ATB-topicalization in Mandarin Chinese: an Intersective Operator Analysis[1]

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Abstract

In this paper, I discuss so-called "ATB-movement" in Chinese. I will show that these are in fact a case of topicalization, since they show the characteristics of both nominal topicalization and of *wh*-topicalization. For example, the ATB-extracted elements can be marked by the so-called 'topic markers' in Chinese. An ATB-extracted *wh*-element shows D-linking effects, which is a general property of *wh*-topics. ATB-topicalization in Chinese obeys all the independent syntactic constraints that apply to general topicalization, such as island effects. It has been shown that TopP exists in the left periphery in Chinese; it is the landing site for all topicalized materials. I will argue that it is also the landing site of ATB-topicalized elements. Semantically I will concentrate on the question how an identity answer is generated in Chinese ATB-movement. I will show that an Intersective Operator is generated at TopP and it extracts the common variable from the conjuncts. The common variable is generated in the intersection of the range (not the domain) of the coordinated functions. Only one copy of the two occurrences of the extracted elements is conserved at TopP due to the economy principle. I will show that Chinese ATB cases differ from English ones in that the Intersective Operator is the only interpretation tool that we need to get an identity reading in Chinese since there is no independent syntactic selectional restrictions on the nature (subject/object) of the exacted materials from both coordinates.

1. Introduction

Chinese is a so-called *wh*-in-situ language: *wh*-words stay in their base positions instead of moving to the scope position (cf. 1a). It has also been argued that so-called *wh*-topicalization exists in Chinese (Tang 1988, Wu 1999, Pan 2007, 2009, *to appear*). The relevant structure is carefully studied in Wu (1999), and the author proposes that the *in-situ wh*-word can undergo topicalization to the left periphery (cf. 1b).

(1) a. Zhangsan mai-le shenme?
Zhangsan buy-Perf what
'What has Zhangsan bought?'

b. # Shenme$_i$ Zhangsan mai-le t_i ?[2]
what Zhangsan buy-Perf
'What has Zhangsan bought?' (Wu 1999 : 82)

[1] The earlier version of this paper was presented at the workshop "Optionality in *wh*-Movement," organized by Anna Roussou and Christos Vlachos at the 19th International Symposium of theoretical and applied linguistics at the Aristotle University of Thessaloniki. I am grateful to the audience, especially, Kleanthes Grohmann and M. Rita Manzini, for their inspiring questions and comments. I also thank Anna Roussou for her detailed comments on the draft of the present paper. Two anonymous reviewers provided me many helpful suggestions. All remaining errors and shortcomings are my own responsibility.

[2] (1b) is a fully grammatical sentence in Wu (1999) since he gave a felicitous context for using it. I checked this sentence with my informants without giving any special context, the majority of them rejected it for the reasons like 'the sentence is unnatural'.

Furthermore Wu (1999) argues that for (1b) to be felicitous, a pre-established purchasing list should be presupposed, which means that the restriction of *shenme* 'what' should be presupposed.

Based on these assumptions, Pan (2006, 2007, *to appear*) further investigates the conditions of *wh*-topicalization and claims explicitly that only D(iscourse)-linked *wh*-words are allowed to be topicalized as shown in (2a), and bare (out-of-the-blue) *wh*-words like *shenme* 'what' cannot undergo topicalization as in (2b).

(2) a. [Na-dao cai]$_i$, Zhangsan chi-le t_i ?
which-CL. dish Zhangsan eat-Perf
'Which dish (is the one that) Zhangsan ate?'

b. * Shenme$_i$, Zhangsan chi-le t_i ?
what Zhangsan eat-Perf
('What did Zhangsan eat ?')

c. ? [Shenme cai]$_i$, Zhangsan chi-le t_i ?
what dish Zhangsan eat-Perf
'What dish (is the one that) Zhangsan ate?'

I also checked the original example (1b) in Wu (1999) and found that the sentence was not natural for many native speakers without any context. The D-linking restriction on *wh*-topics is referred to more generally in Pan (2009) as the 'Contextual Constraint' since a complex form like *shenme cai* 'what dish' in (2c) is still accepted by many native speakers even though the '*what* + NP' form is not generally considered to be a D-linking *wh*-item in the sense of Pesetsky (1987). Syntactically, the nominal restriction on *wh*-topics provides a restrictive set to *wh*-variables. A *wh*-phrase such as *na-wei zuojia* 'which writer' contains a restrictive set {x| x= writer} from which the *wh*-word *na* 'which' can pick out a member. This provides a direct explanation for the fact that all *wh*-topics should be linked to discourse.[3] However, D-linked *wh*-phrases can also stay *in-situ* as in (3). The fact in Chinese is that all *wh*-topics, either those that are derived by movement or those that are base-generated, must be contextually constrained in the sense that they must apply a restrictive set[4]; while in-situ *wh*-words can be 'bare' or contextually constrained (Pan 2009). Therefore, contrary to the claim in Wu (1999) that D-linking is a result of the topicalization of *wh*-phrases, Pan (2007, 2009) takes D-linking as a pre-condition for *wh*-topicalization instead of a result of the latter[5].

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[3] As an anonymous reviewer correctly points out, it is not always appropriate to associate topics with 'given information'. The semantic properties of topicalized *wh*-phrases do not derive from the (incorrect) relationship between topics and given information, but rather from the set of properties associated with D-linked *wh*-phrases (such as the choice from a pre-established set etc.), assuming that only D-linked *wh*-phrases can be topicalized.

[4] See Erteschik-Shir (2007) for detailed discussions on the relationship between restrictive set and topics.

[5] An anonymous reviewer points out quite reasonably that we should test the topicality of a *wh*-word marked by the aggressively non-D-linked element *daodi* 'to-the-bottom' (the equivalent of the English *the hell*). In fact, *daodi* is not that 'aggressively non-D-linked' compared with *the hell* in English, since *the hell* can never be used with a D-linked *wh*-element, but *daodi* in Chinese can, as shown in (i a, b).

(i) a. * Which book the hell did you read yesterday?
b. Ni zuotian daodi kan-le na-ben shu?
you yesterday the-hell read-Perf which-CL. book
'Which book did you read yesterday? (with the meaning of *the hell*)'

Therefore, *daodi* cannot really force a *wh*-element aggressively non-D-linked in Chinese, and thus it is not surprising to see a topicalized D-linked *wh*-element marked by *daodi*, as shown in (ii). In Chinese, *daodi* is an adverb which can be generated in a presubject position as a sentential adverb.

(3) Zhangsan chi-le na-dao cai ?
Zhangsan eat-Perf which-CL. dish
'Which dish did Zhangsan eat?'

Gasde & Paul (1996) are the first ones to show that there is a TopP in the CP domain in Chinese[6]. For both Wu (1999) and Pan (2007, 2009, *to appear*) fronted *wh*-phrases occupy the specifier position of TopP (cf. 4).

(4) [$_{CP}$ [$_{TopP}$ [Na-wei zuojia]$_i$, [$_{IP}$ Zhangsan zui xihuan t_i]]]?
which-CL. writer Zhangsan most like
'Which writer (is the one that) Zhangsan likes most?'

Based on this description of *wh*-topicalization, the present paper deals with so-called Across-The-Board movement in Chinese, which are illustrated in the following examples. In (5a), the Coordinate Phrase (&P) takes two IPs as its coordinates: "Zhangsan likes" and "Lisi dislikes". The coordinated IPs share the same complement, the *wh*-phrase *na-wei zuojia* 'which writer'. This sharing effect is not only syntactic but also semantic, since only a 'Single Identity' answer is allowed in (5b), which means that the answer is a potential complement of both IPs in the original coordination. A non-*wh* ATB-movement is illustrated in (c) where the ATB-fronted element is a normal DP.

(5) a. Na-wei zuojia [$_{\&P}$ [$_{IP1}$ Zhangsan xihuan *e*] [$_{IP2}$ Lisi bu xihuan *e*]] ?
which-CL. writer Zhangsan like Lisi neg. like
'Which writer does Zhangsan like but Lisi dislike?' (ATB question)
b. J.K Rowling. (Single identity answer)
c. Na-wei[7] yingwen laoshi, [$_{\&P}$ [$_{IP1}$ wo xihuan *e*] [$_{IP2}$ wo-jiejie bu xihuan *e*]] .
that- CL. English teacher I like my-sister neg. like
'That English teacher, I like (her) (but) my sister doesn't like (her).'

An anonymous reviewer provides another supporting evidence by using the plural classier *xie*. For example, in the following example, *na-xie* 'which (ones)' requires a plural set. The answer to an ATB question with a plural *wh*-phrase must be the same set of plural individuals/entities for both conjuncts (c.f. 6).

(6) a. Na-xie zuojia, Zhangsan xihuan, Lisi bu xihuan?
which- CL.-PL writer Zhangsan like Lisi neg. like
'Who are those writers, such that Zhangsan likes but Lisi dislikes?'
b. Lu Xun, Ba Jin he Lao She. (Lu Xun, Ba Jin and Lao She).

The Chinese ATB-movement raises several interesting problems concerning syntactic derivation and semantic interpretation. There is an extensive literature on this type of

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(ii) Daodi na-ben shu$_j$, ni zuotian kan-le t_j ?
the-hell which- CL. book you yesterday read-Perf
'Which book is the one that you read yesterday? (with the meaning of *the hell*)'

[6] The fine structure of the CP in Chinese is developed in a detailed way in Paul (2002, 2005).

[7] The *wh*-word *which* (c.f. 5) and the demonstrative *that* (c.f. 6) are transliterated, not spelt in the same way as *na*.

construction in English and several formal mechanisms[8] have been proposed for the derivation and interpretation of ATB-movement. For the sake of space, I will not discuss these analyses in detail. However, there are a number of reasons for studying ATB-movement in Chinese. On the one hand, Chinese allows so-called *wh*-in-situ constructions. On the other hand, SVO is the normal order in Chinese. Therefore, *na-wei zuojia* 'which writer' in (5a) is clearly not in its base position. Thus, we can ask ourselves what syntactic position it occupies. ATB is then interesting because it exhibits what looks like *wh*-topics. Secondly, once we determine that the sentence-initial position of *na-wei zuojia* 'which writer' in (5a) is not its base position, then there are two possible explanations for its presence there: either it has moved or it is base-generated[9]. How can we determine which is the correct analysis? Thirdly, we need to know how 'single identity' answers are generated. This question is linked to the general semantic interpretation of ATB-extraction. In the following sections, I will go over these questions one by one.

2. ATB-topicalization in Chinese

In this section, I will first show the syntactic resemblance between *wh*-topicalization and the observed ATB-configuration. I will then argue that ATB-movement (both *wh*-extraction and normal DP-extraction cases) in Chinese can be reduced to a topicalization configuration.

2.1 *Wh*-topicalization and ATB in Chinese

One can assume that *na-wei zuojia* 'which writer' in (5a) is in the left periphery, that is, in the CP domain. For one thing, *na-wei zuojia* 'which writer' is not the subject of the sentence, so it cannot be in [Spec IP/VP]. Furthermore, *na-wei zuojia* 'which writer' is indeed the object of the IPs 'Zhangsan likes' and 'Lisi dislikes'. Since the sentence is not a passive structure either, the only possible option is that *na-wei zuojia* 'which writer' in (5a) is outside IP/TP, and in particular in [Spec, TopP], which is a position generally holding a topicalized element. If we argue that the inherent nature of the *wh*-ATB-fronting in (5) and that of the *wh*-topicalization in (4) are the same, we have to show that they share similar syntactic and semantic properties. We will also argue that the normal DP ATB-fronting and the normal DP topicalization share similar properties too.

(i) Contextual constraint

As I showed above, only D-linked *wh*-words such as *na-wei zuojia* 'which writer' and complex *wh*-phrases such as *shenme shu* 'what book' are allowed to undergo topicalization. Example (7a) shows that the Contextual Constraint also holds for ATB cases and that a bare *wh*-word like *shenme* 'what' is also excluded from ATB-extraction. The sentence can be

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[8] Munn (1993) proposes a Parasitic Gap analysis by claiming that overt movement of the *wh*-phrase comes from the first conjunct. Hornstein and Nunes (2002) treat ATB as a case of Sideward Movement. Based on Multiple Dominance configurations Citko (2003, 2005) proposes a Parallel Merge solution to the problem: a *wh*-word is merged to both conjuncts in a parallel fashion and this single occurrence of the shared *wh*-phrase is remerged to [Spec, CP]. Ha (2007) shows that there is much similarity between ATB and RNR (Right Node Raising) constructions. Based on the claim that RNR is a type of Ellipsis (Merchant 2001) Ha concludes that ATB is also a case of Ellipsis.

[9] Base-generated topics also exist in Chinese:

(iii) Hua a, wo xihuan meigui.
flower TM I like rose
'As for flowers, I like roses.'

considerably improved when *shenme* 'what' is replaced by *shenme dongxi* 'what thing' as in (7b).

(7) a. * Shenme, ni xihuan ta bu xihuan ?
what you like he neg. like
('What do you like but he doesn't like?')
b. Shenme dongxi, ni xihuan ta bu xihuan ?
what thing you like he neg. like
'What (thing) do you like but he doesn't like?

(ii) Referentiality
A nominal element in the TopP position shows referential effects. In Chinese, a 'demonstrative (such as '*zhe* 'this') + Cl(assifier) + noun' construction is allowed in the topic position (cf. 8). A bare noun in TopP is ambiguous between a 'kind-denoting' reading and a referential reading. When a bare noun[10] in that position appears in a sentence denoting non-episodic eventualities both readings are possible (cf. 9a); while when it appears in a sentence denoting episodic eventualities it has only the definite reading (cf. 9b).

(8) Na-ben shu_i, jiejie mai-le t_i.
that-CL. book sister buy-Perf
'That book, my sister bought (it).'
(9) a. Shu_i, wo-didi bu xihuan t_i.
book my-brother neg. like
'The book(s)/Books, my brother doesn't like.' (definite/kind)
b. Shu_i, jiejie mai-le t_i.
book sister buy-Perf
'The book(s), my sister bought (it/them).' (definite)

The same referentiality effects can also be observed in (Chinese) ATB cases. In (10) the 'demonstrative + CL. + noun' pattern is allowed in the position that an ATB-extracted element occupies. In (11) a bare noun can get either a 'kind-denoting' reading or a definite reading in the landing site for ATB-extraction. All these facts show that ATB-extracted elements are in the TopP position and thus can be treated as topics.

(10) Na-ben shu, jiejie mai-le, wo kan-wan-le.
that-CL. book sister buy-Perf I read-finish-Perf
'That book, my sister bought (it) and I finished reading (it).'
(11) a. Shu, wo xihuan, wo-didi bu xihuan.
book I like my-brother neg. like
'The book(s)/Books, I like but my brother doesn't like.' (definite/kind)
b. Shu, wo mai-le, wo-didi mei mai.
book I buy-Perf my-brother neg. buy
'The book(s), I bought (it/them) but my brother didn't.' (definite)

The crucial fact is that a true indefinite noun is excluded from the topic position in Chinese (cf. 12a) and in English (cf. 12b).

[10] See Cheng & Sybesma (1999) for the detailed discussion on Chinese bare nouns on the subject and object positions.

(12) a. * Yi-ben shu, wo xihuan.
one-CL. book I like
('A book, I like.')
b. * A book, I like.

Tsai (1994) argues that in Chinese the pattern of '*one* + CL. + noun' is acceptable in the topic position only when 'one' has a cardinal reading (not an indefinite reading). His original example is given in (13):

(13) Yi-pian lunwen, wo hai keyi yingfu, (liang-pian na jiu tai duo le).
one-CL. paper I still can handle two-CL. that then too much Prt
'One paper, I still can handle. (Two papers, that's too much.)' (Tsai 1994:138)

ATB-movement shows exactly the same effects. When the ATB-extracted object is a definite noun the sentence is OK (cf. 14a); however, when the ATB-extracted object is an indefinite noun the sentence is bad (cf. 14b). This contrast seems to suggest that the ATB-extracted object can be treated as a topic.

(14) a. Na-ben shu, wo xihuan, wo-didi bu xihuan.
that-CL. book I like my-brother neg. like
'As for that book, I like (it) but my brother doesn't.'
b. * Yi-ben shu, wo xihuan, wo-didi bu xihuan.
one-CL. book I like my-brother neg. like
(*'As for one book, I like (it) but my brother doesn't.')

Let us next turn to another interesting phenomenon in Chinese. It is generally possible to derive the so-called Right-Node-Raising (RNR) structure in Chinese when the concerned nominal is referential (or specific).

(15) Women qicao-le, dongshihui tongguo-le na-xiang jueyi.
we draft-Perf board approve-Perf that-CL. resolution
'We drew up, (and) the board approved that resolution.'

However, it is possible that (15) is derived through the object deletion in the first clause, since we have no evidence to show that there is a landing site for the exacted 'that resolution' at the right periphery if the right periphery exists at all in Chinese. What is for sure is that a topic cannot exist at the right edge in Chinese, as shown in (16).

(16) * Yingwen hen bucuo, Zhangsan a.
English very good Zhangsan TM
('As for Zhangsan, (his) English is very good.')

In (17a) and (18a) we have a coordination of two parallel clauses which contain the same object. If, as in (17b) and (18b), we try to keep only a single occurrence of the object after the second conjunct in order to construct an RNR configuration, then the sentence becomes ungrammatical. This seems to suggest that it is hard to get an RNR when a bare noun is involved in Chinese. Nevertheless, when the shared object is leftward topicalized to TopP, which means deriving a leftward ATB pattern, the sentences are grammatical as indicated in (17c) and (18c).

(17) a. Mama zuotian mai-le yu, baba shao-le yu.
mother yesterday buy-Perf fish father cook-Perf fish
'My mum bought the fish yesterday, (and) my father cooked (the) fish.'
b. * Mama zuotian mai-le, baba shao-le, yu.
mother yesterday buy-Perf father cook-Perf fish
('My mum bought and my father cooked (the) fish yesterday.')
c. Yu, mama zuotian mai-le, baba shao-le.
fish mother yesterday buy-Perf father cook-Perf
'(The) fish, my mum bought (it) and my father cooked (it) yesterday.'

(18) a. Wo zuo-le zuoye, mama jiancha-le zuoye.
I do-Perf homework mother check-Perf homework
'I did (my) homework and my mum checked it.'
b. * Wo zuo-le, mama jiancha-le, zuoye.
I do-Perf mother check-Perf homework
('I did (and) my mum checked (my) homework.')
c. Zuoye, wo zuo-le, mama jiancha-le.
homework I do-Perf mother check-Perf
'(My) homework, I did (it) and my mum checked (it).'

We have three facts here: first, when the shared object is a bare noun, it is difficult to derive RNR in Chinese; second, the only possibility is extracting the shared object to the left periphery; and third, the extracted object shows referentiality effects. All these facts seem to suggest that the landing site for the extracted object is TopP in (17) and (18). For one thing, TopP cannot be on the right edge of the sentence in Chinese. This can explain why RNR is impossible in this case.[11] For another, it is to be expected that an indefinite noun is excluded from such a position as shown in the ATB case in (19).

(19) * Yi-jian yifu, mama xi-hao-le, wo liang-gan-le.
one-CL. cloth mum wash-good-Perf I air-dry-Perf
('A cloth, mum finished washing and I drying.')

(iii) Topic markers

Gasde & Paul (1996) argues that so-called 'pause markers' such as *ne* and *a* can be analyzed as the head of a TopP in Chinese. The idea is then adopted in the relevant literature and those particles, such as *ne*, *a* and *ya*, are called 'topic markers' when they actually appear right after a topic.[12] *Wh*-topics can also be marked by these topic markers (TM) that are generated under Top° (cf. 20a). Examples (20b, c) show that the ATB-fronted elements can be marked by these topic markers too. This supports the idea that ATB-fronted elements should be analyzed as topics as well.

(20) a. [$_{CP}$ [$_{TopP}$ [Na-dao cai]$_i$ [$_{Top°}$ a]], ni zui xihuan chi]]?
which- CL. dish TM you most like eat
'Which dish (is the one) that you like eating most?' (*Wh*-topic)

[11] As for other possible solutions to the RNR problems, we have no space to discuss them here. If we adopt the ellipsis approach or parallel merge approach, we also have to explain why these mechanisms do not work for Chinese RNR-configurations.

[12] *Ne* and *a* can be used at the end of *wh*-questions in Chinese but it is argued that they were not interrogative particles in that they cannot contribute the illocutionary force to *wh*-questions (Li 2006, Pan 2007). Both particles can also be used to mark topics in Chinese, and in this situation, there is not a clear difference between them.

b. Na-wei zuojia a, Zhangsan xihuan Lisi bu xihuan ?
which-CL. writer TM Zhangsan like Lisi neg. like
'Which writer (is the one that) Zhangsan likes but Lisi dislikes?' (ATB)

c. Mali a, Zhangsan xihuan Lisi bu xihuan.
Mary TM Zhangsan like Lisi neg. like
'As for Mary, Zhangsan likes (her) but Lisi dislikes (her).' (ATB)

(iv) Island constraints

An important question concerning ATB-movement is how ATB can escape the CSC (Coordinate Structure Constraint) proposed in Ross (1967). We have evidence to believe that there are actually exceptions to the CSC, such as the Internal Subject Hypothesis. If we believe that the subject is moved from its theta position below *v*P, it can violate CSC by moving to its surface position. Büring & Hartmann (1998) and Hartmann (1998) show that some coordinations are "asymmetric" in a way that permits apparent violations of the CSC. Many other linguists believe that a distinction should be made between CSC and other types of islands in that the CSC is not a movement constraint, but an LF constraint (Ruys1993, Fox 2000, Lin 2002, and Kato 2006). Fox (2000) argues that extraction out of the coordinate structure is possible if each conjunct obeys all the independent grammatical constraints (Multidimensional account).[13]

In this section, I will concentrate on other types of strong islands which are clear constraints on movement cases, such as complex NP and subject islands. Under the assumption that the observed ATB cases can be reduced to topicalization, we have to determine if *na-wei zuojia* 'which writer' in (5) undergoes movement or is base-generated. It is easy to see that in the observed ATB cases each conjunct contains a gap, and I will show that these gaps are derived by movement. Once we assume that the ATB-fronted elements undergo movement, we expect to get island effects if these elements are extracted out of islands. In order to test this claim, I build a complex-NP (a relative clause) within the coordination phrase in (21). If *na-wei zuojia* 'which writer' is a true base-generated topic, then no violation of locality constraints should be found. The ungrammaticality of (21) shows that there is island violation, leading us to conclude that these sentences are derived by movement.

(21) * Na-wei zuojia [Zhangsan xihuan [*e* xie] de shu,
which-CL. writer Zhangsan like write DE book
Lisi bu xihuan [*e* xie] de shu] ?
Lisi neg. like write DE book
('For which writer x, such that Zhangsan likes the books that x wrote but Lisi dislikes the books that x wrote?')

The same result can be found in (22a) and (22b) which contain two types of island respectively: a complex NP (CNPC) and a sentential subject.

(22) a. * Zhangsan, [[dajia dou xihuan *e*] de shuofa shi jiade ,
Zhangsan everyone all like DE rumour be false
[dajia dou bu xihuan *e*] de shuofa shi zhende].
everyone all neg. like DE rumour be true

[13] See Johnson (1996, 2009) for a detailed argumentation in favor of the view that gapping can be reduced to ATB cases.

('As for Zhangsan, the rumour that everyone likes (him) is false; the rumour that everyone doesn't like (him) is true.')

b * Zongtong, [[Zhangsan jian-guo *e*] [Lisi mei jian-guo *e*]]
president Zhangsan meet-Exp Lisi neg. meet-Exp
shi women hen jingya .
make us very surprised
(As for the president, that Zhangsan has met (him) (but) Lisi hasn't met (him) makes us very surprised.')

(v) Scope ambiguity

Wu (1999) makes a distinction between topicalization and normal *wh*-movement by using a scope ambiguity test. In English, *wh*-movement cannot cancel the 'scope ambiguity' effect but topicalization can.

(23) a. *Wh*-movement: [Which student]$_i$ did everyone see t_i? (∃>∀ / ∀>∃)
b. Everyone saw someone. (∃>∀ / ∀>∃)
c. Topicalization: Someone$_i$ everyone saw t_i . (∃>∀ / *∀>∃)

In (23a) the *wh*-movement of *which student* cannot disambiguate the sentence. The sentence is ambiguous between two readings with the universal quantifier phrase *everyone* taking either wide or narrow scope. In the former case, everyone is supposed to have seen a potentially different student, and in the latter case, everyone saw the same student. (23b) is ambiguous between two readings with the existential quantifier phrase *someone* having either narrow or wide scope. In the former case, everyone saw a potentially different person, and in the latter case everyone saw the same person. While in (23c) *someone* is topicalized to [Spec, TopP], the sentence can only have a reading where *someone* takes wide scope. The contrast between (23a) and (23c) shows that *wh*-movement cannot cancel the scope ambiguity but topicalization can. The same result can be found in Chinese. (24) is the original example in Wu (1999).[14]

(24) a. Meigeren dou mai-le shenme?
everyone all buy-Perf what
'What did everyone buy?'
(i) For every x, for which y, x bought y ?
(ii) For which y, for every x, x bought y ?
b. Shenme$_i$ meigeren dou mai-le t_i ?
what everyone all buy-Perf
'What did everyone buy?'
(i) *For every x, for which y, x bought y ?
(ii) For which y, for every x, x bought y ? (Wu 1999 :88)

An ordinary *in-situ wh*-question in (24a) is ambiguous between two possible readings with the universal quantifier expression *everyone* taking either wide or narrow scope. The fronting of the *wh*-object can disambiguate the sentence as shown in (24b). Thus (24b) is an argument to show that this is not *wh*-movement but *wh*-topicalization.

Now let us turn to ATB cases. First, we will start from a simple example,

[14] Wu (1999) uses simple *wh*-words like *shenme* 'what' in topic positions to illustrate the properties of *wh*-topics. However, they are not easily accepted as natural sentences by my informants without any given context. Again, as I pointed out earlier only complex *wh*-phrases can be topicalized.

(25) [$_{\&P}$ [$_{CP1}$ Mei-ge nansheng dou xihuan na-wei laoshi]
every-CL. boy all like which-CL. teacher
[$_{\&'}$ [$_{CP2}$ mei-ge nüsheng dou bu-xihuan na-wei laoshi]]] ?
every-CL. girl all dislike which-CL. teacher
'Which teacher does every boy like, which teacher does every girl dislike ?'
(Ambiguous between ∃>∀ / ∀>∃ in each CP)

In (25) the coordinated CPs are interpreted as two independent questions. These two CPs have the same structure with a universal quantifier phrase as subject and a *wh*-phrase as object. Each of them is ambiguous between two possible readings with *every boy*/ *every girl* taking either wide or narrow scope.

(26) [$_{\&P}$ [$_{CP1}$ [$_{TopP1}$ [Na-wei laoshi]$_i$ [$_{IP1}$ mei-ge nansheng dou xihuan t_i]]],
which-CL. teacher every-CL. boy all like
[$_{\&'}$ [$_{CP2}$ [$_{TopP2}$ [na-wei laoshi]$_i$ [$_{IP2}$ mei-ge nüsheng dou bu-xihuan t_i]]]]]?
which-CL. teacher every-CL. girl all dislike
'Which teacher (is the one that) every boy likes, which teacher (is the one that) every girl dislikes' (Non ambiguous ∃>∀ / *∀>∃ in each CP)

In (26) the *wh*-phrase moves to the left periphery in each CP. Each CP can only have one reading with *every boy*/*every girl* taking narrow scope. I suppose that the *wh*-phrase *na-wei laoshi* 'which teacher' is topicalized to [Spec, TopP] in both CPs respectively.

(27) [$_{CP}$ [$_{TopP}$ [Na-wei laoshi]$_i$, [$_{\&P}$ [$_{IP1}$ mei-ge nansheng dou xihuan t_i],
which-CL. teacher every-CL. boy all like
[$_{\&'}$ [$_{IP2}$ mei-ge nüsheng dou bu-xihuan t_i]]]]]?
every-CL. girl all dislike
'Which teacher does every boy like (but) every girl dislike?' (∃>∀ / *∀>∃)

(27) is the derived ATB-movement. The sentence is not ambiguous, and the only reading is the one with *na-wei laoshi* 'which teacher' taking wide scope over both conjuncts. The fact that the extraction of *na-wei laoshi* 'which teacher' out of the coordinate structure resolves the ambiguity of the original sentence suggests that the nature of this extraction is *wh*-topicalization. Along this line, the possible structure of the sentence in (27) that we can suggest at this stage is that a matrix CP takes a TopP as complement. The *wh*-phrase *na-wei laoshi* 'which teacher' moves to [Spec, TopP]. The complement of the TopP is a Coordinate Phrase which takes two IPs. We will see this in detail in Section 4.1.

(vi) Contrastivity
One difference between English and Chinese ATB-movement is that the former requires the coordinated clauses to be contrastive, while the latter does not. In English if the two conjuncts are not contrastive, the sentence is not as good as the one with contrastive conjuncts.[15]

(28) a. What does John like but Mary dislike?
b. ? What does John like and Mary also like?

However Chinese ATB cases do not require contrastivity as shown in (29).

[15] This contrastivity is crucial for the Ellipsis analysis on English ATB-constructions in Ha (2007).

(29) Na-bu dianying, Zhangsan hen xihuan Lisi ye hen xihuan?
which-CL. movie Zhangsan very like Lisi also very like
'Which movie (is the one that) Zhangsan likes and Lisi also likes?'

Generally in cases of topicalization in Chinese, including *wh*-topicalization, there is no contrastivity requirement on the 'topic-comment' structure. In other words, there is no special rule stating that a topic should bear [+ contrastive] in Chinese. If an ATB-fronted element in Chinese does show contrastivity effect exactly like its English counterpart, then we will be less sure that it is a common topic element like any other kind of topics in Chinese. Nevertheless, the fact that ATB-fronted elements do not trigger contrastivity can be viewed as an indirect argument to support the idea that the ATB-extracted element is a topic, because all of the other kinds of topics in Chinese do not require contrastivity either.

(vii) Finiteness constraint

Lu (1994), Ernst & Wang (1995) and Kuong (2006) observe that in Chinese sentence topics can occur in the initial position of a finite clause (cf. 30a) but not of a non-finite clause (cf. 30b).[16] According to Kuong (2006) this contrast is due to the different internal clausal structures of the two types of verbs. We will not repeat the full analysis here, but simply the relevant examples (c.f. 30).

(30) a. Baba shuo [**Zhangsan**$_i$ [women mingtian hui jiandao t_i]]. (Finite verb)
father say Zhangsan we tomorrow will see
'Father said we'd see Zhangsan tomorrow.'
b. * Zhangsan dasuan [**Mali**$_j$ [gaosu t_j yi-jian shi]]. (Non-finite verb)
Zhangsan intend Mary tell one-CL. thing

The following examples show that this constraint applies to ATB-extractions as well, which confirms the idea that ATB-extraction can be viewed as topicalization. (31a) illustrates extraction of the object DP *na-ben shu* 'which book' to the external topic position of the finite clause embedded under the matrix verb *shuo* 'say'. (31c) shows that such an extraction is impossible when the verb is non-finite. (31b) is the non-ATB-extraction version of (31c)[17].

(31) a. Baba shuo [**na-ben shu**$_i$ [wo yinggai du t_i
father say which-CL. book I should read
didi hai bu neng du t_i]]?
brother still neg. can read (Finite verb)
'Which book$_i$ (is the one that) my father says that I should read t_i but my younger brother cannot read t_i?'
b. Baba dasuan kankan **na-ben shu**
father intend have-a-look-at which-CL. book
(he) mai-xia **na-ben shu** ?
and buy which-CL. book (Non-finite verb)
(Lit.) 'My father intends to have a look at which book and to buy which book?'

[16] See Lu (1994), Ernst & Wang (1995) and Kuong (2006) for the difference of 'finiteness' between English and Chinese. The readers are also referred to Manzini (1992) for the discussion on extraction and finiteness.

[17] As one of the anonymous reviewers points out, in (31) the extracted DP *which book* cannot be regarded as an internal topic (i.e a TP internal topic, please see Paul (2002)) but rather an external topic extracted from the embedded finite VP. More importantly, there is no way to tell whether the object DP *which book* in (31b, c) occupies the TP-internal or the TP-external topic position of the non-finite complement clause.

c. *Baba dasuan **na-ben** **shu**$_j$ kankan t_j
father intend which-CL. book have-a-look-at
(he) maixia t_j ?
and buy (Non-finite verb)
('Which book$_i$ (is the one that) my father intends to have a look at t_j and to buy t_j?')

2.2 ATB-extraction from licensing contexts

Chinese *wh*-words can receive non-interrogative readings, such as existential and universal readings, in certain contexts (Huang 1982, Cheng 1991, Aoun and Li 1993, Tsai 1994, Lin 1996). Pan (2007) calls those contexts 'Licensing Contexts'. Licensing Contexts involve different operators which bind the variable provided by the *wh*-words and assign them the corresponding readings. Generally, these licensing contexts can be divided into two sub-kinds: non-ambiguous and ambiguous. In a non-ambiguous context, a *wh*-word can only have one reading. In an ambiguous context, a *wh*-word can have several readings according to the corresponding prosodic elements[18] placed on them. In this section, we will look at ATB-extraction in terms of these licensing contexts.

Non-ambiguous contexts include *yes-no* questions, 'A-not-A' questions, and *dou*-quantification sentences. According to the classification of the contexts in Pan (2007), non-ambiguous contexts are 'strong' in the sense that the operators generated in these contexts have to bind the *wh*-word as a variable. Our prediction is that if the shared *wh*-word is extracted from the conjuncts that contain non-ambiguous contexts, the sentence becomes ungrammatical due to vacuous quantification. Let us take universal quantification as an example:

(32) a. Zhangsan **wulun** shenme dongxi **dou** xihuan chi,
Zhangsan no-matter what thing all like eat
Lisi **wulun** shenme dongxi **dou** bu xihuan chi.
Lisi no-matter what thing all neg. like eat
'Zhangsan likes eating everything (no matter what) (but) Lisi likes eating nothing.'

b. * [Shenme dongxi]$_j$, Zhangsan **wulun** t_j **dou** xihuan chi
what thing Zhangsan no-matter all like eat
Lisi **wulun** t_j **dou** bu xihuan chi.
Lisi no-matter all neg. like eat

The universal quantification structure in Chinese is (*wulun*)...*dou* 'no matter…all', as pointed out by Lin (1996). Traditionally, *dou* 'all' is treated as a universal quantifier. The presence of *wulun* 'no matter' is not obligatory. Pan (2007) treats *wulun* 'no matter' as the scope marker of *dou*-quantification. (32b) shows that when we ATB-extract the *wh*-word from the coordinate structure, the sentence is bad as we predicted. The universal quantifier binds no variable and this results in vacuous quantification.[19]

[18] Every morpheme (character) has its own fixed tone(s). In a sentence certain words can be stressed in case of need. For example, a contrastive focus is obtained if the relevant lexical item is stressed. Intonation contours (rising, plat and falling) can be put at the end of sentences. In the case of *wh*-words, the different interpretations that arise are due to the interaction of word stress (not necessarily on *wh*-words) and sentence intonation.

[19] There is another way to rule out (32b): [*wulun shenme dongxi*] 'no matter what thing' forms a constituent (DP) and therefore blocks topicalization of the subpart *wulun*. Presumably this alternative will be further pursued.

An anonymous reviewer points out that given that *wulun* 'no-matter' marks the scope of *dou*-quantification, the following sentence is predicted to be grammatical under my analysis in terms of the ban against vacuous quantification in a "strong" context since the ATB-extracted *wh*-phrase is still under the scope of *wulun*. However, this sentence is ungrammatical:

The ambiguous contexts contain negative particles like *bu* 'not', weak quantifiers, such as *yidianr* 'a little', the progressive aspect particle *zai…zhe*, non-factive verbs, such as *renwei* 'think', some psychological verbs as *pa* 'afraid' and probability adverbs as *dagai* 'probably', and etc. When a *wh*-word appears within the scope of these elements, it is possible for it to have different readings, and the only way to disambiguate these is through word stress and sentence intonation. Pan (2007) treats these contexts as 'weak' contexts in the sense that they do not have to require a *wh*-word to be in their scope. Thus a natural prediction is that when the shared *wh*-word is ATB-extracted from the coordinate phrase, which means removed from the scope of the essential element of an ambiguous context, the sentence should also be correct because these essential elements do not create vacuous quantification effects. In this case, the ATB-extracted *wh*-word is not ambiguous any more and it gets an interrogative reading since this is the default reading for Chinese *wh*-words[20]. Here we just pick out two contexts from the list above.

(33) Non-factive verb *renwei* 'think'

a. Zhangsan **renwei** ni mai-le shenme dongxi,
Zhangsan think you buy-Perf what thing
Lisi **renwei** ni mai-le[21] shenme dongxi.
Lisi think you sell-Perf what thing

(i) 'Zhangsan thought that you've bought something; Lisi thought you've sold something' (∃)

(ii) 'What (thing) (is the one that) Zhangsan thought that you've bought (but) Lisi thought that you've sold?' (Q)

b. [Shenme dongxi]$_j$, Zhangsan **renwei** ni mai-le t_j
what thing Zhangsan think you buy-Perf

(iii) * Wulun shenme dongxi, Zhangsan dou xihuan chi, Lisi dou bu xihuan chi.
no-matter what thing Zhangsan all like eat Lisi all neg. like eat
('No matter what Zhangsan likes eating but Lisi dislikes eating.')

I think that this sentence is ruled out by its illogic semantic interpretation. Normally, it is impossible for Lisi not to eat anything in an out-of-the-blue context. The sentence becomes fully acceptable if I change slightly the restrictive set of the relevant *wh*-word:

(iv) Jintian wanshang, wulun na-dao chai, Zhangsan dou xihuan chi, Lisi dou bu xihuan chi.
today evening no-matter which-CL. dish Zhangsan all like eat Lisi all neg. like eat
'(Among all the dishes tonight), Zhangsan likes eating all of them, but Lisi dislikes all of them.'

[20] Pan (2007) claims that the interrogative reading is the default reading of Chinese *wh*-words. This is so because on the one hand, all the non-interrogative readings require an appropriate licensing context and a corresponding prosody; on the other hand, the interrogative reading requires neither context nor intonation as shown in (i). In a neutral context, such as (i) the only possible reading for the *wh*-word is the interrogative one and this leads us to the conclusion that the interrogative reading is the default reading.

(i) Ni xihuan chi shenme?
you like eat what
'What do you like eating?'
*'You like eating something.'

Even if the interrogative reading is an inherent (default) reading of Chinese *wh*-words, it is weak in the sense that it can be overruled by other possible readings when a potential binder with quantificational force appears in the context and c-commands the *wh*-word.

[21] The verb *buy* and the verb *sell* are transliterated, not spelt in the same way as *mai*.

Lisi **renwei** ni mai-le t_j ?
Lisi think you sell-Perf

(i) * 'There is something such that Zhangsan thought that you've bought (but) Lisi thought that you've sold.' (*∃)

(ii) 'What (thing) (is the one that) Zhangsan thought that you've bought (but) Lisi thought that you've sold?' (Q)

When, as in (33a) the *wh*-word *shenme dongxi* 'what thing' appears within the scope of the non-factive verb *renwei* 'think', the former receives an existential reading 'something' or an interrogative reading. In the existential reading, an existential quantifier is triggered by an appropriate prosodic element[22] under the scope of *renwei* 'think' and binds the *wh*-word as a variable. In the same environment, a different prosodic form triggers the interrogative reading of *shenme dongxi* 'what thing'. Since *renwei* 'think' constructs a 'weak' licensing context, it does not require the relevant *wh*-word to be within its scope. Therefore, the idea is that once we extract the *wh*-word out of the scope of *renwei* 'think', thus out of the scope of the existential quantifier, the only possible reading is interrogative, and this is indeed borne out as shown in (33b).

The same result can be found in other weak licensing contexts, such as in (34). When the *wh*-word is in the scope of a weak quantifier *yidianr* 'a little', the former receives either an existential or an interrogative interpretation under the appropriate prosody (cf. 34a). When the *wh*-word is ATB-topicalized out of the scope of *yidianr* 'a little', only the interrogative reading is possible as shown in (34b).

(34) Weak quantifier *yidiandian* 'a little'

a. **Yidiandian** shenme shir jiu zuyi ling mama shangxin;
little what thing just enough make mother sad
yidiandian shenme shir jiu zuyi rang baba nanguo
little what thing just enough make mother grieved

(i) 'Just only a little problem is enough to make mum sad and just only a little problem is enough to make dad grieved.' (∃)

(ii) 'For what problem x, such that just only a little x is enough to make mum sad; and for what problem y, such that just only a little y is enough to make dad grieved?' (Q)

b. [Shenme shir]$_j$, **yidiandian** t_j jiu zuyi ling mama shangxin;
what thing little just enough make mother sad
yidiandian t_j jiu zuyi rang baba nanguo
little just enough make mother grieved

(i) * 'Just only a little problem is enough to make mum sad and dad grieved.' (*∃)

(ii) 'For what problem x, such that just only a little x is enough to make mum sad and dad grieved?' (Q)

2.3 Summary

In this section, we have observed many syntactic properties of ATB-movement in Chinese, and we have argued that ATB can be reduced to topicalization configurations. We discussed two kinds of ATB cases: ATB-extraction of ordinary DPs and ATB-extraction of D-linked *wh*-phrases. The former is argued to be a case of topicalization and the latter is argued to be a

[22] The idea of Pan (2007, *to appear*) is that a prosodic element can be regarded as a realization of a quantifier which binds a *wh*-word as a variable. The insertion of these prosodic forms is only possible in WEAK licensing contexts. These prosodic elements include word stress and sentence intonation.

case of *wh*-topicalization. Since in previous studies, *wh*-topicalization in Chinese has been shown to be reducible to DP/NP topicalization cases, our suggestion is that the ATB-extraction of both DP and D-linked *wh*-phrases can be reduced to topicalization in Chinese. We went through various syntactic resemblances between ATB-extraction and topicalization in this section. In the following part, we will be concentrating on the semantics of ATB-extraction. Namely we have to figure out how single identity answers are generated in the case of ATB-extraction of a D-linked *wh*-phrase.

3. Intersective operator analysis

In ATB-movement, when we extract two identical items from each conjunct, what we get at the final stage is only a single occurrence under the TopP but not two. In previous studies concerning ATB in English, there are many proposals, such as the parasitic gap analysis (Munn 1993, 1999), the Parallel Merge analysis (Citko 2005, 2006) and the Ellipsis analysis (Ha 2007). I will not go into the details of these analyses here. I will concentrate only on the Chinese data reported in section 2, and then show that Chinese ATB cases are more general than English ATB ones. The generation of the single identity answer is crucial for ATB-configurations. In this section I will provide an account in terms of a reading that arises at syntax-semantics interface.

3.1 Intersective operator

We start from the following sentences. I assume that (35a) is the reconstructed original form before the ATB-extraction sentence in (35b). In the previous section, I argued that *na-wei zuojia* 'which writer' was extracted from both conjuncts in (35b) and underwent topicalization to [Spec, TopP].

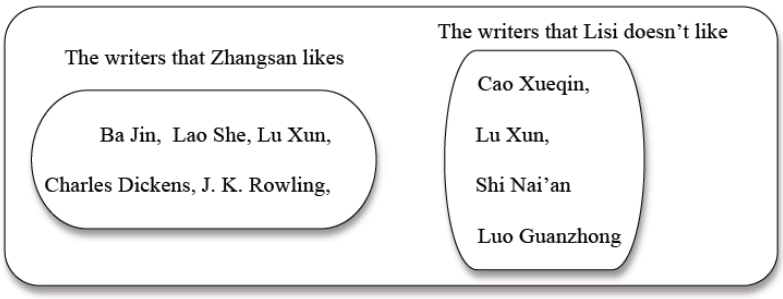
(35) a. Zhangsan xihuan na-wei zuojia,
Zhangsan like which-CL. writer
Lisi bu xihuan na-wei zuojia ?
Lisi neg. like which-CL. writer
'Which writer does Zhangsan like; which writer does Lisi dislike?'

b. [Na-wei zuojia]$_i$, [Zhangsan xihuan t_i, Lisi bu xihuan t_i] ?
which-CL. writer Zhangsan like Lisi not like
'Which writer does Zhangsan like (but) Lisi dislike?'

When we assume that (35b) is derived from (35a), we mean that the possible answers to (35a) contain the possible answers to (35b). The two conjuncts in (35a) can be regarded as two functions indicated respectively in (36a) and (36b). A possible answer to a question f(x) is the set of the range (image) of that function, and is written as 'y'. Thus the possible answers to (35a) can be treated as a UNION of the possible answers to each question in (35a), written as $y_1 \cup y_2$ (cf. 36c), represented in (36d).

(36) a. $y_1 = f(x_1)$ = Zhangsan likes x_1, $x_1 \in$ {writers}
b. $y_2 = f(x_2)$ = Lisi dislikes x_2, $x_2 \in$ {writers}
c. $y_1 \cup y_2$ = { y_1| $y_1 = f(x_1)$ = Zhangsan likes x_1, $x_1 \in$ {writers}} ∪
{ y_2| $y_2 = f(x_2)$ = Lisi dislikes x_2, $x_2 \in$ {writers}}
= { y_1, y_2| $y_1 = f(x_1)$ = Zhangsan likes x_1 & $y_2 = f(x_2)$ = Lisi dislikes x_2,
x_1, $x_2 \in$ {writers}}

d.

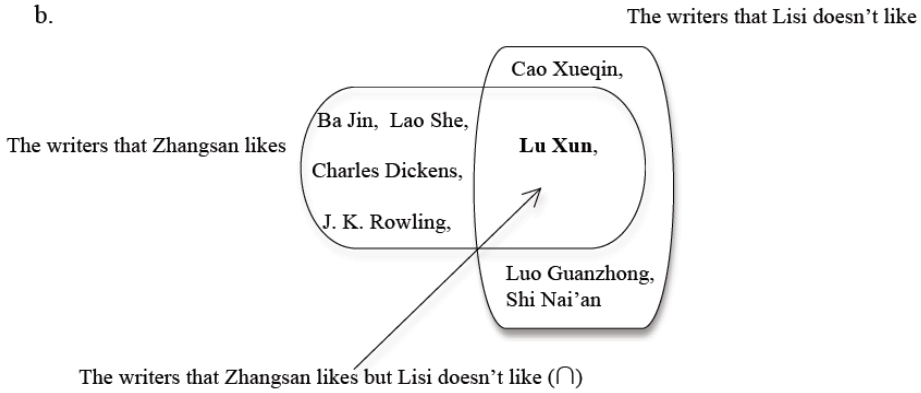


This analysis ensures that the two conjuncts are interpreted as parallel questions. Even though the variables x_1 and x_2 are restricted within the same set of 'writers', they do not necessarily have the same value in each conjunct. In other words, (36c) has two possibilities: either x_1 and x_2 are two distinct individuals, or they apply to the same person. In the former case, the writer that Zhangsan likes and the one that Lisi dislikes are different persons; in the latter case, they refer to the same writer. This leads us to consider the ATB case in (35b). ATB extraction ensures that the writer that Zhangsan likes and the one that Lisi dislikes are exactly the same person. This result is in fact the second possibility illustrated above for (36c). For this reason we say that the possible answers to (35a) include the possible answers to (35b).

Based on these assumptions, the only possible answer to (35b) is obtained when x_1 and x_2 refer to the same writer. The only requirement that can make the writer that Zhangsan likes and the one that Lisi dislikes be the same person is to make $x_1=x_2$. It is not difficult to see that in order for x_1 to equal x_2 what we need is the INTERSECTION of the ranges (images) of the two functions $f(x_1)$ and $f(x_2)$. Thus the question in (35b) can be treated as the intersection of the range of the two sub-questions in (35a). If and only if $x_1=x_2$, a licit answer is generated (cf. 37). A representation of a possible answer to the question in (35b) is given in (37b).

(37) a. $y_1 \cap y_2 = \{ y_1 | \ y_1 = f(x_1) = $ Zhangsan likes $x_1, x_1 \in \{$writers$\}\} \ \cap$
$\{ y_2 | \ y_2 = f(x_2) =$ Lisi dislikes $x_2, x_2 \in \{$writers$\}\}$
$= \{ y_1 = y_2 | \ y_1 = f(x_1) =$ Zhangsan likes x_1 & $y_2 = f(x_2) =$ Lisi dislikes x_2,
$x_1 = x_2 \in \{$writers$\}\}$

b.



The intersective operator gives us a common variable shared by both conjuncts and guarantees that it is the same variable which is extracted and finally moves to TopP. If our assumption is correct, a natural prediction is that the number of the conjuncts should not be limited to two. If the relevant operator is indeed an intersective operator, it can extract the common variable from three, four or even more conjuncts. Our prediction is borne out as

indicated in the following example. In (38) we have three conjuncts, and the extracted element *na-wei zuojia* 'which writer' is the shared object of these three conjuncts.

(38) [Na-wei zuojia]$_i$ [Zhangsan xihuan t_i, Lisi taoyan t_i, Wangwu zenghen t_i]?
which-CL. writer Zhangsan like Lisi dislike Wangwu hate
(Lit.) 'Which writer (is the one that) Zhangsan likes, Lisi dislikes and Wangwu hates?'

The fact that (38) is possible in Chinese suggests that the intersective operator is the only element that we need in order to derive the ATB-configuration in Chinese. Here is a test to prove that the relevant operator is indeed an intersective operator. Given that an intersection is an associative operation, we have:

(39) $A \cap B \cap C \equiv (A \cap B) \cap C \equiv A \cap (B \cap C) \equiv (A \cap C) \cap B$

Now I will use the associative operation to prove that the ATB extraction in (38) is derived by the intersective operation.

Firstly,

$(y_1 \cap y_2) \cap y_3$

= $(\{ y_1 | \ y_1 = f(x_1) =$ Zhangsan likes $x_1, x_1 \in \{writers\}\} \cap$
$\{ y_2 | \ y_2 = f(x_2) =$ Lisi dislikes $x_2, x_2 \in \{writers\}\}) \cap$
$\{ y_3 | \ y_3 = f(x_3) =$ Wangwu hates $x_3, x_3 \in \{writers\}\}$

= $\{y_1 = y_2 | \ y_1 = f(x_1) =$ Zhangsan likes x_1 & $y_2 = f(x_2) =$ Lisi dislikes x_2,
$x_1 = x_2 \in \{writers\}\} \cap \{ y_3 | \ y_3 = f(x_3) =$ Wangwu hates $x_3, x_3 \in \{writers\}\}$

= $\{y_1 = y_2 = y_3 | \ y_1 = f(x_1) =$ Zhangsan likes x_1 & $y_2 = f(x_2) =$ Lisi dislikes x_2 & $y_3 = f(x_3) =$
Wangwu hates $x_3, x_1 = x_2 = x_3 \in \{writers\}\}$

In this sequence, we first obtain the intersection of the first two clauses: the writer that Zhangsan likes and Lisi dislikes, represented as $y_1 \cap y_2$. Then we obtain the intersection of the first two clauses $y_1 \cap y_2$ and the third clause y_3: the write that Zhangsan likes and Lisi dislikes and Wangwu hates, represented as $(y_1 \cap y_2) \cap y_3$.

Secondly,

$y_1 \cap (y_2 \cap y_3)$

= $\{y_1 | \ y_1 = f(x_1) =$ Zhangsan likes $x_1, x_1 \in \{writers\}\} \cap$
$(\{y_2 | \ y_2 = f(x_2) =$ Lisi dislikes $x_2, x_2 \in \{writers\}\} \cap$
$\{y_3 | \ y_3 = f(x_3) =$ Wangwu hates $x_3, x_3 \in \{writers\}\})$

= $\{y_1 | \ y_1 = f(x_1) =$ Zhangsan likes $x_1, x_1 \in \{writers\}\} \cap$
$\{y_2 = y_3 | \ y_2 = f(x_2) =$ Lisi dislikes x_2 & $y_3 = f(x_3) =$ Wangwu hates $x_3, x_2 = x_3 \in \{writers\}\}$

= $\{y_1 = y_2 = y_3 | \ y_1 = f(x_1) =$ Zhangsan likes x_1 & $y_2 = f(x_2) =$ Lisi dislikes x_2 & $y_3 = f(x_3) =$
Wangwu hates $x_3, x_1 = x_2 = x_3 \in \{writers\}\}$

In this sequence we first obtain the intersection of the last two clauses: the writer that Lisi dislikes and Wangwu hates, represented as $y_2 \cap y_3$. Then we obtain the intersection of the last two clauses $y_2 \cap y_3$ and the first clause y_1: the write that Zhangsan likes and Lisi dislikes and Wangwu hates, represented as $y_1 \cap (y_2 \cap y_3)$.

Thirdly, we can get the intersection of these three clauses at the same time:

$y_1 \cap y_2 \cap y_3$

= $\{ y_1 | \ y_1 = f(x_1) =$ Zhangsan likes $x_1, x_1 \in \{writers\}\} \cap$

$\{ y_2 | \ y_2 = f(x_2) =$ Lisi dislikes $x_2, x_2 \in \{writers\}\} \cap$

$\{ y_3 | \ y_3 = f(x_3) =$ Wangwu hates $x_3, x_3 \in \{writers\}\}$

= $\{y_1 = y_2 = y_3 | \ y_1 = f(x_1) =$ Zhangsan likes x_1 & $y_2 = f(x_2) =$ Lisi dislikes x_2 & $y_3 = f(x_3) =$ Wangwu hates $x_3, x_1 = x_2 = x_3 \in \{writers\}\}$

Finally, it turns out that the result of these three sequences is the same:

$(y_1 \cap y_2) \cap y_3 = y_1 \cap (y_2 \cap y_3) = y_1 \cap y_2 \cap y_3$

= $\{y_1 = y_2 = y_3 | \ y_1 = f(x_1) =$ Zhangsan likes x_1 & $y_2 = f(x_2) =$ Lisi dislikes x_2 & $y_3 = f(x_3) =$ Wangwu hates $x_3, x_1 = x_2 = x_3 \in \{writers\}\}$

Thus, we can conclude that ATB-extraction is an intersection of the coordinated clauses (functions). This test confirms that in Chinese ATB-movement, an intersective operator is generated in the left periphery and it extracts the common variable from each of the conjuncts. In other words, the ATB-topicalization of the shared *wh*-word is a necessary requirement of the intersective operator.

(40) $[\cap \ wh\text{-word}_i \ [_{coordination} \ [_{VP1} \ x_i \ ] \ \& \ [_{VP2} \ x_i \ \ldots] \ ]$

Some other arguments in favour of the intersective operator analysis are presented in the following paragraphs.

(i) Subject-object extraction.

If we admit that the intersective operator is responsible for ATB-extraction in Chinese, the prediction that we can make is that the extracted element could be the subject in the first conjunct but the object in the second conjunct. The reason for this is that the intersective operator, being a semantic one, does not put any syntactic selectional restrictions on the choice of the extracted element in each conjunct. This is indeed the case as in (41).

(41) a. Keren a, *e* dou lai-le, keshi wo hai mei jian-dao *e*.
guest TM all come-Perf but I still neg. meet
(Lit.) 'As for the guests, (they) already arrived but I haven't met (them) yet.'

b. Na-ge xuesheng ne, ni yijing jiandao-le *e*, keshi *e* hai mei zhuce?
which-CL. student TM you already meet-Perf but syet neg. enrol
'Which student x (is the one that) you have met x although x hasn't enrolled yet?'

In (41a) *keren* 'guests' is the subject of the first clause but the direct object of the second clause; when it is ATB-extracted, it becomes the intersection of both of the clauses, which means that the guests that arrived and the ones that I haven't met yet should be the same. The same analysis goes for (41b) as well with the ATB-extracted element being the object of the first clause but the subject of the second one.[23]

[23] Of course, it is possible that the subject gap in the first conjunct is a *pro* controlled by the sentence-initial topic (*guest* in (41a)). In other words, it is possible that movement is not involved in the subject gap in (41a). However, if we look at (41b), clearly, the topic is extracted from the object position in the first conjunct and this example supports strongly the movement analysis.

(ii) Non-existence of the 'non-identity reading' for Chinese ATB
Munn (1993, 1999) points out that a non-identity reading can be found in English ATB cases:

(42) a. Where did Mary vacation and Bill decide to live?
b. Mary vacationed in Paris and Bill decided to live in Toronto.

However, under the intersective operator analysis for Chinese ATB cases, the non-identity reading should not be possible because the intersective operator extracts obligatorily the common variable from every conjunct. This is indeed the case as shown in (43). The only possible answer to the question in (43a) is (43b). The city where Zhangsan wants to spend his vacation and the one where Lisi wants to live are the same. The answer in (43c) is illicit for the question in (43a), and this shows that Chinese ATB cases necessarily require single identity answers. This fact also supports our intersective operator analysis.

(43) a. Na-ge chengshi, Zhangsan xiang qu dujia,
which-CL. city Zhangsan want go vacation
Lisi xiang qu dingju ?
Lisi want go live
'What city does Zhangsan want to spend his vacation in (but) Lisi want to live in?'
b. Bali. 'Paris.'
c. # Zhangsan xiang qu Bali, Lisi xiang qu Lundun.
Zhangsan want go Paris Lisi want go London
'Zhangsan wants to go to Paris; Lisi wants to go to London.'[24]

(iii) Non-existence of the distributive reading
In the following sentence (from Fox 2000:59), the extracted element is 'a guard' but it is not the common variable of the two conjuncts. (44) means that in front of every church there is a different standing guard, and at the side of every mosque there is a different sitting guard.

(44) A guard is standing in front of every church and sitting at the side of every mosque.

Under the intersective operator analysis, (44) should not be possible since the intersective operator cannot derive the above distributive reading. Example (45) is the Chinese translation of its English counterpart in (44).

(45) * Yi-ge jingwei, *e* zhan zai mei-ge jiaotang menkou,
one-CL. guard stand at every-CL. church gate
e zuo zai mei-ge qingzhensi pangbian.
sit at every-CL. mosque side
('A guard is standing in front of every church and sitting at the side of every mosque.')

(45) is ungrammatical because an indefinite noun cannot appear in the topic position as we argued in the second section.[25] Another reason why (45) is bad is that what the intersective

[24] The sentence itself is grammatical but cannot be considered as a licit answer to (43a).

[25] The insertion of the existential verb *you* 'there be' cannot save the sentence either in this case:

(ii) * You yi-ge jingwei, zhan zai mei-ge jiaotang menkou,
there-be one-CL. guard stand at every-CL. church gate
zuo zai mei-ge qingzhensi pangbian.
sit at every-CL. mosque side

operator does is extracting the subject *yi-ge jingwei* 'a guard' as the common variable of the two conjuncts, but this operation cannot give the sentence a distributive reading. Semantically the distributive reading should be the only possible one in this case, and when it is not possible, the sentence is uninterpretable.

In this sub-section I proposed an intersective operator analysis for Chinese ATB cases. I claimed that the Chinese ATB-configuration is derived only by the intersection operation and provided several supporting pieces of evidence.

3.2 Deriving the kind-denoting reading and the token reading

Two special cases that we need to discuss are the so-called 'kind-denoting' reading and the 'token' reading in ATB cases.

(46) Mao, Zhangsan xihuan, Lisi taoyan.
cat Zhangsan like Lisi dislike
'Cats, Zhangsan likes (but) Lisi dislikes.' (Kind-denoting)

(47) Na-ben J. K. Rowling de shu, Zhangsan zuotian mai-le,
which-CL. J. K. Rowling DE book Zhangsan yesterday buy-Perf
Lisi ye mai-le ?
Lisi also buy-Perf
(Lit.) 'Which book written by J. K Rowling (is the one that) Zhangsan bought yesterday and Lisi also bought?' (Token reading)

In (46) the ATB-extracted element *mao* 'cat' does not refer to any specific cat that Zhangsan likes and that Lisi dislikes but refers to the kind 'cats'. How can we derive this kind-denoting reading, under the intersective operator analysis? My explanation to this question is based on two observations. Firstly, the extracted element is a bare noun in Chinese, and we have shown that when a bare noun is in the TopP position it gets a kind-denoting reading. Secondly, the verbs in (46), *like* and *dislike*, are experiencer verbs. Generally in Chinese, it is easy for a bare noun to get a kind-denoting reading in a context containing an experiencer verb. The kind-denoting reading arises independently by being a bare NP selected by an experience predicate. However, if we replace them by a non-experiencer one, such as *kanjian* 'see', the extracted *mao* 'cat' can only get a definite reading.

(48) Mao, Zhangsan kanjian-le, Lisi ye kanjian-le.
cat Zhangsan see-Perf Lisi also see-Perf
'The cat, Zhangsan saw (it) (and) Lisi also saw (it).' (Definite reading)

As for (47), it is presupposed that there is a specific book written by J. K. Rowling, say *Harry Potter and the Deathly Hallows*, and Zhangsan bought a copy of this book yesterday and Lisi also bought a copy of it. Thus *na-ben J. K. Rowling de shu* 'which book of J. K. Rowling' cannot refer to the same copy of the book bought by Zhangsan and also bought by Lisi. In this case, the extracted element cannot be the common variable of the two conjuncts. How can we explain this under the intersective operator analysis? My suggestion is that the 'token' meaning is already generated as a restriction of the intersective operator on TopP. The generation of the token reading depends on the type of predicates involved. For example,

(49) a. John bought *Harry Potter and the Deathly Hallows* yesterday and Mary also bought *Harry Potter and the Deathly Hallows*.

('There is a guard, (who) is standing in front of every church and sitting at the side of every mosque.')

b. John bought a copy of *Harry Potter and the Deathly Hallows* yesterday and Mary bought a different copy of it.

(49a) can be paraphrased as (49b). The action expressed by 'buying books' generates the token reading. Along the same line, in (47) it is also the predicate 'buying books' that generates the token reading, and this token reading is realized as a restriction of the intersective operator. The intersective operator is responsible for the extraction of a common variable, and when the restriction is 'different copies of the same object', the intersective operator extracts the different copies of the same book from the two conjuncts. Thus a token reading in an ATB-movement is derived.

In a very general picture, the kind-denoting reading and the token reading do not contradict the intersective operator analysis.

3.3 The syntactic position of the intersective operator

In this sub-section, we will discuss the syntactic position of the intersective operator. We have seen that the ATB case in (35a), repeated here as (50a), was derived from the parallel questions in (35b), repeated here as (50b). (50a) is thus the reconstructed original form before an ATB-extraction.

(50) a. Zhangsan xihuan na-wei zuojia,
Zhangsan like which-CL. writer
Lisi bu xihuan na-wei zuojia ?
Lisi neg. like which-CL. writer
'Which writer does Zhangsan like; which writer does Lisi dislike?'

b. [Na-wei zuojia]$_i$, [Zhangsan xihuan t_i, Lisi bu xihuan t_i] ?
which-CL. writer Zhangsan like Lisi not like
'Which writer does Zhangsan like (but) Lisi dislike?'

If we examine (50) more closely, we find that (50b) resembles the famous "bare conditional" structure in Chinese, such as (51).

(51) [Necessity-Op$_{(x)}$ [Shei$_x$ xian lai, shei$_x$ xian chi]]. (Bare conditional)
who first come who first eat
'For every x, x a person, such that (if) x comes first (then) x eats first.'

The sentence in (51) contains a pair of identical *wh*-words, and even if there is no overt conditional marker, such as *ruguo* (if), the sentence gets a conditional interpretation. Sentences of this type are called "bare conditionals" (Tsai 1994, Cheng and Huang 1996). Tsai (1994) argues that the pair of *wh*-words is bound by a Necessity Operator unselectively and these *wh*-words get systematically an identical universal reading (cf. 51). (50b) shows the same syntactic structure as a bare conditional: there is no overt conditional marker, and the pair of *wh*-words is identical. However, the question that arises is why (50b) cannot get a bare-conditional reading 'for every x, x writer, such that (if) Zhangsan likes x, (then) Lisi doesn't like x'. Let us observe some other data:

(52) a. Zhangsan chi shenme, Lisi chi shenme
Zhangsan eat what Lisi eat what
(i) 'What does Zhangsan eat; and what does Lisi eat?'
(Parallel questions reading)
(ii) ?? 'For every x, x a thing, such that (if) Zhangsan eats x, (then) Lisi eats x.'
(Conditional construal)

b. (Ruguo) Zhangsan chi shenme, Lisi *(jiu) chi shenme
if Zhangsan eat what Lisi then eat what
(i) * 'What does Zhangsan eat; and what does Lisi eat?'
(Parallel questions reading)
(ii) 'For every x, x a thing, such that (if) Zhangsan eats x, then Lisi eats x.'
(Conditional construal)

(53) a. Na-ge xuesheng qu-guo Faguo, na-ge xuheng hui shuo fayu
which-CL. student go-Exp. France which-CL. student can speak French
(i) 'Which student has been in France and which student can speak French?'
(Parallel questions reading)
(ii) ?? 'For every x, x a student, such that (if) x has been in France, (then) x can speak French.' (Conditional construal)

b. (Ruguo) na-ge xuesheng qu-guo Faguo, na-ge xuheng
if which-CL. student go-Exp. France which-CL. student
*(jiu) hui shuo fayu
then can speak French
(i) * 'Which student has been in France and which student can speak French?'
(Parallel questions reading)
(ii) 'For every x, x a student, such that (if) x has been in France, (then) x can speak French.' (Conditional construal)

(52a) and (53a) show that it is not systematic (and not easy) to get a bare conditional reading even if we get two identical *wh*-words within two separate clauses. (52b) and (53b) show that the insertion of the adverb *jiu* 'then' is strongly required in order to get a conditional reading. The conditional pattern in Chinese is *ruguo* 'if'…*jiu* 'then'. The lack of the bare conditional reading in (a) cases shows that the necessity operator cannot be systematically generated in this situation. This observation seems to suggest that the presence of the conditional markers, such as *jiu* 'then' or *ruguo* 'if', is crucial even in the so-called 'bare' conditionals. In the original case of the bare conditional (51), the insertion of the adverb *jiu* 'then' makes the sentence clearer.

(54) Shei_x xian lai, shei_x **jiu** xian chi.
who first come who then first eat
'For every x, x a person, such that if x comes first then x eats first.'

Therefore, we can use the syntactic position of *ruguo*…*jiu* 'if…then' to test the position of the necessity operator and further that of the intersective operator.

Jiu 'then' is a VP adverb in Chinese; and *ruguo* 'if' is higher than TP/AspP, and it is analyzed as a conjunction.

(55) a. Ruguo Zhangsan xihuan na-wei zuojia,
if Zhangsan like which-CL. writer
Lisi jiu bu xihuan na-wei zuojia.
Lisi then not like which-CL. writer
'For every writer x, if Zhangsan likes x, then Lisi dislikes x.'

b. * [[Na-wei zuojia]$_i$ ruguo Zhangsan xihuan t_i,
which-CL. writer if Zhangsan like
[na-wei zuojia]$_j$ Lisi jiu bu xihuan t_j ?
which-CL. writer Lisi then not like

c. [Na-wei zuojia]$_i$, [ruguo Zhangsan xihuan t_i,
which-CL. writer if Zhangsan like
Lisi jiu bu xihuan t_j] ?
Lisi then not like
'For which writer x, such that if Zhangsan likes x, then Lisi dislikes x?'

The fact that the pair of *wh*-phrases gets a universal reading in (55a) suggests that it is bound by the necessity operator unselectively. If the two *wh*-phrases are topicalized out of the c-command domain of *ruguo* 'if' and that of *jiu* 'then', they cannot get the universal reading (cf. 55b). This is because they move out of the scope of the necessity operator (i.e the c-command domain of the lexical item *ruguo* 'if'.) Thus the lack of the universal reading in (55b) suggests that the syntactic position of the necessity operator cannot be higher than *ruguo* 'if'. (55c) shows that if the shared *wh*-phrase is topicalized completely outside the coordination and joins the intersective operator in the left periphery it can get an ATB reading. Along this line, a natural assumption is that the intersective operator in ATB-extraction should be syntactically higher than the necessity operator. Therefore, I propose the following hierarchy of the relevant operators:

(56) [$_{CP}$ In(tersective) operator … [*ruguo* 'if'- Ne(cessity) operator … [$_{IP}$ …]]]

3.4 Summary

In this section I discussed the generation of the identity answers in ATB cases. I argued that an intersective operator is generated in the Chinese ATB configuration, and it extracts the common variable from the conjuncts and generates the identity answers. Under our analysis, the kind-denoting reading and the token reading of the extracted element were also accounted for. Finally, I argued that the intersective operator is generated in the left periphery and is higher than the necessity operator in the bare conditional construal.

4. A proposal, a puzzle and an extension

4.1 A proposal

Recall that we have discussed two sides of ATB cases in Chinese. Syntactically, the extracted shared element from the conjuncts targets TopP. We have observed the referentiality effect of a bare noun and the contextual constraint on the ATB-extracted *wh*-elements in that position. Semantically, the intersective operator is responsible for getting the common variable from the conjuncts, and we argued that the intersective operator was located in the left periphery. In this section, I propose that the intersective operator is generated precisely in TopP. Here is an example:

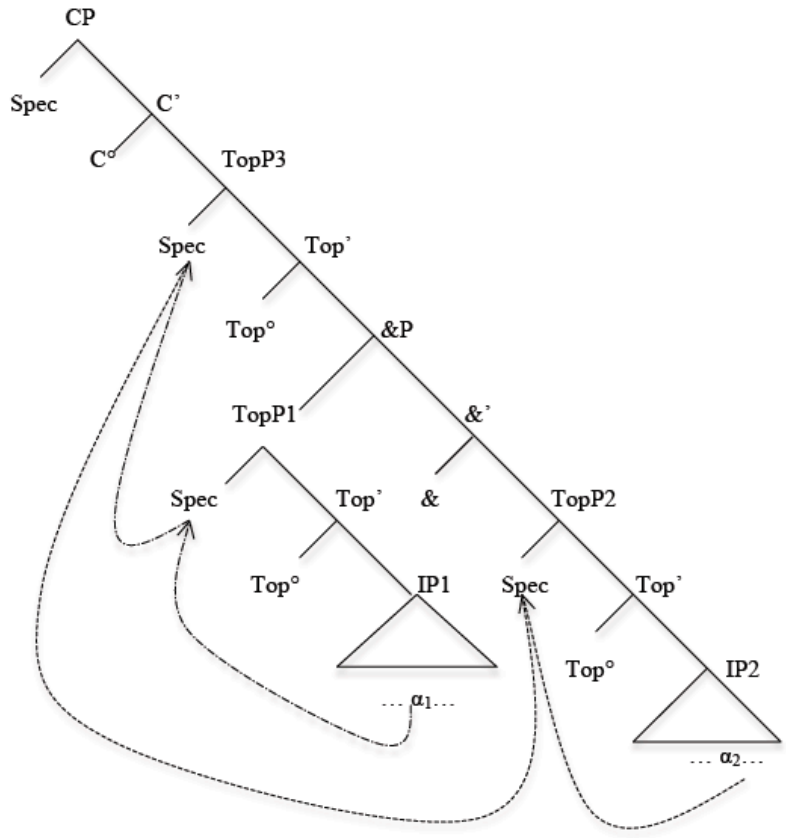
(57) a. Zhangsan xihuan na-wei zuojia,
Zhangsan like which-CL. writer
Lisi bu xihuan na-wei zuojia ?
Lisi neg. like which-CL. writer
'Which writer does Zhangsan like; which writer does Lisi dislike?'

b. [Na-wei zuojia]$_i$, Zhangsan xihuan t_i ,
which-CL. writer Zhangsan like
[na-wei zuojia]$_j$, Lisi bu xihuan t_j ?
which-CL. writer Lisi not like
'Which writer (is the one that) Zhangsan likes; which writer (is the one that) Lisi dislikes?'

c. [Na-wei zuojia]$_i$, [Zhangsan xihuan t_i, Lisi bu xihuan t_i] ?
which-CL. writer Zhangsan like Lisi not like
'Which writer does Zhangsan like (but) Lisi dislike?'

We showed that the ATB pattern in (57c) was derived from the parallel questions in (57a). Based on the assumption that the movement takes place in a cyclic fashion but not in a long-distance fashion, I propose that the shared element in each conjunct moves first to the embedded TopP and further to the matrix TopP. (57b) is an intermediate step. More concretely, the general tree diagram is given below. In (58) the coordinate phrase &P takes two TopPs: TopP1 and TopP2, and each of them takes an IP as its complement. The identical item in each IP (either a *wh*-phrase or a normal topic item) moves to [Spec, TopP] respectively. The specifier position of TopP1 and that of TopP2 are the intermediate landing sites for ATB-extraction. We assume that ATB-extraction occurs in a cyclic fashion in order to avoid long distance movement. Let us assume that α_1 and α_2 are the identical objects of the two IPs. Firstly, α_1 embedded in IP1 moves to [Spec, TopP1], and α_2 embedded in IP2 moves to [Spec, TopP2]. Then, the intersective operator generated at TopP3 extracts the identical variable α_1 and α_2, and only one copy of them, say α, moves to the matrix [Spec, TopP3]. Since the two identical elements have the same phonological form and semantic interpretation, we do not need two pronounced copies for the same element (presumably under economy, as is the standard view in minimalism). Therefore only one copy is conserved at TopP3. If α is a *wh*-phrase, the [wh] is attracted to [Spec, CP] to be checked[26].

(58)



[26] Recall that Chinese is a *wh*-in-situ language, and we don't have any reason to assume that the phonological form of a *wh*-phrase can move to CP.

4.2 A puzzle

A puzzle can be found in the following example with the *wh*-adjunct *weishenme* 'why'. It is not expected for the ATB question in (59a) to get a so-called *respectively* reading under our proposal based on the intersective operator analysis.

(59) a. Weishenme Zhangsan qu Faguo Lisi qu Deguo ?
why Zhangsan go France Lisi go Germany
'Why does Zhangsan go to France, but Lisi go to Germany?'

b. Yinwei tamen xiang qu nianshu.
because they want go study
'Because they want to study there.' (ATB reading)

c. Yinwei Zhangsan xue Fayu, Lisi xue Deyu.
because Zhangsan study French Lisi study German
'Because Zhangsan learns French and Lisi learns German.' (*Respectively* reading)

In order to solve this puzzle, I'd like to point out that an adjunct like *weishenme* 'why' can be generated in a pre-subject position as a sentential adverb in Chinese[27], as shown in (60). *Weishenme* 'why' is interpreted as an out-of-the-blue *wh*-element not as a D-linked *wh*-element. This fact shows that it is not really in TopP.

(60) Weishenme ni qu Faguo ?
why you go France
'Why do you go to France?'

I assume that in order to get a *respectively* reading in (59c), *weishenme* 'why' in (59a) is generated in its normal pre-subject position but not in the TopP. Therefore, it cannot be bound by the intersective operator. On the other hand, in order to get the ATB reading in (59b), *weishenme* 'why' is topicalized to the TopP, and the intersective operator extracts the common variable from the conjuncts. Once we use a nominal D-linked *wh*-phrase to replace *weishenme* 'why', the only possible reading is the ATB reading.

(61) a. Weile na-ben shu, Zhangsan qu-le tushuguan,
for which-CL. book Zhangsan go-Perf library
Lisi qu-le shudian ?
Lisi go-Perf bookstore
'For (getting) which book x, is it the case that Zhangsan went to the library (and) Lisi went to the bookstore?'

b. *Harry Potter and the Deathly Hallows*. (ATB reading)

c. # Zhangsan weile *Harry Potter and the Deathly Hallows*, Lisi weile *Harry Potter and the Half-Blood Prince*.
('Zhangsan (was) for *Harry Potter and the Deathly Hallows,* (and) Lisi (was) for *Harry Potter and the Half-Blood Prince*.' (*Respectively* reading)

The *respectively* reading is impossible on the grounds that the only available position for *weile na-ben shu* 'for which book' is TopP, because being a nominal element it cannot occupy a pre-subject adverbial position contrary to *weishenme* 'why'.

[27] Please refer to Tsai (1994) for detailed analysis of *weishenme* 'why' in Chinese.

4.3 An extension

I have shown earlier that Chinese allows base-generated topics. It leads to wonder whether my Intersective Operator analysis also applies to the case where a base-generated topic takes two conjuncts. (66) shows that this case can be accounted for directly under my analysis. Both base-generated topics, the *wh* one in (66a) and the non-*wh* one in (66b), are clearly the common element that the conjuncts talk about. In (66a), it is the same animal that satisfies two different criteria: it has long nose and short tail. In (66b), it is China that there are many rich people and lots of poor people.

(66) a. [$_{TopP}$ Na-zhong dongwu], [[bizi chang], [weiba duan]]]?
which-kind animal nose long tail short
'What kind of animal is it, such that (its) nose is long (and) (its) tail is short?'
b. [$_{TopP}$ Zhongguo], [[furen hen duo], [qiongren ye bu shao]]].
China rich-people very many poor-people also neg. few
'As for China, there are many rich people, but there are lots of poor people too.'

Therefore, our analysis is strengthened by the supporting fact from the base-generated topics. It might be interesting to examine other languages to see whether the Intersective Operator is enough/not enough to derive ATB reading.

5. Conclusion

In this paper I examined the syntax and semantics of ATB-movement in Chinese. In the first part I discussed two kinds of ATB cases: the extraction of normal DPs and that of D-linked *wh*-phrases. I argued that both cases can be reduced to generalized topicalization in Chinese: the shared element undergoes topicalization to [Spec, TopP]. This movement is subject to all of the syntactic constraints on topicalization and on *wh*-topicalization in Chinese. Semantically an intersective operator is generated at TopP, extracts the common variable from the conjuncts, and thus generates the identity reading. The intersective operator takes the intersection of the range of the coordinated functions (IPs). Only one copy of the two occurrences of the extracted elements is conserved at TopP due to the economy principle. Some tough cases, such as kind-denoting reading and token reading, were also shown to fit into the general picture of our analysis. I have also tested that hierarchically the intersective operator in ATB-movement is higher than the necessity operator in bare conditional constructions.

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