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Some Issues in Korean Syntax and Processing: Rethinking Scope^{*}

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1. Introduction

The standard view of how the language faculty is organized posits both a grammar, which is responsible for matters of well-formedness, and a processor, which uses grammatical information as it goes about producing and interpreting sentence in the course of actual speech (e.g., Fodor 1989:177ff, Frazier & Clifton 1996:9 & 25, Frazier 1998:126, Jackendoff 2002:31 & 57). Moreover, on most accounts, there is a sharp asymmetry in the relationship between the two cognitive systems: the processor is subservient to the grammar. The 'most basic assumption about the nature of the human sentence processor,' Ferreira, Christianson, & Hollingworth (2001:13) write, is 'that it obeys the fundamental principles of grammar when constructing interpretations.'

This notwithstanding, it is widely recognized that there is a certain tension between the grammar and the processor, in that either system could in principle be responsible for the unacceptability of particular types of sentences. A very early example of this tension is exemplified in the work of Fodor (1978), who suggested that the contrast between sentences such as the following was better attributed to a processing constraint than a syntactic principle.

- (1) a. Which violin is this sonata easy to play on?
- b. *Which sonata is this violin easy to play on?

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More recently, however, an increasing number of proposals go considerably further: instead of simply acknowledging that some syntactic phenomena are best understood in terms of processing considerations, it is now being suggested that the core properties of phenomena that have long been central to work in syntactic theory reflect the operation of the processor rather than the effect of grammatical constraints (e.g., Hawkins 2004, O’Grady 2005, Hofmeister et al. 2007).

The position that we adopt in this regard is particularly strong: following O’Grady (2005), we take the view that a simple efficiency-driven processor, not Universal Grammar, lies at the heart of the human language faculty and has a key role to play in addressing the issues that define most work in linguistic theory:

- i. Why does language have the particular properties that it does?
- ii. Why is typological variation involving those properties restricted in particular ways?
- iii. How are those properties acquired by children, based on experience that is limited in particular ways?

We focus here on scope—the relationship between two (or more) operators. Not only has this phenomenon proven to be extraordinarily challenging over the years for all approaches to language, it is of special interest to comparative work on Korean and English, since the two languages appear to differ in interesting ways with regards to scope.

Let us begin by considering scopal relations involving an indefinite and a universal quantifier.

2. Indefinite + Universal Quantifier

2.1 English

A well-known property of English is that it permits two interpretations for sentences such as (2).

- (2) A man climbed every mountain.

On the existential wide scope reading ($a > \text{every}$), the sentence means that a single man (say, Bob) climbed each mountain. We will henceforth refer to this as the 'single referent interpretation.'

On the universal wide scope reading ($\text{every} > a$), in contrast, the interpretation of *a man* can co-vary with the interpretation of the universally quantified NP, so that there could be as many men as there are mountains. We will call this the 'multiple referent interpretation.'

It is frequently observed that the multiple referent reading for sentences in which an existential quantifier precedes a universal quantifier is relatively difficult to construct (e.g., Reinhart 1997:350 & 370, Anderson 2004, Marsden 2004:246). As Reinhart (ibid.:370) observes, this interpretation 'is a marked option: It is often very hard to obtain and it requires a strong discourse motivation.'

Interestingly, a UG-based processing explanation has been put forward to account for this fact. Anderson (2004:48) suggests that the difficulty of the multiple referent interpretation can be traced to the fact that the corresponding Logical Form (LF), with the universally quantified NP raised to a position higher than the indefinite, is more complex than the LF associated with the single referent interpretation because the two levels of representation are not isomorphic. See also Musolino (1998).

- (3) LF for the multiple referent interpretation:
[every mountain_i [a man climbed e_i]]

We propose a somewhat stronger idea: the right processing explanation draws ENTIRELY on processor-internal considerations, without reference to UG or to the mapping between levels of representation such as S-structure or Logical Form.

Our starting point is the proposal outlined in detail by O'Grady (2005), which holds that the core properties of language are best explained by reference to an 'efficiency-driven' processor whose primary objective is not to implement

grammatical rules but simply to minimize the burden on working memory.¹ In the case of scope, two simple ideas come into play. Because each implies a strategy that minimizes the burden on working memory by avoiding delays and revisions, we will refer to them as ‘efficiency assumptions.’

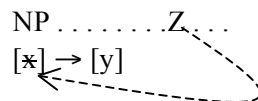
- i. As the processor works its way through a sentence, it immediately assigns each NP an interpretation, based on available clues such as position, determiner type, case marker, context, and so forth.
- ii. The revision of a previously assigned interpretation is costly since it disrupts the normal linear operation of the processor, which forms and interprets sentences in real time under conditions that value quickness.

We are particularly concerned here with the situation that is schematically depicted below.

- (4) a. An NP is encountered and assigned an interpretation x , based on its position and other local properties:

NP
[x]

- b. Based on the properties of a subsequently encountered element Z , the NP’s interpretation is recomputed:



¹ Following Carpenter et al. (1994), we take working memory to be a pool of operational resources that both holds representations and supports computations on them. See also Jackendoff (2002:200).

On the view we adopt, the latter procedure adds to the burden on working memory resources by requiring both the recovery of the earlier interpreted NP and its recomputation.

Consider now the single referent interpretation, which can be derived as follows.

- (5) First: Formation of the NP *a man* and assignment of the single referent interpretation:

[A man]

↓

Later: Formation of the rest of the sentence, with no change to the interpretation of the subject NP.

[A man climbed every mountain.]

↓

Now consider the multiple referent interpretation.

- (6) First: Formation of the NP *a man* and assignment of the single referent interpretation:

[A man]

↓

Later: Formation of the rest of the sentence, with revision to the previous interpretation of the indefinite NP after encountering the universally quantified NP.

[A man climbed every mountain.]

↓ → ↓ ↓ ↓
←

According to our efficiency assumptions, computation of the multiple referent interpretation in this case should be computationally difficult since the processor has to depart from its normal linear course and revise an earlier assigned interpretation.

Kurtzman & MacDonald (1993:257) propose a processing explanation essentially along these lines (see also Fodor 1982:143-45). An indefinite NP, they suggest, is initially interpreted as referring to a single entity ('the single reference principle'). This interpretation must then be revised upon exposure to the universally quantified NP in direct object position if the multiple referent reading is to be derived.

2.2 Korean

It is widely held that Korean has 'frozen scope' in that the surface order of operators determines their scopal relationship. What this essentially means is that a sentence such as (7) has only the interpretation in which the indefinite has wide scope—in other words, it permits only the single referent interpretation (Kim 1989:366, cited by Marsden 2004:240; Yang 1992:15; Han et al. 2007: 16-17).²

- (7) Nwukwunka-ka motun san-ul ollaka-ss-ta.
 someone-NOM every mountain-ACC climb-PST-DECL
 'Someone climbed every mountain.'
 (single referent interpretation only: 'There is a particular person who
 climbed every mountain.')

There is experimental evidence in support of this judgment. Working with 26 adult native speakers of Korean, Marsden (2004) elicited judgments about the match between sentences such as the following and the pictures in Figure 1.

²Following tradition, we translate *motun* as 'every' even though it also resembles 'all' in many respects.

- (8) Nwukwunka-ka motun koyangi-lul ssutatum-ess-ta.
 Someone-NOM every cat-ACC stroke-PST-DECL
 'Someone stroked every cat.'



single referent interpretation



multiple referent interpretation

Figure 1. Sample pictures from Marsden (2004)

Marsden reports (p. 202) a mean rating of 2.11 (out of 3) for the match between the sentence and the picture illustrating the single referent interpretation, compared to just .49 for the match with the picture depicting the multiple referent reading.

Why should the multiple referent interpretation be prohibited in this sort of pattern in Korean? On our view, what makes Korean different from English is simply that the processor balks at the extra cost associated with the multiple referent interpretation, refusing to revise the previously computed interpretation for the indefinite NP.

This is consistent with what we know about processor-related typological variation in general—if two patterns or interpretations differ in terms of their computational difficulty, then one of two things can happen (Hawkins 2004:256, O'Grady 2005:214, 2007:105-06).

- i. A language can permit both interpretations. This is what happens in English, which allows both the single referent reading and the multiple referent reading in patterns with an indefinite subject and a universally quantified direct object.

- ii. A language can permit only the less difficult interpretation. This is what happens in Korean, where the computationally straightforward single referent reading is permitted, but the more demanding multiple referent interpretation is barred.

Crucially, however, there should be no languages in which only the more difficult multiple referent reading is allowed when an indefinite subject NP precedes a universally quantified co-argument. As far as we know, this too is correct.

The viability of this idea is obviously dependent on the claim that the multiple referent interpretation places a heavy burden on the processor. There is an interesting way to get evidence for this idea, and it comes from a pattern that undermines the claim that Korean allows only frozen scope. The key sentence type is exemplified in (9), with the quantifier *kakkak* ‘each’ instead of *motun* ‘every.’

- (9) Aphathu aph-eyse nwukwunka-ka himtulkey kakkak-uy cim-ul nallassta.
 apartment front at someone-NOM with.difficulty each-GEN item-ACC delivered
 ‘In front of the apartment, someone arduously delivered each item.’

Here, at least some Koreans permit the multiple referent reading in which different people delivered the various items. This in turn leads to the following prediction: if Korean speakers are sensitive to the computational cost associated with the derivation of the multiple referent reading in patterns such as this, not only should they have access to this interpretation less frequently, there should be measurable effects of the computational burden that it creates.

In fact, O’Grady & Lee (2006) report just such a result. In our experiment, subjects had to judge the truth of sentences such as (9) in two sorts of contexts—those that favored a single referent interpretation and those that favored a multiple referent interpretation. Table 1 summarizes our results.

Table 1. Mean percentages of True or False responses

Context	T	F
Single referent (someone > each)	91.2%	8.8%
Multiple referent (each > someone)	47.3%	52.7%

As can be seen here, our subjects accepted the truth of the test sentence 47.3% of time in contexts favoring the multiple referent reading. This rate of acceptance is very close to the rate obtained for English (53%) by Anderson (2004:62), suggesting that the multiple referent interpretation is in fact available in Korean.

The test sentences in our experiment were presented to the subjects via a self-paced reading format controlled by PsyScope software running on a Macintosh computer. The sentence was divided into regions (see below), which were revealed one by one as the subject pressed the space bar. This allowed us to get a series of measurements relating to incremental reading times.

- (10) Region 1 2 3 4 5 6
Aphathu aph-eyse / nwukwunka-ka / himtulkey / kakkak-uy / cim-ul / nallassta.
apartment front at someone-NOM with.difficulty each-GEN item-ACC delivered
'In front of the apartment, someone arduously delivered each item.'

The key region for us is the fourth one, where subjects encounter the universal quantifier and have an opportunity to revise the single referent interpretation previously assigned to the indefinite NP, giving the multiple referent interpretation. Table 2 presents our findings.

Table 2. Mean reading times by context

	R1	R2	R3	R4	R5	R6
Single ref. context	501.52	674.04	602.56	616.49	589.53	625.46
Multiple ref. context	514.94	706.97	632.57	706.36	719.37	731.23

As can be seen here, a very noticeable increase in reading time takes places at position 4 when the test sentence follows a context favoring the multiple referent reading compared to a context favoring the single referent interpretation. This difference is significant both by subjects and by items ($F(1, 21) = 12.39, p < .05$; $F(1, 23) = 13.37, p < .05$). Significant reading time differences were also observed in region 5 ($F(1, 21) = 6.65, p < .05$; $F(1, 23) = 13.95, p < .05$) and in region 6 ($F(1, 21) = 22.12, p < .05$; $F(1, 23) = 4.93, p < .05$)—possibly reflecting a ‘spill-over’ effect (i.e., a delayed effect of the processing difficulty occasioned by the second quantifier).

In sum then, there is reason to think that the processor makes at least a preliminary attempt to construct the multiple referent interpretation for the previously interpreted indefinite NP upon encountering the universal quantifier *kakkak*, and that this attempt is costly—hence the increase in reading time in region 4 in the multiple referent context compared to the single referent context. This is consistent with the overall perspective on scope taking that we propose—the difficulty and typological markedness of particular interpretations stems from the burden that they place on the processor.

Another issue now arises: why is the multiple referent interpretation permitted with *kakkak* in the patterns we are considering, but not with *motun*? The suspicion is that this asymmetry follows from the semantics of the quantifiers themselves: *kakkak* has a strongly distributive connotation, while *motun* seems to invoke a group-type interpretation. If only one of the two is able to induce the processor to undertake the extra burden associated with the multiple referent reading, it makes sense that *kakkak* should be that quantifier. That is because the multiple referent

interpretation is inherently distributive: the various referents of the indefinite are matched with the different individual entities in the set denoted by the universally quantified NP, often in a one-to-one manner.

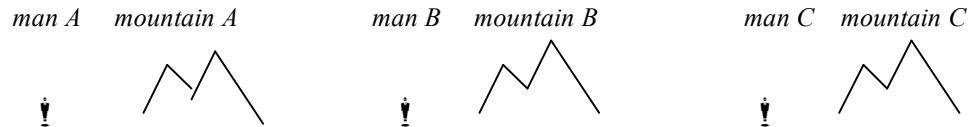


Figure 2. *A man climbed every mountain*—multiple referent (distributive) interpretation

Now let us turn to a different scopal phenomenon, this one involving the relationship between a universal quantifier and negation. As we will see, its syntax too manifests properties that are best understood in terms of the operation of a processor whose operation is sensitive to the burden on working memory.

3. Negation + Universal Quantifier

3.1 English

The interaction of negation and universal quantifiers results in scopal ambiguities in many languages, including English.

- (11) Every man didn’t get on the bus.

There are two interpretations here. On the first reading, traditionally called the ‘universal wide scope reading’ (*every* > *not*), all members of the discursively defined set of men behave alike with respect to some property or event—in this case, they all fail to get on the bus. We will refer to this as the ‘full set interpretation.’

On the second interpretation, traditionally labeled the ‘negation wide scope reading’ (*not* > *every*), the set of men differ internally with respect to a property or

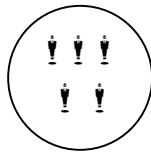
event—in the case at hand, it is generally understood that some men got on the bus and some men didn't. We will call this the 'partitioned set interpretation.'

The two readings differ with respect to their compliance with our efficiency assumptions. Consider first the full set interpretation, which can be derived as follows.

(12) The full set interpretation

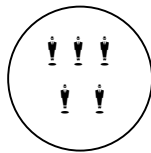
First: Formation of the NP *every man* and assignment of the full set interpretation:

[Every man]



Later: Formation of the rest of the sentence, with no change to the interpretation of the subject NP.

[Every man didn't get on the bus]

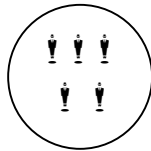


As can be seen here, the formation of this interpretation is straightforward, with no need to revise the full set interpretation that has already been assigned to the quantified NP. Matters are very different in the case of the partitioned set reading.

(13) The partitioned set interpretation

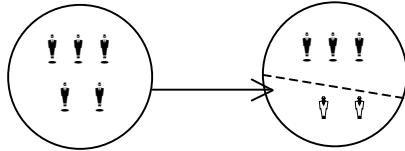
First: Formation of the NP *every man* and assignment of the full set interpretation:

[Every man]



Later: The negative operator is encountered and assigned wide scope, forcing recomputation of the previously interpreted subject NP by partitioning the earlier formed set.

[Every man didn't ...]



Consistent with our efficiency assumptions, computation of the partitioned set interpretation is expected to create an extra burden for working memory. This is because the processor has to depart from its normal linear course and revise an previously assigned interpretation, partitioning the set that was constructed when the universally quantified NP was first encountered. This leads to a number of predictions.

Predictions

First, the processing account predicts that in contexts favoring the partitioned set interpretation there should be signs of increased processing difficulty once the negative is encountered, compared to what happens in contexts that favor the full set interpretation. Using a technique similar to the one described above for the

kakkak experiment, Sunyoung Lee (to appear) has reported just such a result for adult native speakers of English.

- (14) Every kid / didn't feed / the ducks / in the pond.

↑

increased reading time here for the partitioned set interpretation

Second, we would expect the partitioned set interpretation in these sorts of patterns to be typologically marked. Particularly relevant in this regard is Chinese, in which sentences such as the following have only the full set interpretation in which the property of not having jumped over the fence is attributed to the entire group of horses (Musolino et al. 2000:22).

- (15) Mei-pi ma dou mei tiao-guo langan.
 Every horse all not jump over fence
 'Every horse didn't jump over the fence.'

Crucially, however, we know of no language in which the reverse situation holds and negation *MUST* have scope over a universally quantified subject NP to its left. We are thus left with the following situation.

- There are languages such as English in which either a full set reading or a partitioned set reading is permitted when a universally quantified NP is followed by a negative.
- There are languages such as Mandarin in which only the full set reading is permitted.
- There are no languages in which only the partitioned set reading is allowed.

This is of course exactly what the processing account predicts.

Finally, assuming that children gravitate toward the less demanding interpretation in cases of ambiguity, we can look to acquisition data for evidence that the partitioned set interpretation is more difficult. Musolino & Lidz (2006)

report on the results of a truth-value judgment task that they carried out with 20 five years olds, following up on earlier work by Musolino et al. (2000). The children watched an experimenter use props to act out a scenario in which two of three horses succeed in jumping over a fence. The children were then asked to judge the truth of *Every horse didn't jump over the fence*.



Figure 3. Scene used to test the truth of *Every horse didn't jump over the fence*

Given the scenario presented by the experimenter, the sentence is true on the partitioned set interpretation (since one horse didn't jump over the fence) and false on the full set interpretation (since two horses succeeded in jumping over the fence). The children opted for the full set interpretation 85% of the time, accepting the sentences as true just 15% of the time.³

In the studies just reported, adults manifested no difficulty with the partitioned set interpretation, but more recent work involving a different experimental paradigm suggests that they too prefer the full set interpretation. Conroy & Lidz (2007) used an incremental verification task in which ten adults were asked to judge the truth of a sentence such as *Every dog isn't wearing a hat* as they uncovered each of the four pictures below, one at a time from left to right.

³The acceptance rate increased to 55% when children were presented with 'contextual support' in the form of a contrastive sentence such as the following.

- (i) Every horse jumped over the log, but every horse didn't jump over the fence.

This suggests a dispreference for the partitioned set interpretation rather than its absolute rejection.

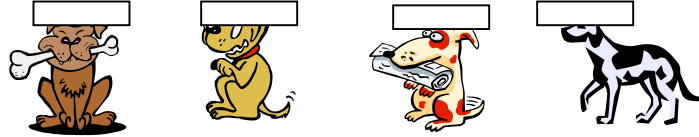


Figure 4. Sample item used to test the interpretation of *Every dog isn't wearing a hat*, based on Conroy & Lidz (2007)

As Conroy & Lidz note, subjects who adopt the partitioned set reading will be able to judge the sentence to be true upon seeing the leftmost picture since that dog is not wearing a hat.



Figure 5. Exposure to the first picture indicates that the sentence is true on the partitioned set (*not* > *every*) interpretation.

In contrast, subjects who prefer the full set interpretation will have to go through the full series of pictures in order to be sure that all of the dogs are hatless.

Crucially, adults manifest a strong tendency for the full set interpretation in this sort of task. Conroy & Lidz interpret this result as evidence for the default status of this reading, even in adults. This is just what our proposal predicts.

3.2 Korean

Korean manifests scope ambiguities similar to those of English when the universal quantifier is in either subject position or object position.

- (16) a. In subject position:
 Motun salam-i an ttena-ss-ta.
 every person-NOM not leave-PST-DECL
 'Everyone didn't leave.'

b. In direct object position:

John-i motun salam-ul an po-ass-ta.

John-NOM every person-ACC not see-PST-DECL

'John didn't see everyone.'

As in the case of English, two interpretations have been reported, although there is considerable disagreement on what the facts are (see Han et al. 2007 for a review.)

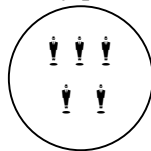
As illustrated below, we expect the full set reading to be completely straightforward for the processor since it requires no revision to the interpretation that is initially assigned to the universally quantified NP.

(17) The full set interpretation

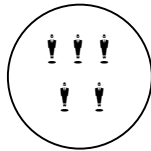
First: Formation of the NP *motun salam* 'everyone' and assignment of the full set interpretation:

John-i motun salam-ul

John-NOM every person-ACC



Later: Formation of the rest of the sentence, with no change to the interpretation of the quantified NP.

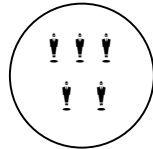
John-i motun salam-ul **an** po-ass-ta.John-NOM every person- ACC **not** see-PST-DECL

Matters are very different in the case of the partitioned set interpretation. There, as illustrated below, the quantified NP is initially assigned the full set interpretation, which must subsequently be revised.

(18) The partitioned set interpretation

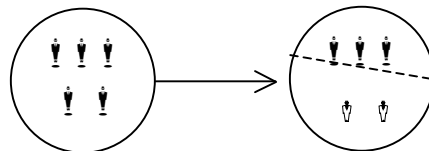
First: Formation of the NP *motun salam* ‘everyone’ and assignment of the default full set interpretation:

John-i motun salam-ul
John-NOM every person-ACC



- b. Later: The negative operator is encountered and assigned wide scope, forcing recomputation of the previously interpreted NP by partitioning the earlier formed set.

John-i motun salam-ul **an** po-ass-ta.
John-NOM every person-ACC **not** see-PST-DECL



As can be seen here, in order to derive the partitioned set reading, the processor has to depart from its normal linear course to recompute the interpretation of the quantified NP, partitioning the set that it denotes. As in the case of English, the increased computational cost associated with this operation leads to various predictions.

Predictions

A first prediction is that in contexts that favor the more difficult partitioned set reading there should be an increase in reading time at the point where the negative is encountered, compared to what happens in contexts that favor the easier full set interpretation.

increased reading time here for the partitioned set interpretation



- (19) John-i motun salam-ul **an** po-ass-ta.
 John-NOM every person-ACC **not** see-PST-DECL

Sunyoung Lee (to appear) has uncovered just such a contrast.

Second, we predict that if in fact there is variation among native speakers of Korean in the admissibility of the two interpretations, it should involve the computationally more difficult partitioned set reading. In particular, we predict that whereas some speakers might reject the partitioned set interpretation, no one should reject the full set reading.

Table 3. Predictions for scope interpretation in Korean

	<u>full set reading</u>	<u>partitioned set reading</u>
Possibility 1	accept	reject
Possibility 2	accept	accept (but disfavored)
Impossible	reject	accept

These predictions seem to be at least partially borne out in the study conducted by Han et al. (2007). Using a truth-value judgment task, they found an acceptance rate by their adults subjects of 98% for the full set interpretation. In contrast, the

acceptance rate for the partitioned set interpretation was just 37%, with ten of the twenty subjects rejecting it on all the test items.⁴

Third, we predict a parallel asymmetry in the preferences of children acquiring Korean. Assuming once again that children gravitate toward the computationally less demanding interpretation, they should manifest a robust preference for the computationally easier full set reading—regardless of the judgments that they go on to have as adults. As predicted, Han et al.’s child subjects (all four year olds) accepted the full set interpretation 81.67% of the time, compared to just 36.67% for the partitioned set reading. Ten of fifteen child subjects rejected the partitioned set interpretation on all test items.

4. Concluding remarks

The interpretations associated with widely studied scope ambiguities involving indefinites, universally quantified NPs, and negation are not equal with respect to processing considerations. As we have seen, the multiple referent interpretation for an indefinite subject with a universally quantified co-argument (*A man climbed every mountain*) creates a measurable burden on working memory because of the need to revise the single referent interpretation initially assigned to the indefinite. A similar effect is observed for the partitioned set interpretation of patterns in which a universally quantified NP precedes a negated verb (*Every man didn’t get on the bus*), in which it is necessary to revise the full set interpretation initially assigned to the quantified NP. As we have tried to show, this burden is responsible for key facts concerning scope interpretation, including the increased processing difficulty observed in experimental work, the judgment preferences found in adults, the markedness facts observed typologically, and the developmental facts manifested in acquisition studies.

There is much still to do, of course—we have said nothing about the effect of scrambling, the possible relevance of c-command, the syntax of variable binding, or the interpretation of biclausal scopal patterns, for instance. However, we are

⁴ Because of Han et al.’s between-participants design, it is impossible to know whether any Koreans permit ONLY the partitioned set interpretation. We predict that there are no such speakers.

optimistic that these phenomena too will lend themselves to an analysis built on processing considerations.

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