'I would prefer drinking tea.'

- My proposal for the use of *shì* follows [Krifka 1992](#): *shì* could be considered as an ASSERT operator which restricts the alternative set:

(14) *shì* takes an element of whatever type and generates its alternative set.
 $\text{Alt}(\text{shì}(\alpha)) = \{\text{assertion of } \alpha, \text{denial of } \alpha\}$
In *hái-shì*-sentences:
 $\text{Alt}(\text{shì}(\alpha)) = \{\text{assertion of } \alpha, \text{denial of } \alpha\}$
 $\rightarrow \{\text{within the range of having the property } \alpha, \text{beyond the range of having the property } \alpha\}$

- Evidence:

(15) a. hái zài xià xiǎo yǔ.
HAI at fall small rain
Assertion: it is drizzling at the reference time.
Presupposition: it has been raining for a while. – it could be the case that previously it rained heavily.
The scale of raining state: {raining heavily, raining, drizzling, no rain}

b. hái shì zài xià xiǎo yǔ.
HAI FOC at fall small rain
Assertion: it is drizzling at the reference time.
Presupposition: it was drizzling previously. – if previously, it rained heavily, the presuppositional requirement could not be satisfied.
The scale of raining state: {within the range of drizzling (i.e., drizzling), beyond the range of drizzling (i.e., no drizzling)}

2.4 Formal implementation: [Krifka 1992](#)'s structured meaning

- Here I follow [Krifka 1992](#)'s structured meaning approach to implement the compositional analysis.
- [Krifka 1992](#)'s definition of types is given in (16) and his recursive definition of extended application is given in (17). (17d) is crucial for point-wisely composing the meaning of a focus construction containing two scales.

(16) Definition of types
a. e, t are types (entities, truth values)
b. If σ, τ are types, then

- $(\sigma)\tau$ is a type (of functions from σ -denotations to τ -denotations)
- $\sigma \bullet \tau$ is a type (of a list of σ -denotations to τ -denotations)
- $\langle \sigma, \tau \rangle$ is a type (of a focus-background structure)

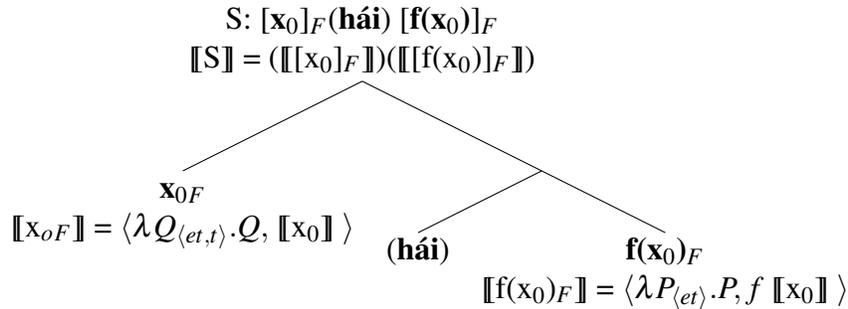
(17) Recursive definition of extended application:

- a. If α is of type $(\sigma)\tau$ and β is of type σ , then $\alpha(\beta)$ is of type τ and is interpreted as functional application.
- b. Focus inheritance from operator:
If $\langle \alpha, \beta \rangle$ is of type $\langle (\sigma)(\tau)\mu, \sigma \rangle$, and γ is of type τ , then $\langle \alpha, \beta \rangle(\gamma)$ is of type $\langle (\sigma)\mu, \sigma \rangle$, and is interpreted as $\langle \lambda X_{\sigma}. [\alpha(X)(\gamma)], \beta \rangle$.
- c. Focus inheritance from argument:
If γ is of type $(\sigma)\tau$ and $\langle \alpha, \beta \rangle$ is of type $\langle (\mu)\sigma, \mu \rangle$, then $\gamma(\langle \alpha, \beta \rangle)$ is of type $\langle (\mu)\tau, \mu \rangle$, and is interpreted as $\langle \lambda X_{\mu}. \gamma(\alpha(X)), \beta \rangle$.
- d. Focus inheritance from operator and argument:
If $\langle \alpha, \beta \rangle$ is of type $\langle (\sigma)(\tau)\mu, \sigma \rangle$ and $\langle \gamma, \delta \rangle$ is of type $\langle (\nu)\tau, \nu \rangle$, then $\langle \alpha, \beta \rangle(\langle \gamma, \delta \rangle)$ is of type $\langle (\sigma \bullet \nu)\mu, \sigma \bullet \nu \rangle$, and is interpreted as $\langle \lambda X_{\sigma} \bullet Y_{\nu}. [\alpha(X)(\gamma(Y))], \beta \bullet \delta \rangle$, where X and Y are distinct variables.

• A two-dimensional *hái*-sentence: $[\mathbf{x}_0]_F \text{ hái } [\mathbf{f}(\mathbf{x}_0)]_F$

- (18) – $[[\mathbf{x}_0]]$ stands for an entity x'_0 of type e or a generalized quantifier $\lambda P.[P(x'_0)]$ of type $\langle et, t \rangle$.
- $[[\mathbf{f}(\mathbf{x}_0)]]$ denotes a property $f[[\mathbf{x}_0]]$ ($= f(x'_0)$) of type $\langle et \rangle$.
- *hái*'s requirement:
- * There is a contextually salient mapping function f that monotonically aligns up the scale of $[[\mathbf{x}_0]]$ and the scale of $[[\mathbf{f}(\mathbf{x}_0)]]$. It maps entities to properties.
 - * $\exists a \in Alt(x'_0)$ such that
 - (i) a is lower than x'_0 in the scale $Alt(x'_0)$ and
 - (ii) the property $f(a)$ entails the property $f(x'_0)$ ¹.

LF of a two-dimensional *hái*-sentence:



¹ Alternatively, we could consider two-dimensional *hái* as an operator which takes a sentence (i.e., $[(\mathbf{x}_0)(\mathbf{f}(\mathbf{x}_0))]$) or two structured meaning (i.e., $[[\mathbf{x}_0]]$ and $[[\mathbf{f}(\mathbf{x}_0)]]$) and returns a sentence: it requires its argument to be composed by two alternative sets and it has other requirements listed above. However, there is no evidence that *hái* is necessarily an operator. It could be the case that the operator is silent but *hái* simply brings the requirements. The actual word order (that *hái* follows \mathbf{x}_0) might be due to the movement of \mathbf{x}_0 (consider also the use of the Chinese additive particle *yě*).

$$\begin{aligned} \llbracket S \rrbracket &= (\langle \lambda Q_{\langle et,t \rangle} \cdot Q, \llbracket x_0 \rrbracket \rangle) (\langle \lambda P_{\langle et \rangle} \cdot P, f \llbracket x_0 \rrbracket \rangle) \\ &= (\langle \lambda Q_{\langle et,t \rangle} \cdot Q, \lambda P \cdot P(x'_0) \rangle) (\langle \lambda P_{\langle et \rangle} \cdot P, f(x'_0) \rangle) \\ &= (\langle \lambda Q_{\langle et,t \rangle} \bullet P_{\langle et \rangle} \cdot [Q(P)], \lambda P \cdot P(x'_0) \bullet f(x'_0) \rangle) \leftrightarrow \\ \text{Assertion: } & f(x'_0)_{\langle et \rangle} (x'_{0(e)}) - \text{The property } f(x'_0) \text{ holds for the entity } x'_0. \end{aligned}$$

(Pre/post-)suppositional requirement of *hái*:

$\exists a \in Alt(x'_0) \cdot [a < x'_0 \wedge f(a) \subseteq f(x'_0) \wedge f(a)(a)]$

There is an element a in the contextually salient scale of x'_0 , such that

(i) a is lower than x'_0 on that scale

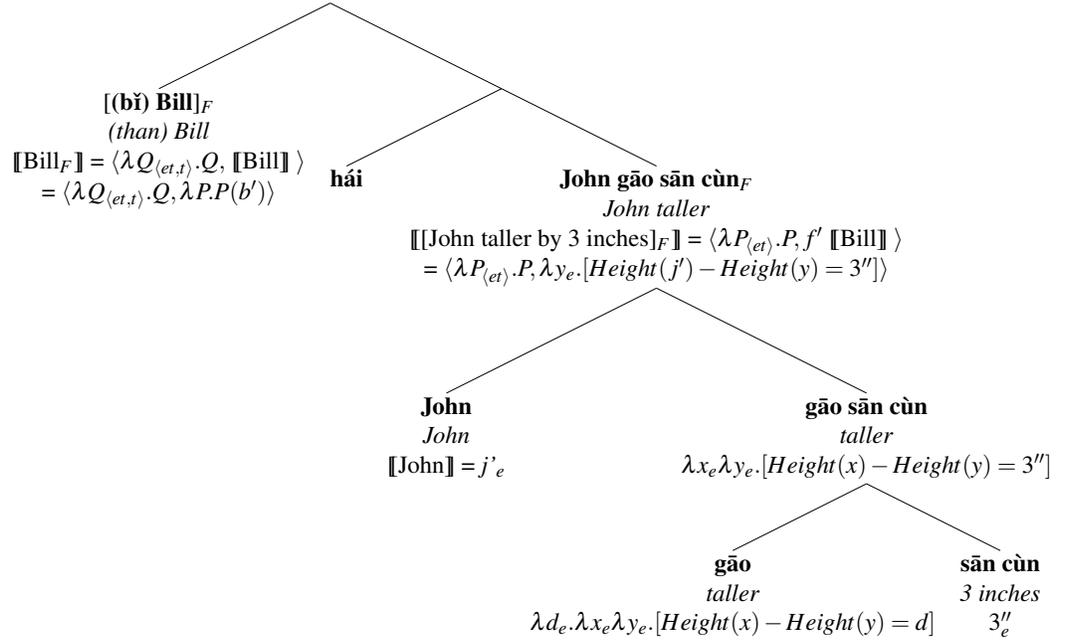
and (ii) the property $f(a)$ entails the property $f(x'_0)$.

Following the mapping function f , the third part of the presupposition – $f(a)(a)$ – would be trivially true.

- Here is an example:

- (19) John [bǐ Bill]_F hái [gāo sān cùn]_F
 John compared-to Bill HAI tall(er) three inch
 ‘John is taller even than Bill by three inches.’

- (20) S: [(bǐ) Bill]_F hái [John gāo sān cùn]_F
Even compared to Bill, John is still the taller one by 3 inches.
 $\llbracket S \rrbracket = (\llbracket [(than) Bill]_F \rrbracket) (\llbracket [John taller by 3 inches]_F \rrbracket)$



There is a contextually salient mapping function f mapping each person in the set of people ordered by their height from short to tall, to an element in the scale of properties $\{\lambda x \cdot [Height(j') - Height(x) = d, d \in \mathbb{R}]\}$.

$$\begin{aligned} \llbracket S \rrbracket &= (\llbracket [(than) Bill]_F \rrbracket) (\llbracket [John taller by 3 inches]_F \rrbracket) \\ &= (\langle \lambda Q_{\langle et,t \rangle} \cdot Q, \llbracket [Bill] \rrbracket \rangle) (\langle \lambda P_{\langle et \rangle} \cdot P, f' \llbracket [Bill] \rrbracket \rangle) \\ &= (\langle \lambda Q_{\langle et,t \rangle} \cdot Q, \lambda P \cdot P(b') \rangle) (\langle \lambda P_{\langle et \rangle} \cdot P, \lambda y_e \cdot [Height(j') - Height(y) = 3''] \rangle) \\ &= (\langle \lambda Q_{\langle et,t \rangle} \bullet P_{\langle et \rangle} \cdot [Q(P)], \lambda P \cdot P(b') \bullet \lambda y_e \cdot [Height(j') - Height(y) = 3''] \rangle) \end{aligned}$$

Assertion: $Height(j') - Height(b') = 3''$

(Pre/post-)suppositional requirement of *hái*:

$\exists z \in Alt(b'). [z <_{height} b' \wedge f'(z) \subseteq f'(b') \wedge (f'(z))(z)]$

$= \exists z \in Alt(b'). [z <_{height} b' \wedge f'(z) \subseteq \lambda y_e. [Height(j') - Height(y) = 3''] \wedge (f'(z))(z)]$

$= \exists z \in Alt(b'). [z <_{height} b' \wedge Height(j') - Height(z) > 3'']$

$= \exists z \in Alt(b'). [z <_{height} b']$

3 One-dimensional *hái*, i.e., additive *hái*

3.1 Discourse order + similarity / strengthening

- The use of additive *hái* requires the utterance of a precedent sentence; and the additive *hái*-sentence (i) either introduces an event similar to the one introduced by the precedent sentence or (ii) or strengthens the meaning of the precedent sentence to a contextually salient extremity.

(21) a. John (bù jǐn) mǎi-le píng-guǒ, hái mǎi-le lí.
John NEG only buy-PRF apple HAI buy-PRF pear

b. John (bù jǐn) mǎi-le lí, hái mǎi-le píng-guǒ.
John NEG only buy-PRF pear HAI buy-PRF apple

c. Assertion: $\llbracket 21a \rrbracket = \llbracket 21b \rrbracket = \exists e_1. [John\ bought\ apples(e_1)] \wedge \exists e_2. [John\ bought\ pears(e_2)]$
Presupposition: $\llbracket 21a \rrbracket = \llbracket 21b \rrbracket = e_1 \neq e_2 \wedge e_1 \approx e_2$

(22) Context: John should not eat any apples, not to mention the biggest one.

a. John (bù jǐn) chī-le píng-guǒ, hái chī-le nà-gè zuì-dà-de.
John NEG only eat-PRF apple HAI eat-PRF that-CL most-big

‘John ate an apple, and he ate the biggest one.’

John only ate one apple – the biggest one. The two sentences are about the same event.

b. * John (bù jǐn) chī-le nà-gè zuì-dà-de píng-guǒ, hái chī-le píng-guǒ.
John NEG only eat-PRF that-CL most-big apple HAI eat-PRF apple

Intended meaning: ‘John ate the biggest apple, and he ate an apple. (This sentence is also ungrammatical in English.)’

c. * John (bù jǐn) chī-le píng-guǒ, hái chī-le nà-gè zuì-xiǎo-de.
John NEG only eat-PRF apple HAI eat-PRF that-CL most-small

Intended meaning: ‘John ate an apple, and he ate the smallest one.’

- Without the utterance of a precedent sentence, only the two-dimensional *hái* reading would be available:

(23) Out-of-blue utterances:

a. John **hái** mǎi-le píng-guǒ.
John HAI buy-PRF apple

Temporal reading is available: previously, John bought apples; this time, it’s still the case that John bought apples.

Additive reading – ‘John also bought apples.’ – is not licensed.

b. yǔ **hái** xià de hěn dà.

rain HAI fall DE very big

Temporal reading is available: previously, it was raining heavily; currently, it is still raining heavily.

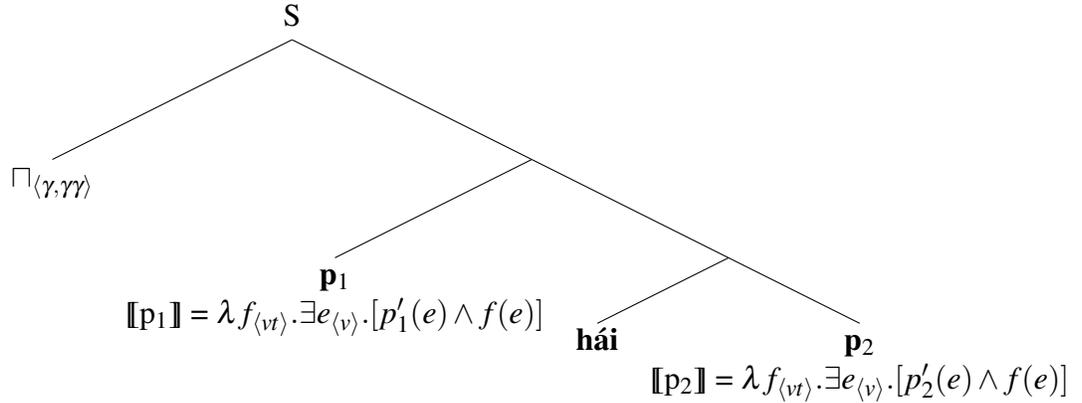
Additive reading – ‘in addition to the fact that it’s raining, it’s raining heavily’ – is not licensed.

3.2 A compositional analysis of additive *hái*

- Here is a compositional analysis for an additive *hái*-sentence implemented in the event semantics:

(24) **p₁ hái p₂**

LF of a one-dimensional *hái*-sentence (a silent intersective operator is inserted):



- For the reading that the events introduced by **p₁** and **p₂** are different but similar:

$$[[S]] = \cap_{\langle \tau, \tau \tau \rangle} ([[p_1]]) ([[p_2]]) = \lambda f. [\exists e. [p'_1(e) \wedge f(e)] \wedge \exists e'. [p'_2(e') \wedge f(e')]]$$

Assertion: $\exists e. [p'_1(e)] \wedge \exists e'. [p'_2(e')]$ – There are two events.

Presupposition of *hái*:

(i) $p'_1 \not\subseteq p'_2 \wedge p'_2 \not\subseteq p'_1$ – The two events are different.

(ii) There is a contextually salient choice function f to close $[[S]]$, such that $[[S]] = \exists f. [\exists e. [p'_1(e) \wedge f(e)] \wedge \exists e'. [p'_2(e') \wedge f(e')]]$ – Both of the two events are in some f way².

- For the reading that **p₂** specifies and strengthens **p₁**:

$$[[S]] = \cap_{\langle \tau, \tau \tau \rangle} ([[p_1]]) ([[p_2]]) = \lambda f. [\exists e. [p'_1(e) \wedge f(e)] \wedge \exists e'. [p'_2(e') \wedge f(e')]]$$

Assertion: $\exists e. [p'_2(e)]$ – There is an event.

Presupposition of *hái*:

(i) $p'_2 \subset p'_1$ – the description of the event in the second sentence (i.e., *hái*-sentence) entails the description of the event in the precedent sentence (i.e., p'_2 specifies p'_1).

(ii) there is a contextually salient scale such that p'_2 is an extreme case on that scale (e.g., in a certain context, a heavy rain is considered to be more extreme than a mild rain).

² See Barker 2007 for a detailed analysis on ‘sameness’.

- Two examples:

- (25) guā-zhe fēng, **hái** xià-zhe yǔ.
blow-PROG wind HAI fall-PROG rain
'There's wind and there's rain.'

$$\begin{aligned} \llbracket p_1 \rrbracket &= \lambda e. [\text{wind}(e)] \\ \llbracket p_2 \rrbracket &= \lambda e. [\text{rain}(e)] \\ \llbracket S \rrbracket &= \sqcap_{\langle \tau, \tau \tau \rangle} (\llbracket p_1 \rrbracket)(\llbracket p_2 \rrbracket) = \\ &\lambda f. [\exists e. [p'_1(e) \wedge f(e)] \wedge \exists e'. [p'_2(e') \wedge f(e')]] \\ \text{Assertion: } &\exists e. [\text{wind}(e)] \wedge \exists e'. [\text{rain}(e')] \end{aligned}$$

Presupposition of *hái*:

- (i) $[\lambda e. \text{wind}(e) \not\subseteq \lambda e. \text{rain}(e)] \wedge [\lambda e. \text{rain}(e) \not\subseteq \lambda e. \text{wind}(e)]$
(ii) There is a contextually salient choice function f such that $\llbracket S \rrbracket = \exists f. [\exists e. [\text{wind}(e) \wedge f(e)] \wedge \exists e'. [\text{rain}(e') \wedge f(e')]]$, i.e. both of the raining event and the winding event are in some f way.
- (26) wài-miàn (bù jǐn_{only}) xià-zhe yǔ, **hái** xià de hěn dà.
outside NEG only fall-PROG rain HAI fall DE very big
'Not only it's raining, but also it's raining heavily.'

$$\begin{aligned} \llbracket p_1 \rrbracket &= \lambda e. [\text{rain}(e)] \\ \llbracket p_2 \rrbracket &= \lambda e. [\text{rain}(e) \wedge \text{heavy}(e)] \\ \llbracket S \rrbracket &= \sqcap_{\langle \tau, \tau \tau \rangle} (\llbracket p_1 \rrbracket)(\llbracket p_2 \rrbracket) = \\ &\lambda f. [\exists e. [p'_1(e) \wedge f(e)] \wedge \exists e'. [p'_2(e') \wedge f(e')]] \\ \text{Assertion: } &\lambda e. [\text{rain}(e) \wedge \text{heavy}(e)] \end{aligned}$$

Presupposition of *hái*:

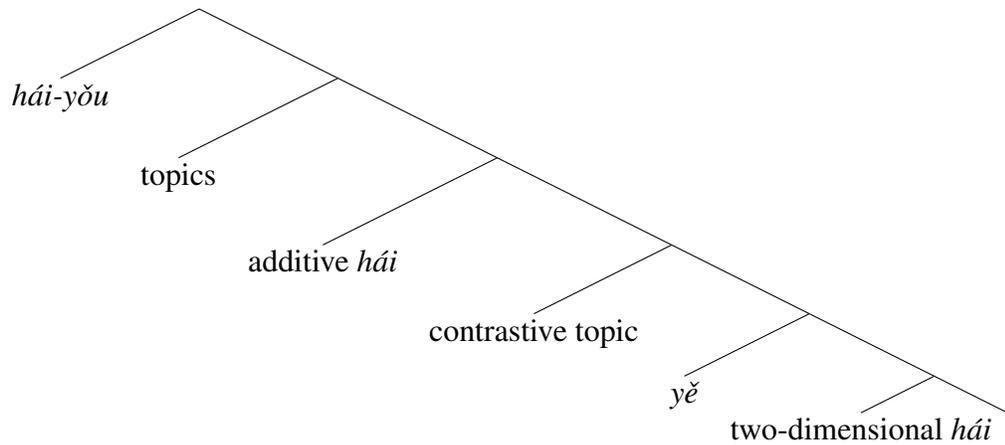
- (i) $\lambda e. [\text{rain}(e) \wedge \text{heavy}(e)] \subset \lambda e. [\text{rain}(e)]$
(ii) there is a contextually salient scale such that $\lambda e. [\text{rain}(e) \wedge \text{heavy}(e)]$ is an extreme case on that scale.

4 Is there a unified account?

4.1 Perhaps no?

- Syntactically, two-dimensional *hái* and additive *hái* have different positions: two-dimensional *hái* is the lower-positioned one and additive *hái* is the higher-positioned one.

- (27) The syntactic hierarchy:



• Evidence:

(28) *hái-yǒu* / additive *hái* > contrastive topic > *yě*

a. John gěi wǒ xiě-le yī-fēng xìn, (tā) **hái** gěi Bill **yě** xiě-le yī-fēng
 John to 1SG write-PRF one-CL letter 3SG HAI to Bill also write-PRF one-CL
 (xìn).
 letter

b. Meaning: John sent a letter to me, he also sent a letter to Bill.
 Assertion of the second part (the *hái*-sentence part): John sent a letter to Bill.
 Presuppositions of the second part:

- *hái-yǒu* / *hái*: there is a precedent sentence; the events introduced in the *hái*-sentence and in the precedent sentence are different events but these two events are similar.
- *yě*: there is a contextually salient event, such that the event introduced in the *yě*-sentence and that event are different events but these two events are similar.

Only the additive reading is possible in all the three sentences; no two-dimensional reading is available.

(29) *yě* > two-dimensional *hái*:

a. Paris **yě** **hái** zài xià yǔ.
 Paris also HAI at fall rain

b. Meaning: it is still raining at Paris, too.
 Assertion: At the reference time t_0 , it is raining in Paris.

Presuppositions:

- *hái*: There is a contextually salient time point t' earlier than t_0 such that it was also raining at t' in Paris.
- *yě*: There is a contextually salient city a other than Paris, such that it is also still raining in a at the reference time t_0 , i.e., in that city a , it is raining at t_0 , and there is a contextually salient time point t'' earlier than t_0 such that it was also raining at t'' in the city a .

- Since the structural positions of additive *hái* and two-dimensional *hái* are different, this difference might suggest that the two *hái* are actually different.
- However, it might also be possible that *hái* has a basic meaning, and the position difference of the two uses of *hái* leads to the semantic difference. Then what is the basic meaning of *hái*?

4.2 Perhaps yes?

- Actually the additive use of *hái* is very similar to the use of *and*:
 - Both of them are licensed by the discourse order: it's weird to start a sentence by '*and* ...' out of blue.
 - Both of them require that the items it connects are somehow similar.

- (30) a. John bought apples, **and** he bought pears.
 b. John mǎi-le píng-guǒ, **hái** mǎi-le lí.
 John buy-PRF apple HAI buy-PRF pear
 'John bought apples, *and* John bought pears.'

- There is evidence in support of the view that *and* is not an operator, but marks an itemization.

(31) Among Bill, Mary, Sue, John and Sandy, John is the tallest person. (F. Moltmann)

- Could *hái* be a similar marker, which especially marks the last item of an order-sensitive itemization?
 - In the case of additive *hái*, the order-sensitive itemization is based on the discourse order.
 - In the case of two-dimensional *hái*, the order-sensitive itemization is based on the order of the scale in the dimension of the independent variable of the mapping function f . The *hái*-sentence entails all the previous propositions along this scale.

5 Concluding remarks

- This paper gives a detailed account for various uses of Chinese additive particle *hái*:
 - For the two dimensional use of *hái*, essentially speaking, two scales are involved in the *hái*-sentence and they are monotonically mapped up by a function f : *hái* brings the meaning that while things in the dimension of the independent variable of f change, things in the dimension of the dependent variable of f do not change a lot.
 - The use of additive *hái* is based on the discourse order: additive *hái*-sentences require the utterance of a precedent sentence, and the *hái*-sentence either expresses something similar to the precedent sentence or strengthens the meaning of the precedent sentence.
- A further question is whether there is a way to unify two-dimensional *hái* and additive *hái*.
 - This question is left for future studies.

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