Wh-indefinites in Mandarin: The case of *shenme*

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September 19, 2023

Wh-indefinites in Mandarin

(1) Zhangsan yudao *shei* / *shenme* ren liao le yihui
Zhangsan meet who what person chat ASP a.while
'Who did Zhangsan meet and chat with for a while?'
'Zhangsan met someone and chatted with her for a while. (I don't know who he met).'

(2) Zhangsan cang zai *nali* / *shenme* difang
Zhangsan hides in where / what place
'Where does Zhangsan hide?'
'Zhangsan hides somewhere. (I don't know where he hides).'

- *Wh*-words in Mandarin can have a non-interrogative indefinite reading in addition to its interrogative use (and henceforth *wh*-indefinites).

Shenme?

(3) Zhangsan yudao *san ge *shei* / san ge *shenme* ren
Zhangsan meet three CL who three CL what person
liao le yihui
chat ASP a.while
'What three people did Zhangsan meet and chat with for a while?'
'Zhangsan met three people and chatted with them for a while. (I don't know who he met).'

(4) Zhangsan cang zai *yi ge *nali* /
Zhangsan hides in one CL where /
yi ge *shenme* difang
one CL what place
'Where does Zhangsan hide?'
'Zhangsan hides somewhere. (I don't know where he hides).'

What are classifiers in Mandarin?

(5) a. shu
book
'a book / the book / books / the books'
Bare nouns

b. yi/san ben shu
one/three CL book
'one book / three books' Non-bare nouns

- No morphology for singularity/plurality, (in)definiteness
- Mostly, classifiers are required to count/measure nouns
$\mapsto$ bare nouns vs. non-bare nouns

Shenme: bare vs. non-bare forms

(6) a. Zhangsan mai-le *shenme* shu
Zhangsan buy-PRF what book
'Zhangsan bought book(s). (I don't know what).'
'What book(s) did Zhangsan buy?'

Bare *shenme*

b. Zhangsan mai-le yi/san ben *shenme* shu
Zhangsan buy-PRF one/three CL what book
'Zhangsan bought one book / three books. (I don't know what).'
'What one book / three books did Zhangsan buy?'

Non-bare *shenme*

- Similarly, *shenme* can appear with and without classifiers
  $\mapsto$ bare *shenme* vs. non-bare *shenme*

Now . . .

- Treat *shenme* as an epistemic indefinite (henceforth EI)
- Show the distribution of bare and non-bare *shenme* with respect to the uses identified for EIs

Epistemic indefinites

- Having a conventionalized ignorance inference [AP10, AP15]
  - German *irgendein*, Spanish *algún*, Italian *un qualche*
  - Mandarin *shenme*

(7) a. *Irgendein* Student hat angerufen. #Rat mal wer?
some student has called guess PART who
'Some student called. (I don't know who).'

b. Xiaohong gen (yi ge) *shenme* ren jiehun-le. #Ni cai shi shui? / #Jiushi Xiaoming.
Xiaohong with (one CL) what person marry-PRF you guess be who / namely Xiaoming
'Xiaohong married somebody. (I don't know who).'

c. *Somebody* called. Guess who?

Possible functions of EIs

- Ignorance (more than one alternatives possible) $\mapsto$ SU, epiU
  - Unembedded $\mapsto$ SU
  - Embedded under epistemic modals $\mapsto$ epiU
- Plain negated existentials $\mapsto$ NPI
- Free choice (all the alternatives possible) $\mapsto$ deoFC
- Co-variation (narrow scope reading) under universal quantifiers $\mapsto$ co-var

	SU	epiU	NPI	deoFC	co-var
Bare *shenme*	✓	✓	✓	#[1]	✓
Non-bare *shenme*	✓	✓	#	✓	✓
German *irgendein*	✓	✓	✓	✓	✓
Spanish *algún*	✓	✓	✓	#	✓
Italian *un qualche*	✓	✓	#	#	✓

[1] Judgement by [Law19].

Partial vs. total variation

(8) a. Partial variation: $\exists x \exists y(\Diamond\phi(x) \wedge \Diamond\phi(y) \wedge x \neq y)$

b. Total variation: $\forall x \Diamond\phi(x)$

epiU

Context: John and Mary knew that Peter went on a trip last week, but they did not know where he went. They were talking about where Peter could have gone. John suggested:

(9) Ta keneng qu-le (yi ge) Ouzhoude *shenme* chengshi.
he possibly go-PRF (one CL) European what city
'He could have gone to an European city.'

Context: Mary knew that Peter stayed with a friend during his trip, and Peter only had two overseas friends, one in London and one in Berlin. So, she added:

(10) *Bu dui. Ta zhi keneng qu-le Lundun huo Bolin.
not right he only possibly go-PRF London or Berlin
'No, he could only have gone to London or Berlin.'

NPI

(11) a. Zhangsan mei mai *shenme* shu.
Zhangsan NEG buy what book
'Zhangsan didn't buy any book.' NPI ✓

b. ?Zhangsan mei mai san ben *shenme* shu.
Zhangsan NEG buy three CL what book
'Zhangsan didn't buy any three books.' NPI
'Zhangsan didn't buy three specific books (and I don't know which three). SU ✓

deoFC

Context: John and Mary were planning a trip to Europe. John suggested:

(12) Women keyi qu *(yi ge) Ouzhoude *shenme* chengshi.
we can go one CL European what city
'We can go to an European city (whichever will work).'

Context: Mary knew that they could only visit an European city where they had a friend to stay with. Since they only had a friend in London and a friend in Berlin, she added:

(13) Bu dui. Women zhi keyi qu Lundun huo Bolin.
no right we only can visit London or Berlin
'No, we can only go to London or Berlin.'

[Law19]

Co-var

(14) Mei ge ren dou mai-le (yi ben) *shenme* shu.
every CL person PART buy-PRF one CL what book
'Everyone bought one book / book(s).'
⇝ Wide scope reading: There is/are (a) specific book(s) bought by all the people, and I don't know which book(s).
SU ✓

⇝ Narrow scope reading: Different people bought different books. There are at least two different books / two combinations of books being bought.
co-var ✓

Interim summary

	SU	epiU	NPI	deoFC	co-var	Q
Bare *shenme*	✓	✓	✓	#[2]	✓	✓
Non-bare *shenme*	✓	✓	#	✓	✓	✓

- Form distinction between bare and non-bare *shenme*
  - NPI only available for bare *shenme*
  - deoFC only available for non-bare *shenme* [Law19]
- *Shenme* as both an EI and a question word

[2] Judgement by [Law19]

Proposal

- Team Semantics [AD22, AD23]
  - Formulas are interpreted with respect to teams (as sets of assignments)
  - Two-sorted: individuals in D and possible worlds in W
- Extending Team Semantics [AD22, AD23] with:
- Plurality:
  - Allowing both singular and plural individuals in the domain
  - Numeral classifiers individuate and count Mandarin nouns in terms of atoms (one, two, ... CL: $\#x = 1, 2, \ldots$) [Law19]
- Questions:
  - The distinction between declarative and interrogative is captured at the level of contexts (pairs of an initial team and an issue)

Plurality

Definition (Pluralized Domain)

Given a domain of individuals D, the pluralized domain generated by D is the join semi-lattice $(\uparrow D, \oplus)$ isomorphic to $(\mathcal{P}(D) \setminus \{\varnothing\}, \cup)$ with $D \subseteq \uparrow D$ as set of atoms.

- In terms of the idempotent, commutative and associative binary operation of summation $\oplus$, we can further define a binary relation $\leq$ for elements in $\uparrow D$ as follows: for all $x, y \in \uparrow D$, $x \leq y$ if and only if $x \oplus y = y$. Then the sum of x and y, $x \oplus y$, is the smallest entity in $\uparrow D$ which has x and y as its parts.
- For each plural individual $d \in \uparrow D$, we denote by $\textsc{atom}(d)$ the set of atoms a in D such that $a \leq d$ (or equivalently $d = a \oplus d$):

$$\textsc{atom}(d) = \{a \in D : a \leq d\}$$

Logic

Definition (Language)

Given a first-order signature σ (composed of predicates $P^n \in \mathscr{P}^n$ with $n \in \mathbb{N}$), and individual variables $z_d \in \mathscr{Z}_d$ and world variables $z_w \in \mathscr{Z}_w$, the terms and formulas of our language are:

$$t ::= z_d \mid z_w \mid \#z_d$$

$$\phi ::= P(\vec{z}) \mid \phi \wedge \psi \mid \phi \vee \psi \mid \exists_s z \phi \mid \exists_l z \phi \mid \forall z \phi \mid dep(\vec{z}, y) \mid var(\vec{z}, y)$$

Definition (Interpretation of Terms)

$$\begin{array}{ll} \text{if } t = z\text{:} & i(t) = i(z) \\ \text{if } t = \#z_d\text{:} & i(t) = |\textsc{atom}(i(z_d))| \end{array}$$

EI in proposal by [AD22, AD23]: variation

- EI: $\lambda P.\exists_s x[P(x, v) \wedge var(\varnothing, x)]$
- Core hypothesis in [AD22, AD23]: EIs are strict existentials triggering the variation atom $var(\varnothing, x)$

v	x
...	d_1
...	d_2

Figure: Variation

My proposal: variation + maximality

- (Bare) *shenme*: $\lambda P.\exists_s x[P(x,v) \wedge var(\varnothing, x) \wedge max(x,v,P)]$
- Non-bare *shenme*: for example, *three* CL *shenme*, $\lambda P.\exists_s x[P(x,v) \wedge var(\varnothing, x) \wedge max(x,v,P) \wedge \#x = 3]$
- The maximality condition:
  - $max(x,v,P)$: the value of x is maximal with respect to the property P in the possible world v
- This derives ...
  - SU, epiU, co-var (from [AD22, AD23])
  - NPI for bare rather than non-bare *shenme*

Definition (Maximality)

$\uparrow M, T \models max(x,v,P)$ iff for all $i \in T$: $\langle i(x), i(v)\rangle \in I_{\uparrow M}(P)$ and for all $d \in \uparrow D$: if $\langle d, i(v)\rangle \in I_{\uparrow M}(P)$, then $d \leq i(x)$.

The maximality condition

(15) a. Zhangsan mai-le *shenme* shu.
Zhangsan buy-PRF what book
'Zhangsan bought book(s).' Bare *shenme*

b. Zhangsan mai-le yi ben *shenme* shu.
Zhangsan buy-PRF one CL what book
'Zhangsan bought one book.' Non-bare *shenme*

- Context: You saw Zhangsan coming out from a bookstore with the book *a* on his hand, but you didn't know if he bought another book *b*. In this context, (15-a) is true whereas (15-b) is NOT.

v	x
w_a	a
w_{ab}	b

(a) Without maximality: (15-b) is true (#)

v	x
w_a	a
w_{ab}	$a \oplus b$

(b) With maximality: (15-b) is false (✓)

Deriving NPI: three forms under negation

(16) Zhangsan mei mai *shenme* shu.
Zhangsan NEG buy what book
'Zhangsan didn't buy any book.' NPI

Bare *shenme* $\mapsto$ NPI

(17) ?Zhangsan mei mai yi/liang ben *shenme* shu.
Zhangsan NEG buy one/two CL what book
\# 'Zhangsan didn't buy any one/two book(s).' #NPI
'Zhangsan didn't buy one/two specific book(s).' SU

Non-bare *shenme* $\mapsto$ SU

(18) Zhangsan mei mai *yi/liang ben shu.
Zhangsan NEG buy one/two CL book
'Zhangsan didn't buy one/two book(s).'

Only numeral classifiers under negation

*one CL vs. two CL

Deriving NPI

	Construction	Interpretation	Reason
	bare *shenme*	0	NPI
#	one CL	$\ngeq 1$	in competition with bare *shenme*
#	one CL *shenme*	$\neq 1$	non-convex
	two CL	$\ngeq 2$	
#	two CL *shenme*	$\neq 2$	non-convex

Definition (Intensional Negation [AD23, FB20])

$\neg\phi \Leftrightarrow \forall w[\phi(v/w) \rightarrow v \neq w]$

- Bare *shenme* under negation $\mapsto$ NPI as in [AD23]
- Non-bare *shenme* under negation (given the maximality condition) $\mapsto$ only nouns having the exact number of atoms in accordance with that of the numeral classifier are negated

Illustration: bare *shenme*

$$\forall w(\exists_s x[P(x,w) \wedge dep(vw,x) \wedge var(\varnothing,x) \wedge max(x,w,P)] \rightarrow v \neq w)$$

v	w	x
$w_\varnothing$	$w_\varnothing$	a
$w_\varnothing$	w_a	a
$w_\varnothing$	w_{ab}	$a \oplus b$
$w_\varnothing$	w_{abc}	$a \oplus b \oplus c$

(a) Initial team $T = \{w_\varnothing\}$

v	w	x
w_a	$w_\varnothing$	a
w_a	w_a	a
w_a	w_{ab}	$a \oplus b$
w_a	w_{abc}	$a \oplus b \oplus c$

(b) Initial team $T = \{w_a\}$

v	w	x
w_{ab}	$w_\varnothing$	a
w_{ab}	w_a	a
w_{ab}	w_{ab}	$a \oplus b$
w_{ab}	w_{abc}	$a \oplus b \oplus c$

(c) Initial team $T = \{w_{ab}\}$

v	w	x
w_{abc}	$w_\varnothing$	a
w_{abc}	w_a	a
w_{abc}	w_{ab}	$a \oplus b$
w_{abc}	w_{abc}	$a \oplus b \oplus c$

(d) Initial team $T = \{w_{abc}\}$

Figure: Bare *shenme*: felicitous when initial team $T = \{w_\varnothing\}$

Illustration: two CL

$$\forall w(\exists_s x[P(x,w) \wedge dep(vw,x) \wedge \#x = 2] \rightarrow v \neq w)$$

v	w	x
$w_\varnothing$	$w_\varnothing$	$a \oplus b$
$w_\varnothing$	w_a	$a \oplus b$
$w_\varnothing$	w_{ab}	$a \oplus b$
$w_\varnothing$	w_{abc}	$a \oplus b$

(a) Initial team $T = \{w_\varnothing\}$

v	w	x
w_a	$w_\varnothing$	$a \oplus b$
w_a	w_a	$a \oplus b$
w_a	w_{ab}	$a \oplus b$
w_a	w_{abc}	$a \oplus b$

(b) Initial team $T = \{w_a\}$

v	w	x
w_{ab}	$w_\varnothing$	$a \oplus b$
w_{ab}	w_a	$a \oplus b$
w_{ab}	w_{ab}	$a \oplus b$
w_{ab}	w_{abc}	$a \oplus b$

(c) Initial team $T = \{w_{ab}\}$

v	w	x
w_{abc}	$w_\varnothing$	$a \oplus b$
w_{abc}	w_a	$a \oplus b$
w_{abc}	w_{ab}	$a \oplus b$
w_{abc}	w_{abc}	$a \oplus b$

(d) Initial team $T = \{w_{abc}\}$

Figure: Two CL: felicitous when initial team $T = \{w_\varnothing\}, \{w_a\}$

Illustration: two CL *shenme*

$\forall w(\exists_s x[P(x,w) \wedge dep(vw,x) \wedge var(\varnothing,x) \wedge max(x,w,P) \wedge \#x = 2] \rightarrow v \neq w)$

v	w	x
$w_\varnothing$	$w_\varnothing$	a
$w_\varnothing$	w_a	a
$w_\varnothing$	w_{ab}	$a \oplus b$
$w_\varnothing$	w_{abc}	$a \oplus b \oplus c$

(a) Initial team $T = \{w_\varnothing\}$

v	w	x
w_a	$w_\varnothing$	a
w_a	w_a	a
w_a	w_{ab}	$a \oplus b$
w_a	w_{abc}	$a \oplus b \oplus c$

(b) Initial team $T = \{w_a\}$

v	w	x
w_{ab}	$w_\varnothing$	a
w_{ab}	w_a	a
w_{ab}	w_{ab}	$a \oplus b$
w_{ab}	w_{abc}	$a \oplus b \oplus c$

(c) Initial team $T = \{w_{ab}\}$

v	w	x
w_{abc}	$w_\varnothing$	a
w_{abc}	w_a	a
w_{abc}	w_{ab}	$a \oplus b$
w_{abc}	w_{abc}	$a \oplus b \oplus c$

(d) Initial team $T = \{w_{abc}\}$

Figure: Two CL *shenme*: felicitous when initial team $T = \{w_\varnothing\}, \{w_a\}, \{w_{abc}\}$

Questions

Definition (Interrogative Extension)

$T[\exists_s \vec{x}\phi] = T'[\vec{f_s}/\vec{x}]$, where T' is a maximal subset of T such that $T'[\vec{f_s}/\vec{x}] \vDash \phi$ if there is such a unique $\vec{f_s}$, otherwise undefined.

Definition (Partition)

The partition $\textsc{Part}(\exists_s \vec{x}\phi, T)$ generated by an interrogative $\exists_s \vec{x}\phi$ over the initial team T is an equivalence relation R over T such that for all $i, j \in T$, $R(i,j)$ iff

$$i \preceq T[\exists_s \vec{x}\phi]_{\vec{x}=\vec{d}} \Leftrightarrow j \preceq T[\exists_s \vec{x}\phi]_{\vec{x}=\vec{d}} \text{ for all } \vec{d},$$

where $T_{\vec{x}=\vec{d}} = \{i \in T : i(\vec{x}) = \vec{d}\}$.

v
$w_\varnothing$
w_a
w_b
w_{ab}

(a) Initial team T

v	x
w_a	a
w_b	b
w_{ab}	$a \oplus b$

(b) Maximal subteam T' such that $T'[\vec{f_s}/\vec{x}] \vDash C(x,v) \wedge max(x,v,C)$ with a unique $\vec{f_s}$

v	
$w_\varnothing$	
w_a	a
w_b	b
w_{ab}	$a \oplus b$

(c) Partition

Figure: 'Who came?' $\exists_s x[C(x,v) \wedge max(x,v,C)]$

Application: plain polar interrogative

(19) a. Zhangsan mai-le Zhanzhengyuheping ma?
Zhangsan buy-PRF war.and.peace PART
'Did Zhangsan buy *War and Peace*?'

b. $\exists_s P(b, v)$

v
$w_\varnothing$
w_a
w_b
w_{ab}

(a) Initial team T

v
w_b
w_{ab}

(b) Maximal subteam $T' \vDash P(b, v)$

v
$w_\varnothing$
w_a
w_b
w_{ab}

(c) Partition

Figure: Plain polar interrogative

Application: existential polar interrogative using *shenme*

(20) a. Zhangsan mai-le *shenme* shu ma?
Zhangsan buy-PRF what book PART
'Did Zhangsan buy book(s)?'

b. $\exists_s[\exists_s x[P(x,v) \wedge var(\varnothing, x) \wedge max(x,v,P)]]$

v
$w_\varnothing$
w_a
w_b
w_{ab}

(a) Initial team T

v	x
w_a	a
w_b	b
w_{ab}	$a \oplus b$

(b) Maximal subteam $T' \models \exists_s x[P(x,v) \wedge var(\varnothing, x) \wedge max(x,v,P)]$

v	x
$w_\varnothing$	
w_a	a
w_b	b
w_{ab}	$a \oplus b$

(c) Partition

Figure: Existential polar interrogative

Application: *wh*-interrogative using *shenme*

(21) a. Zhangsan mai-le *shenme* shu?
Zhangsan buy-PRF what book
'What book(s) did Zhangsan buy?'

b. $\exists_s x[P(x, v) \wedge var(\varnothing, x) \wedge max(x, v, P)]$

v
$w_\varnothing$
w_a
w_b
w_{ab}

(a) Initial team T

v	x
w_a	a
w_b	b
w_{ab}	$a \oplus b$

(b) Maximal subteam T' such that $T'[\vec{f_s}/\vec{x}] \models P(x, v) \wedge var(\varnothing, x) \wedge max(x, v, P)$

v	x
$w_\varnothing$	
w_a	a
w_b	b
w_{ab}	$a \oplus b$

(c) Partition

Figure: *Wh*-interrogative with bare *shenme*

Questions: decomposing forms

Form	Type
$P(a, v)$	plain declarative
$\exists_s x[P(x, v) \wedge var(\varnothing, x) \wedge max(x, v, P)]$	declarative with *wh*-indefinites *wh*-interrogative
$\exists_s P(a, v)$	plain (polar) interrogative
$\exists_s[\exists_s x[P(x, v) \wedge var(\varnothing, x) \wedge max(x, v, P)]]$	existential polar interrogative

- $\exists_s \vec{x} = \exists_s x_1, \ldots, x_n$, where:
  - Plain declaratives: ϕ without $\exists_s \vec{x}$
  - Plain/polar interrogatives: $\exists_s \vec{x}\phi$ with $n = 0 \mapsto \exists_s \phi$
  - $\exists_s \vec{x}\phi$ with $n \neq 0$: either declaratives or interrogatives depending on the context, namely, sentences with *shenme*
- Or, in terms of support in a context $C = (T, I)$:
  - Plain declaratives: for all C, $C \nvDash \phi_{int}$
  - Plain/polar interrogatives: for all C, $C \nvDash \phi_{decl}$
  - Mixed type of sentences: there are C, C' such that $C \vDash \phi_{decl}$ and $C' \vDash \phi_{int}$

Dual use of *shenme*: declarative & *wh*-interrogative

(22) a. Zhangsan mai-le *shenme* shu
Zhangsan buy-PRF what book
'Zhangsan bought book(s) (I don't know which).'
'What book(s) did Zhangsan buy?'

b. $\exists_s x[P(x,v) \wedge var(\varnothing, x) \wedge max(x,v,P)]$

v	x
w_a	a
w_b	b
w_{ab}	$a \oplus b$

(a) Context supporting declarative

v	x
$\boxed{w_\varnothing}$	
$\boxed{w_a}$	a
$\boxed{w_b}$	b
$\boxed{w_{ab}}$	$a \oplus b$

(b) Context supporting *wh*-interrogative

Figure: Declarative vs. *wh*-interrogative using bare *shenme*

Conclusion

- *Shenme* is a strict existential with additionally the conditions of variation and maximality
- Deriving a uniform account for *shenme* to be used as an EI in declaratives and as a question word in interrogatives
- Future work for cross-linguistic comparison: if the maximality condition can be generalized to *wh*-indefinites in other languages

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