Tracking Down (C)overt Movement with Adverbial Distributive Numerals in Mandarin Chinese

Filipe Hisao Kobayashi and Sherry Yong Chen

1. Introduction

In this paper we investigate the distribution of Mandarin Chinese adverbial distributive numerals (DistNums), a kind of manner adverbial that semantically associates with a DP argument in its clause. We focus on the syntactic constraints on this association and argue for a generalization which provides further support for a unified account of overt and covert movement. Furthermore, we show how DistNums can be used to diagnose whether or not movement has taken place in a Mandarin Chinese sentence.

Mandarin DistNums, illustrated in (1), are pre-verbal adverbials formed by (i) reduplicating a numeral-classifier sequence and (ii) attaching to it the adverbializing particle *de* (referred to as de_2 in the literature on Mandarin). Their meaning is roughly equivalent to that of English adverbs *N by N* and *in Ns*.

(1) Xuesheng-men **liang-ge-liang-ge-de** dao-le.
student-PL two-CL-two-CL-DE arrive-PFV
'The students arrived two by two/in twos.'

The DistNum in (1) associates with the subject, as it specifies the manner in which the students arrived (i.e., in groups of two). The fact that DNs associate with a argument DP is made clearer in the example in (2), which is ambiguous: since both the subject and object can be counted with the general classifier *ge*, the DistNum may associate with either of them, giving rise to two different readings in (2a) and (2b).

(2) Xuesheng-men **liang-ge-liang-ge-de** chi-le pingguo.
student-PL two-CL-two-CL-DE eat-PFV apple

a. SUBJECT READING: 'The students, in groups composed of two students, ate the apples.'

b. OBJECT READING: 'The students ate the apples in groups of composed of two apples.'

In what follows, we defend the following generalization: a DistNum can only associate with a DP that has moved across it. Crucially, this generalization makes no distinction between overt and covert movement, providing further arguments that overt and covert movement should be treated as being instances of the same basic operation.

The paper is organized as follows: in §1 we present the data that motivates our key generalization; in §2 this generalization is derived by extending the analysis of parasitic gaps in Nissenbaum (2000) to DistNums; §3 shows how we can use DistNums to detect instances of covert movement; §4 concludes.

2. DistNum association and movement

2.1. Some syntactic constraints on DistNum association

There are many possible ways to account for the dependency established between a DistNum and its associate given what we have seen so far. A simple hypothesis is that DistNum association involves

* Filipe Hisao Kobayashi, Massachusetts Institute of Technology, filipek@mit.edu; Sherry Yong Chen, Massachusetts Institute of Technology, sychen@mit.edu. For comments and/or discussion, we are grateful to Danny Fox, Martin Hackl, Sabine Iatridou, David Pesetsky, and the audience of WCCFL 39. All mistakes are our own.

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pronominal anaphora: DistNums have a silent pronominal argument and the ambiguity in (2) is just a matter of pronoun resolution, as illustrated in (3).

(3) a. SUBJECT READING: the students$_1$ [two-two pro$_1$] ate the apples$_2$

b. OBJECT READING: the students$_1$ [two-two pro$_2$] ate the apples$_2$

The problem with such an analysis is that DistNum association is syntactically constrained in ways that anaphora is not. We present two cases in which a DistNum cannot associate with a DP: one in which the DistNum is too low to associate with the subject, and another in which the DistNum is too high to associate with the object. Based on this, we conclude that the dependency established between a DistNum and its DP associate cannot be reduced to pronominal anaphora.

The first set of examples involve constructions in which the object is promoted to a pre-verbal position. This construction, referred in the literature as the *ba*-construction, is illustrated in the sentences in (4): as shown in (4a), Mandarin basic word order is SVO, but the object may appear pre-verbally if immediately preceded by the particle *ba*, as shown in (4b). As it is not relevant to our discussion, we set aside certain semantic properties of the *ba*-construction.

(4) a. Wo chi-le na-ge pingguo.
1SG eat-PFV that-CL apple
'I ate that apple.'

b. Wo **ba** na-ge pingguo chi-le.
1SG BA that-CL apple eat-PFV
'I ate that apple.'

We adopt the simplistic account of these constructions shown in (5), where *ba* is an exponent of v and the object moves to Spec,VP[1]. The only relevant aspect of this analysis given the discussion to come is that there is a low attachment site for adverbs which c-commands the object's trace but not the subject's.

(5) $[_{vP}$ Subj [BA$_v$ $[_{VP}$ Obj$_i$ [V t_i]]]]

Donazzan & Müller (2015) observe that there is an asymmetry concerning subject DistNum association in *ba*-constructions. This is shown in (6): although a DistNum that precedes *ba* can associate with subject (6a), a DistNum that follows the promoted object cannot (6b).

(6) a. **Ta-men liang-ge-liang-ge-de** ba na-ge xigua chi-le.
3-PL two-CL-two-CL-DE BA that-CL watermelon eat-PFV
'They, in twos, ate that watermelon.'

b. ***Ta-men** ba na-ge xigua **liang-ge-liang-ge-de** chi-le.
3-PL BA that-CL watermelon two-CL-two-CL-DE eat-PFV

The example in (7) shows that DistNums can appear in such a low position in the clause if they associate with the object. Thus, the ungrammaticality of (6b) can only be due to the impossibility of subject association when the DistNum occupies that position.

(7) Wo ba **na-ge xigua liang-kuai-liang-kuai-de** chi-le.
1SG BA that-CL watermelon two-CL-two-CL-DE eat-PFV
'I ate that watermelon, two pieces by two pieces.'

Turning to cases where object association is not possible with a high DistNum, we focus on sentences with the progressive marker *zai*, as shown in (8). In (8a), the DistNum follows *zai* and object association is possible. However, if the DistNum precedes *zai*, as in (8b), object association is strongly dispreferred.

[1] This is an analysis contemplated in Huang et al. (2009), which we adopt here without further argumentation.

(8) a. Wo zai **liang-ke-liang-ke-de** chi **na-xie tang**.
1SG PROG two-CL-two-CL-DE eat that-PL candy
'I am eating the candy in twos.'

b. ?? Wo **[iang-ke-liang-ke-de** zai chi **na-xie tang**.
1SG two-CL-two-CL-DE PROG eat that-PL candy

In (9), we see that DistNums precede *zai* if they associate with the subject. Thus, the asymmetry (8) can only be due to the fact that objects cannot associate with pre-*zai* DistNums.

(9) **Wo-men liang-ke-liang-ke-de** zai chi **na-xie tang**.
1-PL two-CL-two-CL-DE PROG eat that-PL candy
'We, in groups of two, are eating the candy.'

These constraints on DistNum association thus rule out a simple analysis in which it is treated as just pronominal anaphora. In the following subsection we show that the picture is further complicated by overt movement interacts with this dependency.

2.2. Movement as a licensor

In (8b), we saw that a pre-*zai* DistNum cannot associate with the direct object. What we observe in (10) is that if the object is overtly moved to a sentence-initial topic position, then object association suddenly becomes possible.

(10) **Na-xie tang**, wo **[liang-ke-liang-ke]-de** zai chi.
that-PL candy 1SG two-CL-two-CL-DE PROG eat
'Those candies, I'm eating in twos.'

The sentence in (11) is very similar to the one in (10), but it contains a resumptive pronoun rather than a gap in the object position. However, DistNum association with the object is no longer possible in (11). This asymmetry suggests that DistNum association in (10) is possible because of movement, and not just because the associate is pronounced in the left periphery.

(11) ?? **Na-xie tang**, wo **[liang-ke-liang-ke]-de** zai chi ta-men.
that-PL candy 1SG two-CL-two-CL-DE PROG eat 3-PL
Intended: 'Those candies, I'm eating in twos.'

The data presented so far suggest that there is a tight connection between DistNum association and syntactic movement. We propose that DistNum association is constrained by the following aforementioned generalization: a DistNum may associate with a DP only if it has moved across it. We now show how this generalization is able to capture these observations.

We saw in §2.1 that in clauses where the object is promoted, a DistNum that precedes the object can associate with the subject but a DistNum that follows it cannot. This is schematized in (12). The DistNum-movement generalization is able to account for this contrast: although the subject moves across the DistNum in (12a), it does not in (12b), since the DistNum is in a position that is lower than the one in which the subject was base generated.

(12) a. Subj_1 DistNum [$_{v\text{P}}$ t_1 [BA$_v$ [$_{\text{VP}}$ Obj_i [V t_i]]]]
b. *Subj_1 [$_{v\text{P}}$ t_i [BA$_v$ [$_{\text{VP}}$ Obj_i [DistNum V t_i]]]]

We can also quite straightforwardly account for the contrast illustrated in (8b) and (10): an object may not associate with a pre-*zai* DistNum unless it moves across it.

(13) a. Subj_1 DistNum ZAI [$_{\upsilon P}$ t_1 υ [$_{VP}$ V Obj]]

b. Obj_i [Subj_1 DistNum ZAI [$_{\upsilon P}$ t_i υ [$_{VP}$ V t_i]]]

The generalization we have advanced accounts for the observations presented so far. It does however suffer from an undergeneration problem: we have seen many cases in which an object is able to associate with a DistNum that c-commands it, which can in principle appear to be incompatible with the aforementioned generalization. This brings us to a necessary refinement: the movement that enables DistNum association may be overt or covert. In the next section, we present further evidence to take covert movement into account and broaden the scope of our generalization.

2.3. QR as a licensor

We propose that in sentences like (14), the DistNum and the object can only associate if the object covertly moves across it. This means that sentences like the one in (14) have the structure in (15), where the object has QR-ed over the DistNum.

(14) Wo **liang-ge-liang-ge-de** chi-le **pingguo**
1SG two-CL-two-CL-DE eat-PFV apple
'I ate the apples in twos.'

(15) I ⟨apple_i⟩ two-two eat apple_i

The evidence we provide in favor of this conclusion comes from the interaction of QR and the Coordinated Structure Constraints (CSC). Ruys (1993) observed that although QR generally obeys the CSC, it can be obviated in certain cases. This is illustrated in the contrast in (16): in (16a), *every girl* cannot take scope over the indefinite subject as this would require it to move out of the coordinated structure; in (16b), *every girl* is allowed to obviate the CSC and scope over the subject if the second conjunct contains a pronoun bound by it.

(16) a. A different teacher talked to every girl and Bob. *$\forall \gg \exists$

b. A different teacher talked to every girl and her mom. ✓$\forall \gg \exists$

A very similar state of affairs can be found with DistNum association. In (17), the DP *naxie zhu* 'those pigs' is the only DP in the clause that is compatible with the classifier in the DistNum ('*tou*'). This sentence is ungrammatical: the classifier restriction on DistNum make it so that it could only associate with *naxie zhu* 'those pigs', but it seems that embedding this DP in a coordination blocks DistNum association.[2]

(17) Wo **liang-tou-liang-tou-de** jiancha-le **naxie zhu** he Shancai.
1SG 2-CL-2-CL-DE examine-PFV those pig and Shancai
Intended reading: 'I examined the pigs in twos and I examined Shancai.'

Crucially, if we change (17) slightly so that there is a bound pronoun in the second conjunct, the sentence becomes grammatical, as shown in (18):

(18) Wo **liang-tou-liang-tou-de** jiancha-le **naxie zhu** he taxmen-de zhuren.
1SG 2-CL-2-CL-DE examine-PFV those pig and their owners
Attested reading: 'I examined the pigs in twos and I examined their owners.'

The above parallel with (16) is striking: DistNum association with a single conjunct is only possible if the other conjunct has a pronoun bound by it. The DistNum-movement generalization can account this in a

[2] The examples in Ruys (1993) involve VP coordination but we believe that the same holds for DP coordination.

straightforward way: since object association with a preceding DistNum requires QR, if QR is impossible then DistNum association should also be so.

There is still a remaining issue to be solved, which conerns the contrast between the sentences in (8), repeated below in (19). If objects can QR to associate with DistNums, then why does the position of the DistNum is these two sentences matter?

(19) a. Wo zai **liang-ke-liang-ke-de** chi **na-xie tang**.
1SG PROG two-CL-two-CL-DE eat that-PL candy
'I am eating the candy in twos.'

b. ?? Wo **liang-ke-liang-ke-de** zai chi **na-xie tang**.
1SG two-CL-two-CL-DE PROG eat that-PL candy

We suggest that this is due to the locality of QR, which is known to be very restricted (e.g., it cannot cross finite clauses). We follow Fox (2000) in assuming that QR attaches to its closest possible landing site unless it can scopally interact with other operators in the clause (*Scope Economy*). The non-grammaticality of (19b) due to the fact that QR to a position as high as above *zai* is not licensed since it can QR to a lower position in the clause and yield the same truth conditions.[3]

Another piece of evidence in favor of the claim that covert movement licenses DistNum association comes from cover *wh*-movement. Mandarin Chinese is a *wh*-in-situ language, which means that *wh*-phrases do not move to the left periphery in *wh*-questions, as illustrated in (20). Huang (1982) proposed that *wh*-phrases do move to the left periphery in Mandarin, but they only do so covertly. This is the view we will adopt here.

(20) Ni xihuan shei?
2SG like who
'Who do you like?'

We can now use DistNums to detect whether movement has taken place in these configurations. We saw that in-situ objects cannot associate with DistNums that precede the progressive marker *zai*, but that association becomes possible if the object is topicalized. Our analysis of DistNums thus makes the following prediction: if Mandarin *wh*-phrases do move covertly to Spec,CP, then *wh*-phrases in the object position should associate with a pre-*zai* DistNum. This prediction is indeed attested, as shown in (21).

(21) Ta **liang-kuai.liang-kuai-de** zai chi **na-xie xigua**.
2sg two-CL-two-CL-DE PROG eat that-PL watermelon
'They (sg) are eating that watermelon in twos.'

3. Proposal

We now present our proposal, which consists of an extension of Nissenbaum's (2000) account of parasitic gaps to DistNums (see also Barker 2007). The idea, in a nutshell, is that movement creates constituents denoting predicates (Heim & Kratzer 1998) and that DistNums can only modify these predicates. The close connection between movement and DistNum licensing is thus accounted for.

The analysis is framed of Neo-Davidsonian algebraic event semantics (Davidson 1967, Krifka 1989, Champollion 2017). We assume that the domain of individuals D_e and the domain of event D_v that contain both singularities (singleton sets) and pluralities (sets with more than one member).[4] Verbs denote predicates of potentially plural events, and arguments are glued to the verb via silent heads that introduce thematic roles (functions from potentially plural events to potentially plural individuals). Sample lexical entries are given in (22).

[3] For this to work, it is crucial for DistNum association to not interact with the evaluation of Scope Economy.

[4] More precisely, given the sets E and V s.t. E is the set of all individuals and V is the set of all events, $D_e = 2^E/\{\varnothing\}$ and $D_v = 2^V/\{\varnothing\}$.

(22) a. $[\![\text{smokes}]\!] = \lambda e_v.\ \mathbf{smokes}(e)$

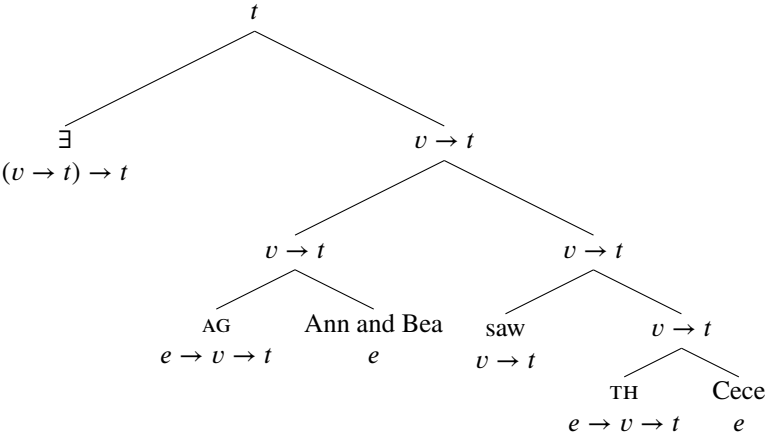
b. $[\![\text{AG}]\!] = \lambda x_e.\lambda e_v.\ \mathbf{ag}(e) = x$

As in Krifka 1989, verbs and thematic roles are are lexically cumulative. That is, for any two events e,e^* in the denotation of a verb V, their sum $e \cup e^*$ is also in it; and for any two individuals x,x^* such that x bears the thematic role θ in e and x^* bears θ in e^*, then their sum $x \cup x^*$ bears θ in $e \cup e^*$.

We illustrate these assumptions with the simple sentence in (23a). Assuming no movement has taken place, we take its syntactic structure to be the one in (23b), where each argument is introduced by a silent thematic role head. This structure is mapped to the meaning in (23c). To show the role of lexical cumulativity, assume that Ann saw Cece in e and Bea saw Cece in a different event e^*. Sentence (23a) is true is such a context and lexical cumulativity ensures $e \cup e^*$ to be a witness for (23c).

(23) a. Ann and Bea saw Cece.

b.



c. $\exists e.\ \mathbf{ag}(e) = \mathbf{ann} \cup \mathbf{bea} \wedge \mathbf{saw}(e) \wedge \mathbf{th}(e) = \mathbf{cece}$

With these assumptions in mind, we can now move on to the issue concerning the meaning of DistNums. In the sentence in (24), the DistNum describes the internal composition of a plural event of students dancing, in which each salient non-overlapping subevent contains two students dancing.[5]

(24) **Xuesheng-men** **liang-ge-liang-ge-de** tiao-le-wu.
student-PL two-CL-two-CL-DE jump-PFV-dance
'The students danced two by two/in twos.'

To model that DistNums quantify over non-overlapping subevents, we follow Balusu (2006) and make use of the notion of a partition. We define a function $\boldsymbol{\pi}$ that takes a contextually given set of events c and event e and yields c only if c is a partition of e (i.e., c is a set of non-overlapping events that sum up to e):

(25) $\boldsymbol{\pi}_c(e) = c$ if c is a partition of e

Following Cable (2014), our entry will also make us of a predicate $\boldsymbol{\theta}$, true of any event e and individual x such that x bears a thematic role in e. The domain of the quantifier in (26) is restricted to all and only attested natural language thematic roles, and we leave open the possibility of it being contextually restricted.

(26) $\boldsymbol{\theta}(e)(x) = \exists\theta.\ \theta(e) = x$

[5] The events need to be non-overlapping because otherwise we would incorrectly predict (24) to be true in a scenario where three students a, b, c dancing at the same time, since one can break this event into two subevents e, e^* such that a and b are dancing in e and b and c are dancing in e^*.

Our entry for DistNum is given in (27). Since these adverbials need access to the main event described by the verb and one of the event's participant, we have it denote a function that takes both an event argument e and an individual argument x. This function yields true if, and only if, any part of x that bears a thematic role in a salient subevent of e has cardinality n, where n is the numeral in specified by the DistNum.[6]

(27) $[\![n - n]\!]^c = \lambda x.\lambda e.\, \forall x' \subseteq x.\, (\exists e' \in \boldsymbol{\pi}_c(e).\, \boldsymbol{\theta}(e')(x')) \rightarrow \#(x) = n$

To see how (27) yields the correct meaning, in (28), we provide the denotation of the sentence in (24) using our proposed meaning. The first two conjuncts of the formula state that e is an event of students dancing. The final conjunct specifies the contribution of the DistNum: every student that participates in a salient subevent e have cardinality **2**. Combining these two components together yields the desired result: every element of the salient partition of e has two students dancing. We will soon see that such an inference is not always present, which turns out to be a good prediction.

(28) $\exists e.\, \mathbf{ag}(e) = \mathbf{the.students} \wedge \mathbf{dance}(e) \wedge \forall x \subseteq \mathbf{the.students}.\, (\exists e' \in \boldsymbol{\pi}_c(e).\, \boldsymbol{\theta}(e')(x)) \rightarrow \#(x) = 2$

We have a problem, however: given the meaning of DistNums, it is not very clear where in the structure they should be interpreted. They are modifiers of $e \rightarrow v \rightarrow t$ so they must be merged to another node that denotes a function of this type.[7] However, if one inspects the structure of a simple transitive sentence we are assuming, shown in (23b), there is no such node in the clausal structure of the sentence.[8]

The solution to this problem will give us an account of the DistNum-movement generalization. We follow the by now standard approach in Heim & Kratzer (1998). As shown in (29a), on the syntactic side, every time a constituent is moved, (i) it leaves a trace with an index n, and (ii) its landing site must be sister to a constituent headed by a λ_n-operator, coindexed with the trace. Semantically, the trace is interpreted as a pronoun and the constituent $[\lambda_n\ \varphi]$ is interpreted via the rule of *predicate abstraction* stated in (29b). If the denotation of φ is of type σ, the denotation of $[\lambda_n\ \varphi]$ will be of type $\tau \rightarrow \sigma$, where τ is the type of the denotation of the trace.

(29) a. $[\mathrm{X\ Y}] \rightarrow [\mathrm{X}\ [\ \lambda_1\ [\ t_1\ \mathrm{Y}\ ]\ ]\ ]$

b. $[\![\lambda_1\ \varphi]\!]^g = \lambda x.\ [\![\varphi]\!]^{g[1 \mapsto x]}$

These assumptions now allow movement to create predicates that DistNum can modify: if φ is any clausal node of type $v \rightarrow t$, then $[\lambda_n\ \varphi]$ will denote functions of the right type. As shown in Figure 1, movement can create a node of type $e \rightarrow v \rightarrow t$. Thus, if we allow these constituents to be targeted by DistNums, we can account for the DistNum movement generalization - DistNum association requires its DP associate to move across it because because it can only merge to constituents created by movement.

This proposal has at its core the idea that Nissenbaum (2000) advances for parasitic gaps. It is also worth mentioning that the analyses of DistNums and other similar adverbials in Beck & von Stechow (2007) and Cable (2014) also took them to be modifiers of predicates of type $e \rightarrow v \rightarrow t$ and that movement can create the predicates they modify. What we add to the existing literature is showing that the syntactic predictions of these proposals are born out empirically using data from a language unrelated to English.

Finally, the fact that covert movement licensed DistNum association still leaves open some open questions. The proposal in Huang (1982) was that covert movement took place at LF, but if that were the case, DistNums would not be able to be merged in narrow syntax. We suggest that this issue can be resolved if we adopt the view defended in Bobaljik (1995): all movement occurs in narrow syntax and the difference between overt and covert movement is a consequence of PF – overt movement occurs when the

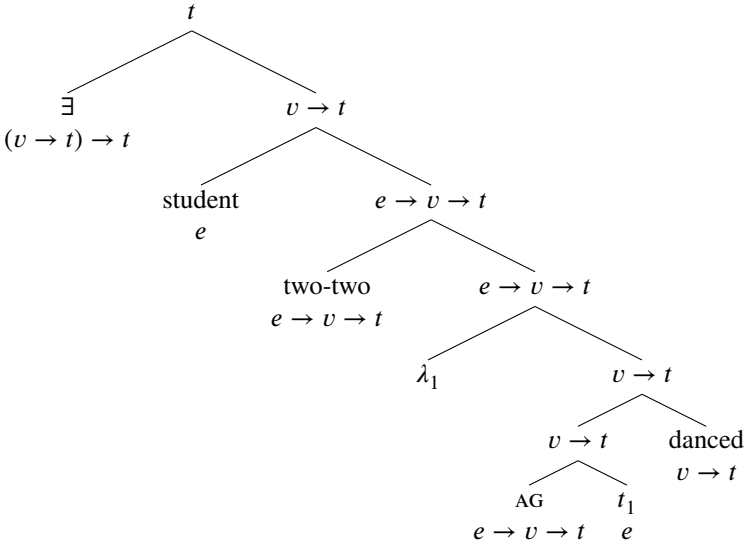
[6] We ignore the contribution of the classifier to the meaning of DistNums for ease of exposition.

[7] As in Heim & Kratzer (1998), we take intersective modifiers to merge to nodes of the same type and that such structures are interpreted via a generalized version of the rule of *Predicated Modification*. We could equivalently have assumed that DistNums are of type $(e \rightarrow v \rightarrow t) \rightarrow e \rightarrow v \rightarrow t$.

[8] Thematic role heads are of type $e \rightarrow v \rightarrow t$, but perhaps there are other syntactic constraints that block adverbials from modifying

higher copy is pronounced, covert movement occurs when the lower one is. Our proposal can thus account for all the data discussed in §2.

Figure 1: Interpreting clauses with DistNums



Before concluding this section, we would like to go back to (18), repeated below in (30). The interpretation of this sentence is that the speaker examined the pigs and their owners, and that the pigs were examined two at a time — and nothing is said about how the pig owners were examined. What we would like to show is that our meaning for the DistNums is able to correctly account for this interpretation.

(30) Wo **liang-tou-liang-tou-de** jiancha-le **na-xie zhu** he taxmen-de zhuren.
1SG 2-CL-2-CL-DE examine-PFV those pig and their owners
Attested reading: 'I examined those pigs in twos and I examined their owners.'

As discussed in §2, we take this sentences to have the structure in (31a), where the DP 'the pigs' is QR-ed out of the disjunct licensing the DistNum. The meaning we assign to this structure is in (31b). The first conjuncts state that e is an event in which the speaker examines the pigs and the pig owners. The final conjunct, the contribution of the DistNum, states that every pig that participates in a salient subevent of e has cardinality two. Once we put these two components together we get exactly what we want: every salient subevent of e where pigs were being examined, they were two in number.

(31) a. [those pigs] λ_1 [[AG I] examined [TH [t_1 and pro$_1$'s pig owners]]]

b. $\exists e.\ \mathbf{ag}(e) = \mathbf{spkr} \wedge \mathbf{examine}(e) \wedge \mathbf{th}(e) = \mathbf{those.pigs} \cup \mathbf{owners}(\mathbf{those.pigs})$
$\wedge\ \forall x \subseteq \mathbf{those.pigs}.\ (\exists e' \in \boldsymbol{\pi}_c(e).\ \boldsymbol{\theta}(e')(x)) \rightarrow \#(x) = 2$

4. Diagnosing other cases of covert movement

Before ending the paper, we briefly show how one can use DistNums to diagnose whether movement has taken place or not in Mandarin Chinese. Having established that movement feeds DistNum association, we now look at two constructions that have been claimed to involve covert movement in Mandarin Chinese: *wh*-questions with *wh*-phrases inside movement islands and object drop.

A challenge for the view in which Mandarin Chinese *wh*-questions involve covert movement is that the *wh*-phrase can appear within a movement island. As shown in the examples in (32), the *wh*-phrase *shei* 'who' can be a nominal possessor and can also appear within a relative clause.

(32) a. Ta chi-le [shei de xigua]?
3SG eat-PFV who DE watermelon
'Whose watermelon did you eat?'

b. Ta chi-le [[shei mai-lai de] xigua]?
3SG eat-PFV who buy-come DE watermelon
'Who is the person that you ate the watermelon that they bought?'

These environments are islands for overt movement. As shown in (33), these positions cannot be replaced by gaps in relative clauses. If, as we have defended, overt and covert can be conceptualized as one and the same syntactic operation, the contrast between (32) and (33) remains a challenge.

(33) a. Ta shi [[Op$_i$ ni chi-le t_i-de xigua]-de ren]
3SG eat-PFV who-DE watermelon
'Whose watermelon did you eat?'

b. Ta shi [[Op$_i$ ni chi-le [t_i mai-le]-de xigua]-de ren]
3SG eat-PFV who bought-PFV-DE watermelon
'Who is such that you ate the watermelon that they bought?'

Recently, Chen (2020), building on Nishigauchi (1990), argued the constructions in (32) do involve covert *wh*-movement but, rather than having the *wh*-phrases themselves moving to Spec,CP, it is their host DP that does. Since covert pied-piping is at play, no island is violated in these structures. This proposal makes very clear predictions concerning the licensing of DistNums: if indeed the main clause's object moves to Spec,CP, a pre-*zai* DistNum can associate with it. That is indeed attested, as we can see in (34).

(34) a. Ta **liang-kuai-liang-kuai-de** zai chi [shei-de xigua]?
3SG two-CL-two-TWO-DE PROG eat who-DE watermelon
'Whose watermelon did you eat?'

b. Ta **liang-kuai-liang-kuai-de** zai chi [[shei mai-le de] xigua]?
3SG two-CL-two-TWO-DE PROG who bought-PFV-DE watermelon
'Who is such that you ate the watermelon that they bought?'

Turning to object drop, Mandarin Chinese allows objects to not be pronounced in certain contexts, such as in (35). Huang (1984) proposes that these configuration involve the topicalization of a null element.

(35) a. Na-xie xigua ne?
that-PL watermelon NE
'What about those watermelons?'

b. Wo zai chi *e*.
1SG PROG eat
'I'm eating them.'

We can once again use DistNum association to test this proposal: if these indeed involve movement from the object position to Spec,CP, a pre *zai* DistNum should be able to associated with it. Once again, this prediction is borne out, as the following is grammatical:

(36) a. Na-xie xigua ne?
that-PL watermelon NE
'What about those watermelons?'

b. Wo **liang-kuai-liang-kuai-de** zai chi *e*.
1SG two-CL-two-TWO-DE PROG eat
'I'm eating them two pieces at a time.'

5. Conclusion

In this paper, we have examined the syntactic conditions under which Mandarin Chiense DistNums can associate their target DP. We have argued for the following generalization: DistNum may associate with a DP only if it has moved across it, be this movement overt or covert. The fact that this generalization holds suggests that proposals that take these phenomena to have the same source are on the right track. Building on Nissenbaum's (2000) work on parasitic gaps, and previous analyses of DistNums and similar adverbials by Beck & von Stechow (2007) and Cable (2014), we have provided an account of this generalization, with the central idea being that the kinds of predicates that DistNums modify can only be created by movement. We also have provided a semantics for these adverbials that is capable of assigning the correct truth-conditions to sentences in which they associate with only one of the DPs in a coordinated structure.[9] Finally, we have shown how one can use DistNums to detect movement in Mandarin Chinese sentences, and use DistNum association to provide new arguments in favor of the existence of covert pied-piping in Mandarin Chinese *wh*-questions and null topic movement in clauses with object drop.

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[9] For more discussion on the meaning of Mandarin DistNums, we refer readers to Kobayashi & Chen (2020a,2020b).

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