

A Hybrid Approach to Floating Quantifiers: Some Experimental Evidence*

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Ko, Heejeong & Oh, Eunjeong. 2012. A Hybrid Approach to Floating Quantifiers: Some Experimental Evidence. *Linguistic Research* 29(1), 69–106. The non-local dependency between a noun and its associate quantifier has been widely discussed. The details may differ, but the formal analyses of floating quantifiers can be divided into three schools of research. One is an adnominal approach, which argues that the noun and the quantifier are externally-merged together (at some point of the derivation), and that the noun has undergone leftward movement in a later derivation (e.g. Kuroda 1983, Sportiche 1988, Ueda 1990, Bošković 2004). Another is an adverbial approach, which claims that the quantifier modifies the event structure of the verb phrase, and that the noun and the quantifier are not related to each other by movement (e.g. Kayne 1975, Fukushima 1991, Bobaljik 1995, 2003, Brisson 1998, Nakanish 2003, Kim and Yang 2006, Kim 2011). The other is a hybrid approach (e.g. Ishii 1998, Kang 2002, Ko 2005, 2007, Fitzpatrick 2006) which argues that some floating quantifiers are adnominals while some are adverbials. This paper evaluates the predictions and validity of the three approaches with new experimental data, and provides some evidence for the overall hybrid approach from on-line processing and off-line judgment data. At the conclusion of the paper, we also discuss remaining issues to solidify the hypotheses of the hybrid approach.

Keywords floating quantifiers, hybrid approach, Edge generalization, self-paced reading, scaled judgment, cyclic linearization, experimental syntax

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1. The Issue

The three major approaches to capture the non-local dependency between a noun and its associate quantifier have different predictions and implications. On the adnominal approach, floating Q(uantifier) constructions are transformationally related to a corresponding non-floating Q construction. For instance, *the students* in (1a) is externally-merged with *all* in base position and has undergone leftward movement, as in (1b).¹

- (1) a. [TP ____ [T have [VP [DP all [DP the students]]] had lunch]]]
 b. [TP [DP the students] i [T have [VP [DP all t₁] had lunch]]]

This approach has some advantages in explaining the close relationship between floating and non-floating Q constructions. The semantic similarities between (1a) and (1b) straightforwardly follow from the claim that they share the base structure. The fact that the floating Q shows the same agreement pattern with its host noun as the non-floating Q is also naturally explained by the adnominal approach (e.g. Shlonsky 1991, Merchant 1996). It also explains the fact that floating Qs appear in the original or intermediate positions of its host noun (e.g. Bošković 2004). Floating Qs were also taken as empirical evidence for the predicate-internal subject hypothesis (e.g. Sportiche 1988; see Fitzpatrick 2006 for an excellent summary).

Under the adverbial approach, on the other hand, the quantifier modifies the event structure of the verb phrase, and crucially, the noun and its associate Q are not directly related to each other by syntactic movement. For instance, (1a) and (1b) are not related to each other by syntax. Instead, the “apparent” ability of the adjunct Q to modify the noun is derived *indirectly* by the semantics. Due to its lexical meaning, *all* “maximizes” the external argument of the verbal phrase, as stated in (2) (Dowty and Brody 1984, adopted by Bobaljik 1995), and this leads to the semantics

¹ In the strict sense, *all* is “stranded” in its base position rather than “floated” in an arbitrary place under the adnominal approach. For the sake of simplicity, however, we use the term *floating* theory-neutrally to denote a non-local dependency between a noun and its associate Q. There are numerous previous studies on the base position of floating quantifiers. Due to the limitation of the space, I cannot cite or properly review all of the previous studies on this issue in this paper. I refer the reader to Bošković (2004), Bobaljik (2003), and Fitzpatrick (2006) for a summary of the literature for general discussion. See Ko (2005, 2009) and references therein for the review on the issue in Korean.

that *all* modifies the noun *the students* in (1b) without any involving syntactic movement.

$$(2) [[\text{all}]] = \lambda P <e, t>. \lambda x P(\max(x))$$

The adverbial approach has certain advantages, too. When a floating Q appears in non-argument position, the adverbial approach claims to best explain the distribution of the floating Q. Some semantic differences between floating and non-floating Q constructions are also naturally explicable by the adverbial approach (see a detailed discussion by Bobaljik 1995, 2003).

Lastly, the hybrid approach argues that both adnominal and adverbial approaches are basically on the right track. It argues that in languages, some floating Qs are adnominal while some are adverbial, and that the two types of floating Qs show different semantic and syntactic properties. For instance, Ishii (1988) argues that floating Qs are ambiguous between a stranded Q and adverbial Q, and that systematic counterexamples to the adnominal Q approaches are limited to the cases where the floating Qs bear a distributive reading, which should be analyzed as an adverbial Q.

Kang (2002) argues that floating Qs in Korean can be used as a verbal modifier in some special contexts - where quantificational information is in focus. If the quantifier itself is marked with a focus, case or a delimiter (e.g. *sey-myeng-man* '3-Cl-only', *sey-myeng-ul* '3-Cl-Acc', *sey-myeng-in-a* '3-Cl-delimiter'), the floating Q is interpreted as an adverbial modifier of the relevant event. This is illustrated with the examples in (3). Furthermore, Kang notes that if the quantifier is used as an answer to a question (as the focus of information), as in (4), or in gapping construction, as in (5), it can be interpreted as a verbal modifier, too.²

- (3) a. **Haksayng-tul-i** sakwa-lul **twu-myeng-i** mek-ess-ta.
 student-Pl-Nom apple-Acc 2-Cl-Nom eat-Past-Dec
 'Two students ate apples.'

² See also detailed arguments by Kim (2011), who argues that focus and pragmatics play an important role in licensing adverbial Qs, and refer to Kim (2011) for interpretation concerning the floating Q data (especially type (9) and (11)) under a functional, non-derivational view.

- b. **Haksayng-tul-i** sakwa-lul **sey-myeng-man** mek-ess-ta.
 student-Pl-Nom apple-Acc 3-Cl-only eat-Past-Dec
 ‘Only three students ate apples.’
- (4) A: Haksayng myech-myeng-i khemphyuthe chayk-ul sass-ni?
 student how-many-Cl-Nom computer book-Acc bought-Q
 ‘How many students bought the computer book?’
- B: **?Haksayng-i** kukes-ul **twu-myeng** sasse.
 student-Nom it-Acc 2-Cl bought
 ‘Two students bought it.’
- (5) **?Haksayng-i** chayk-ul **twu-myeng**, nothu-lul **sey-myeng** sassta
 student-Nom book-Acc 2-Cl note-Acc 3-Cl bought
 ‘Two students bought books and three (students bought) notes.’

Based on Korean and Japanese data, Ko (2005, 2007) also argues for a hybrid approach to floating quantifiers. Ko shows that while the distribution of adnominal Qs is affected by various syntactic factors (e.g. grammatical function of the host noun, argument structure of the verb, and position of the intervening element), the distribution of adverbial Qs is not restricted by those syntactic factors. The distributions of adverbial Qs are rather free, in comparison to those of adnominal Qs (but see Ko 2005, Chapter 4 for some restriction on the position of adverbial floating Qs). Ko (2005, 2007) agrees with Kang’s overall observation that focus plays an important role in deciding whether a certain Q is interpreted as an adverbial or adnominal. Departing from Kang (2002), however, Ko argues that there is some fundamental difference between examples like (3) vs. (4-5).

Specifically, speakers render a uniform judgment on examples like (3) where a focus/case-marker is attached to a quantifier whereas the judgment on examples like (4-5) varies a lot among speakers. There is a consensus that the examples in (3) are judged simply grammatical. On the contrary, the grammatical status of (4-5) is still under debate - where the quantifier is not suffixed with any overt focus marker, and only the pragmatic context signals that informational focus falls on the quantifier. Most of the speakers find that the relevant examples in (4-5) are judged better than corresponding examples in out-of-the-blue context, but it is also true that many speakers still find them degraded in varying degrees. Unlike the examples in (3), prosodic factors such as pause and stress play a great role in judgment variation (see

Miyagawa and Arikawa 2007 for similar observations on Japanese that Ko (2005) is inspired by, but Ko (2005) takes a different view from Miyagawa and Arikawa in the interpretation of the data). Given the different status of (3) and (4-5), Ko claims that the overtly focus-marked quantifiers are adverbial in underlying structure, whereas bare quantifiers such as (4) and (5) are basically adnominal and can be interpreted as an adverbial only when special pragmatic and semantic factors strongly signal it.

Fitzpatrick (2006) focuses more on semantic properties of floating Qs and proposes that the split between the two types of floating Qs exists not only between languages (e.g. Japanese vs. English), but also within a single language (e.g. Korean, West-Ulster English). Fitzpatrick (2006) shows that exhaustivity is systematically related with the Q type, and the adverbial type Qs bear the semantics of exhaustivity. Fitzpatrick (2006) also argues that adverbial floating Qs are characterized by the A-movement-like properties of the host noun, whereas adnominal floating Qs are diagnosed by A'-movement-like properties of the host noun.

As will be scrutinized later, it is certain that the overall predictions of the three approaches to floating Qs are quite divergent. Under the adnominal approach, we predict that the distribution of floating Qs will be restricted by the locality conditions on NP-movement since the distribution of floating Qs are contingent on the feasibility of nominal movement. Under the hybrid approach, on the other hand, only a subset of floating Qs would show such locality effects. On the adverbial approach, floating Qs may appear rather freely as long as event quantification is possible.

Though the predictions can be clearly stated, there has been lack of consensus on which prediction is supported by quantifiable psychological data. Each approach often discusses different sets of data in different languages, and researchers occasionally report different judgments on the same data set, too (e.g. Hoji and Ishii 2005, Miyagawa and Arikawa 2007 for debates on Japanese floating Q data). Moreover, it has been unclear what we mean by “unacceptability”. It remains unclear whether “unacceptability” of floating Q constructions comes from mere processing difficulty or quintessential ungrammaticality (cf. Miyagawa and Arikawa 2007 for a suggestion that prosody plays a crucial role in processing floating Q constructions). If the former is correct, we expect that the unacceptability can be overcome in off-line judgment tasks. If the latter is correct, however, we predict that the

unacceptability will be maintained both in on-line and off-line tests.

To tackle the issue of judgment variations properly, we need a controlled experiment on floating Q constructions so that we may apply statistical analyses on the psychological data. Furthermore, to test whether unacceptability originates from processing difficulty or ungrammaticality, we need both real time and off-line data. It may be worth noting, however, that linguistically-informed processing studies on floating Qs are in fact quite rare. Miyagawa and Arikawa (2007) properly addressed the issue of prosody in processing floating Qs but conducted a pilot study only. Kang (2002) pointed out the effects of discourse focus, but experimental evidence is yet to be given (see also Kim and Yang 2006 for comments).

The goal of our study is to evaluate the predictions and validity of the three approaches to floating Q constructions with new experimental data from Korean. Korean is a language that is claimed to have both adnominal and adverbial Qs in the literature (see Kang 2002, Ko 2005, 2007, Fitzpatrick 2006). Thus, some systematic correlations between various syntactic factors and Q-types are expected. Furthermore, the two types of floating Qs are claimed to be minimally different from each other in morphology: the adnominal Qs are caseless and the adverbial Qs are focus/case-marked. Otherwise, they look the same on the surface. Therefore, Korean floating Qs may provide an ideal background to test the hypotheses concerning the syntactic differences associated with Q-types in an experimental setting.

This paper is organized as follows. In section 2, we lay out theoretical background of our study and explain the design and predictions of our experiments. In particular, we set the baseline by introducing the hybrid approach advanced by Ko (2005, 2007) and provide detailed predictions on each stimulus item. In section 3, we report the experimental results from our self-paced reading tests and off-line judgment tests and provide statistical analyses on them. In this section, we report the experimental results that we collected from 138 native speakers of Korean with the relevant stimuli. In section 4, we discuss theoretical implications of our study for underlying structure of floating quantifiers. We argue that the overall results support for the hybrid approach but there is also an important caveat to be filled in to firmly argue against different schools of research. Section 5 concludes the paper. The appendix contains the stimuli items that we employed in our experiments.

2. Theoretical Background

As briefly mentioned above, there exist many researchers who argue for a hybrid approach to floating quantifiers in the literature (e.g. Ishii 1998, Kang 2002, Ko 2005, Fitzpatrick 2006). Among others, however, we take Ko's (2005, 2007) approach as our starting point for the following reasons. First, the main focus of the paper is to evaluate how underlying structure of floating quantifiers affects their distribution in the overt syntax. Thus, we attempt to collect *testable syntactic diagnostics* to evaluate the available hypotheses on the *structure* of floating Qs. A strongly semantically-oriented approach such as Ishii's (1998) does not provide us with enough resources to define the syntactic environment where a certain Q is interpreted as an adverbial Q. Unless there is some independent way to match the semantic notion such as "distributivity" or "exhaustivity" with syntactic terms, it is hard to make a prediction on syntax based on such semantic notions only. Furthermore, Ishii's work is heavily built on Japanese data so it requires rather serious caution to extend it to Korean data, which are of our main interest. Secondly, though Ko (2005) has different reasoning to support for a hybrid approach, Ko is inspired by previous syntactic approaches such as O'Grady (1991) and Kang (2002) which argue that only sub-set of quantifiers are adverbials. Thus, if the predictions made by Ko (2005) are borne out, it naturally follows that the previous hypotheses that Ko adopts are also supported, at least in its overall attempts. Lastly, the recent semantic-syntactic approach by Fitzpatrick (2006) inherits Ko's hybrid approach and provides further support for it. Hence, we believe that Ko's hybrid approach would provide us with some initial and concrete baseline to evaluate the underlying structure of floating quantifiers (but see section 4 for further discussion). As will be discussed later, the predictions of the hybrid approach partially overlap both with those of the adnominal Q approaches or of adverbial Q approaches. Thus, we can test the overall predictions of adnominal and adverbial approaches by testing the hybrid approach as well.

2.1 Edges vs. Split Edges

Ko (2005, 2007) argues that (at least) three factors in (6) are involved in licensing floating adnominal Qs, and claims that the distribution of floating

adnominal Qs conforms to the *Edge Generalization*, stated in (7).

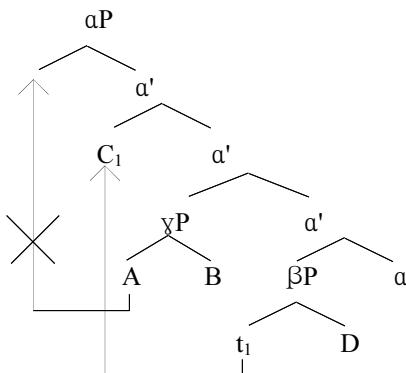
- (6) a. Grammatical function of the host noun (e.g. subject vs. object)
- b. Type of the quantifier (e.g. adverbial vs. adnominal Q)
- c. Argument structure (e.g. unergative vs. unaccusative verb)

(7) *Edge Generalization*

Elements that are externally merged as a constituent in syntactic edges cannot be separated by their domain-mates.

Ko (2005) argues that the Edge Generalization is a consequence of *Cyclic Linearization* (Fox and Pesetsky 2005) and a *probe-goal Search* (Chomsky 2001). As described in (8), when the two elements A and B are base-generated as a constituent at the syntactic edge of αP , their domain-mate C may precede or follow them. Crucially, however, A or B would not be able to move over C within αP since they are not in the search domain (i.e. c-command domain) of the head α (Chomsky 2001). Consequently, A and B are not separable by C within αP . If αP is a Spell-out domain, the linear orderings in αP must be preserved in the higher domains, due to Cyclic Linearization (Fox and Pesetsky 2005). Hence, A and B are not separable by their domain-mate C in the higher domains, either. As dubbed in Ko (2005), we call this ordering restriction the *Edge Effect*.

(8) *[A ... C ... B]: *Edge Effect*



If (8) is correct, we make a particular prediction about the distribution of floating

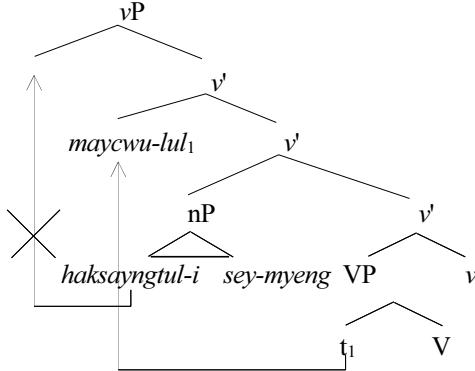
Qs. If the floating Q is adnominal (e.g. B in (8)), we predict that the floating Q will show Edge Effects. More specifically, if vP is a Spell-out domain (Chomsky 2001), we predict that the external argument (e.g. transitive subject, unergative subject) cannot be separated from its associate Q by their domain-mate (e.g. object). We also predict that the internal argument (e.g. unaccusative subject, transitive object) can be separated by vP-internal elements from its associate Q since it may undergo vP-internal movement (just like C in (8)).

Ko shows that caseless N(umerical) Qs in Korean show this Edge Effect, as expected for adnominal Qs. Some examples are given in (9). As shown in (9a), the transitive subject *haksayngtul-i* cannot be separated from its Q *sey-myeng* by the vP-domain-mate *maykcwu-lul* (see (9c) for tree diagram). (9b) demonstrates that contrary to (9a), the object *makcwu-lul* can be separated from its Q *sey-pyeng* by the subject *John-i* (recall that as depicted by the tree diagram in (8), C may undergo domain-internal movement, in contrast to edge elements such as A and B in (8): see (9d)).³

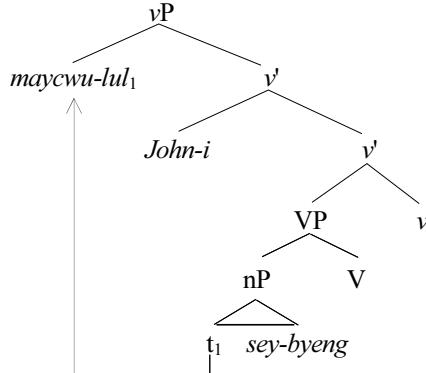
- (9) a. ***Haksayngtul-i** maykcwu-lul **sey-myeng** masiessta
students-Nom beer-Acc 3-Cl_{person} drank
'Three students drank beer.' [see (9c)]
- b. **Maykcwu-lul** John-i **sey-pyeng** masiessta
beer-Acc J-Nom 3-Cl_{bottle} drank
'John drank three bottles of beer' [see (9d)]

³ See also Ko (2011) for the distribution of the object when it functions as the subject of a secondary predicate or small clause. Ko (2011) shows that when the object is externally-merged as the *subject* of a small clause domain, its distribution is restricted by the Edge Effects, just like transitive subjects. Empirical evidence for this claim comes from resultative constructions, depictive constructions, and various types of small clauses construction, which were not investigated in Ko (2005, 2007). Nothing in this paper, however, does not conflict with Ko (2011) since all the objects employed in our experiments are purely transitive objects, which are not the subject of a secondary predicate.

c. *[A ... C ... B]: *Edge Effect* in (9a) (unnecessary details omitted)

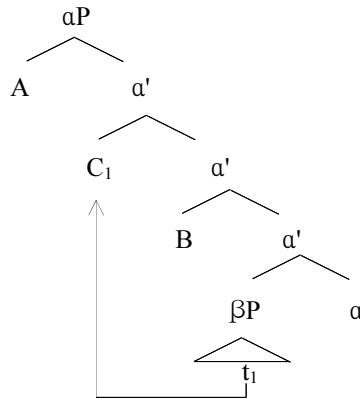


d. *domain-internal movement is fine* in (9b) (unnecessary details omitted)



Ko (2005) further argues that when two elements are merged at the edge as non-constituents, they are separable by their domain-mate, in contrast to (8). This is illustrated in (10). As shown in (10), the domain-mate C may be merged above B before A is merged (or tuck-in between A and B) within aP. Hence, A < C < B ordering is possible in split edges. As named in Ko (2005), we call this the *Split Edge Effect*.

- (10) $\checkmark [A \dots C \dots B]$: *Split Edge Effect*



Ko (2005, 2007) argues that adverbial Qs typically show *Split Edge Effects* described in (10) (inspired by the proposals of O'Grady 1991 and Kang 2002). Specifically, focus-marked Qs, case-marked Qs and universal quantifiers, and noun-associated NPIs belong to this type of floating Qs, which does not form a constituent with its host noun in underlying structure. For instance, the subject-oriented case-marked Qs may be separated by vP-internal elements (e.g. object) from its host noun, as illustrated in (11) - showing Split Edge Effects.⁴ Note that this sharply contrasts with the ungrammaticality of (9a) with adnominal caseless NQs.

- (11) **Haksayngtul-i** maykcwu-lul **sey-myeng-i** masiessta
 Students-Nom beer-Acc 3-Cl_{person}-Nom drank
 ‘Three students drank beer.’ (cf. caseless NQ in (9a))

⁴ In this paper, we categorize the case-marked Q into an adverbial-type. To be precise, however, the case-marked Qs may be a different type from adverbial Qs. As long as it is merged as a non-constituent from its host noun (e.g. secondary predicate; Miyagawa 1989), it would show the *Split Edge Effect* (10). Ko (2005) has argued that focus-marked Qs, universal Qs, and noun-associated NPIs show the same distribution as case-marked Qs, but it requires a further research whether we need a finer grained typology for the so-called “adverbial” floating Qs. See section 4 for further discussion. A reviewer also asks why so-called adverbial Qs cannot be merged as a sister of a nominal (say, B and D in (8)). I follow that the basic premise that adverbials cannot be a predicate of a nominal, and thus cannot be merged in adnominal predicate position such as B and D. Adverbials are adjuncts of a verbal projection due to its semantic property.

Though Ko (2005, 2007) provides various types of empirical evidence that the predictions depicted in (8) and (10) are borne out, a large-scale experimentation has not been conducted yet. As mentioned above, the judgments on sentences like (9a) are not without controversy due to many pragmatic factors, which indicates that a systematic experimentation is duly needed. Furthermore, on-line processing data have not been provided in the previous studies, either. In this paper, we evaluate Ko's proposal with experimental data more thoroughly, and tie the experimental results with the general discussion of floating Qs presented in Section 1.

2.2 Stimuli and Predictions

In our experiment, we examined how the three factors in (6) affect on-line and off-line judgments of floating Q constructions. The stimuli consist of 16 types of floating Qs, with 4 tokens each (64 main items). There were 16 fillers (see the appendix for the full list of stimuli). The items were matched in word length. In this paper, we report the results focusing on the contrast between caseless bare NQs vs. NQs that are overtly marked with a focus or a case.⁵ The schema of the main item is given in (12). As depicted in (9), we tested the effects of verb types (argument structure), Q-types, and the grammatical function of the host noun in processing and judging floating Q constructions. In the intransitive constructions (12g-l), vP-internal adverbs were used to test the ordering (see Ko (2005, 2007) for the behavior of vP-external adverbs, which does not make a difference between the subject and object in licensing for floating NQs for a principled reason).

⁵ In the experiment, we also examined the distribution of universal Qs (e.g. *motwu* 'all'), which is claimed to show *Split Edge Effects* by Ko (2005). The overall results are as expected by Ko (2005), but the universal Qs behaved somewhat differently from focused or case-marked Qs for independent reasons. For the sake of space, we omit detailed discussion concerning universal Qs, but see note 9 for a brief summary of the results.

(12) Schema of Stimuli Items

Q	Transitive Verb		Intransitive Verb	
	Subject-oriented NQ	Object-oriented NQ	Unergative subject-NQ	Unaccusative subject-NQ
caseless NQ e.g. <i>sey-meyng</i>	a. S-O-NQ _{subj}	d. O-S-NQ _{obj}	g. S-adv-NQ _{subj}	j. S-adv-NQ _{subj}
case-marked NQ e.g. <i>sey-meyng-i/ul</i>	b. S-O-NQ _{subj} -NOM	e. O-S-NQ _{obj} -ACC	h. S-adv-NQ _{subj} -NOM	k. S-adv-NQ _{subj} -NOM
focus-marked NQ e.g. <i>sey-meyng-man</i>	c. S-O-NQ _{subj} -FOC	f. O-S-NQ _{obj} -FOC	i. S-adv-NQ _{subj} -FOC	l. S-adv-NQ _{subj} -FOC

Under the hybrid approach proposed by Ko (2005), we predict that only the shaded cells in (12) (*i.e.* items (12a) and (12g)) would show the Edge Effects. Put differently, we predict that the subject and its NQ cannot be separated from the object only when the NQ is adnominal. In the case where the NQ is suffixed with a case or a focus-marker, it is expected that they behave as an adverbial modifier so that there will be no Edge Effect. In those contexts, we would expect a Split Edge Effect where the two edge elements can be separated from their domain-mate. Thus, we predict that the subject and its NQ suffixed with case/focus (12b, 12c, 12h, 12i) would all be judged grammatical, in contrast to the sentences with caseless NQs in (12a) and (12g). As for object-oriented NQs, we expect that the object can be separated from its NQ whether the NQ is bare or case/focus-marked. As explicated with (8), the object is merged within vP, so it can undergo domain-internal movement. Thus, the object can be separated from its NQ regardless of whether the NQ is adnominal or adverbial.

Under the across-the-board adnominal approach, the differences related to argument structure and the host noun may be relevant. However, no differences between the Q-types are expected. Hence, if the adnominal approach is correct regardless of Q-types, we would expect that the subject-oriented NQ cannot be separated from its host by an object or an adverb in all contexts - in other words, (12a), (12b), (12c), (12g), (12h), and (12i) would all show the same Edge Effect. Under the across-the-board adverbial approach, the floating Q constructions listed in (12) would behave in the same way (as long as their event structure is not different from each other). Hence, no significant difference due to argument structure, the host

noun, or the Q-type would be expected.

The overall predictions of each approach are summarized in (13). To illustrate the point with concrete examples, the relevant sample stimuli that we employed in the test are given in (14)-(17). For the full-list of stimuli, refer to the appendix. We conducted two different types of experiment based on the stimuli in (12), and the procedure of the experiment will be demonstrated in the next section with detailed results.

(13) *Predictions*

- A. Hybrid Approach: the stimuli (12a) and (12g) will show Edge Effects. Hence, a processing delay and/or ungrammaticality is expected only for these items.
- B. Adnominal Approach: the stimuli (12a), (12b), (12c), (12g), (12h), and (12i) [all the transitive/unergative subject-related NQs] will show Edge Effects. Hence, processing delay and/or ungrammaticality is expected only for these items.
- C. Adverbial Approach: No differences among the stimuli types in (12) are expected (unless a theory of event structure leads us to the contrary).

(14) Sample stimuli items for transitive subject-oriented Q (stimuli 12a-c)

- a. $S < O < NQ_{subj}$ [transitive subject-oriented caseless NQ] [see (12a)]

Haksayngtul-i kongchayk-ul **ney-myeng** sassta
 students-Nom notebook-Acc 4-Cl bought
 ‘Four students bought a notebook.’

- b. $S < O < NQ_{subj}\text{-NOM}$ [transitive subject-oriented case-marked NQ] [see (12b)]

Haksayngtul-i kongchayk-ul **ney-myeng-i** sassta
 students-Nom notebook-Acc 4-Cl-Nom bought
 ‘Four students bought a notebook.’

- c. $S < O < NQ_{subj}\text{-FOC}$ [transitive subject-oriented focus-marked NQ] [see (12c)]

Haksayngtul-i kongchayk-ul **twu-myeng-man** sassta
 students-Nom notebook-Acc 2-Cl-only bought
 ‘Only two students bought a notebook.’⁶

- (15) Sample stimuli items for transitive object-oriented Q (stimuli 12d-f)

a. O<S<NQ_{obj} [transitive object-oriented Caseless NQ] [see (12d)]

Kongchayk-ul haysayngtul-i **han-kwen** sassta
notebook-Acc students-Nom 1-Cl bought
'Students bought one notebook.'

b. O<S<NQ_{obj}-ACC [transitive object-oriented case-marked NQ] [see (12e)]

Kongchayk-ul haysayngtul-i **han-kwen-ul** sassta
notebook-Acc students-Nom 1-Cl-Acc bought
'Students bought one notebook.'

c. O<S<NQ_{obj}-FOC [transitive object-oriented focus-marked NQ] [see (12f)]

Kongchayk-ul haysayngtul-i **han-kwen-man** sassta
notebook-Acc students-Nom 1-Cl-only bought
'Students bought only one notebook.'

- (16) Sample stimuli items for unergative subject-oriented Q (stimuli 12g-i)

a. S<Adv<NQ_{subj}[unergative subject-oriented Caseless NQ] [see (12g)]

Haksayngtul-i culkepkey **ney-myeng** wusessta
Students-Nom happily 4-Cl laughed
'Four students laughed happily.'

b. S<Adv<NQ_{subj}-NOM [unergative subject-oriented case-marked NQ] [see (12h)]

Haksayngtul-i culkepkey **ney-myeng-i** wusessta
Students-Nom happily 4-Cl-Nom laughed
'Four students laughed happily.'

c. S<Adv<NQ_{subj}-FOC [unergative subject-oriented focus-marked NQ] [see (12i)]

Haksayngtul-i culkepkey **sey-myeng-man** wusessta

⁶ In the stimuli, bare NQs and case-marked NQs were not only matched in the classifiers but also matched in numbers, but focus-marked NQs sometimes have different numerical value from the bare or case-marked NQs. This was necessary to balance the number of numerical values used in the experiment, and we would like to stress that this did not affect the results. Even though the numerical values for focus-marked NQs and case-marked NQs were different from each other, their syntactic behavior in processing and judgment were the same. This in fact supports our claim that the speakers are affected by the syntax of focus-marked or case-marked NQs, not by the surface numerical values.

- Students-Nom happily 4-Cl-only laughed
 'Only three students laughed happily.'
- (17) Sample stimuli items for unaccusative subject-oriented Q (stimuli 12j-l)
- S<Adv<NQ_{subj}[unaccusative subject-oriented Caseless NQ] (see (12j))
Haksayngtul-i coyonghi **ney-myeng** tulewassta
 students-Nom quietly 4-Cl came
 'Four students came in quietly.'
 - S<Adv<NQ_{subj}-NOM [unaccusative subject-oriented case-marked NQ](see (12k))
Haksayngtul-i coyonghi **ney-myeng-i** tulewassta
 students-Nom quietly 4-Cl-Nom came
 'Four students came in quietly.'
 - S<Adv<NQ_{subj}-FOC [unaccusative subject-oriented focus-marked NQ](see (12l))
Haksayngtul-i coyonghi **sey-myeng-man** tulewassta
 students-Nom quietly 3-Cl-only came
 'Only three students came in quietly.'

To test the predictions in (13), we conducted on-line processing (self-paced reading task) and off-line judgment tests (scaled judgment task) with native speakers of Korean. In Section 3, we report the results.

3. Experiment

3.1 On-line Study

A time course study was conducted with 74 native speakers of Korean (male 37; female 37) to test when and where, if at all, anomaly occurs with floating Q constructions. On-line test stimuli were randomized and presented by the DMDX program word-by-word (a Windows display program with millisecond accuracy: Foster and Foster 2003). After reading a stimulus, subjects were asked to judge whether a follow-up sentence about the stimulus is true or false, as given in (18) and

(19). If the subject cannot judge the follow-up sentence properly, we take it as evidence that the subject did not pay attention to the stimulus item. For instance, after the stimulus sentence (18a) is presented to the subject, the subject must answer whether the follow-up sentence in (18b) is true or false. If the subject presses the [False] button as a response to (18b), we assume that the subject understands the content of the stimulus item. If not, we assume that s/he did not read the stimulus item carefully. As shown in (18b), the follow-up question aims at checking whether the subject understands the content of the sentence properly, not the word order of the sentence. Thus, the follow-up questions were always presented in non-scrambled canonical word order without splitting the host noun and the numeral. The true answers and false answers were balanced so that there were 40 true follow-up sentences and 40 false follow-up sentences each.

- (18) On-line study: a sample stimuli and a follow-up question, targeting
[FALSE]

a. *stimulus sentence*

Nointul-i byektol-ul twu-pwun patassta
old.men-Nom bricks-Acc 2-Cl.Hon received
'Two old men received bricks'

b. *follow-up sentence*

Haksayngtul-i twu-myeng byektol-ul patassta
students-Nom 2-Cl bricks-Acc received
'Two students received bricks'

c. *expected answer:* [FALSE]

- (19) On-line study: a sample stimuli and a follow-up question, targeting
[TRUE]

a. *stimulus sentence*

Chinkwutul-i maykcwu-lul sey-myeng masiessta
friends-Nom beer-Acc 3-Cl drank
'Three friends drank beer'

b. *follow-up sentence*

Chinkwutul-i sey-myeng maykcwu-lul masiessta
friends-Nom 3-Cl beer-Acc drank
'Three friends drank beer'

c. *expected answer:* [TRUE]

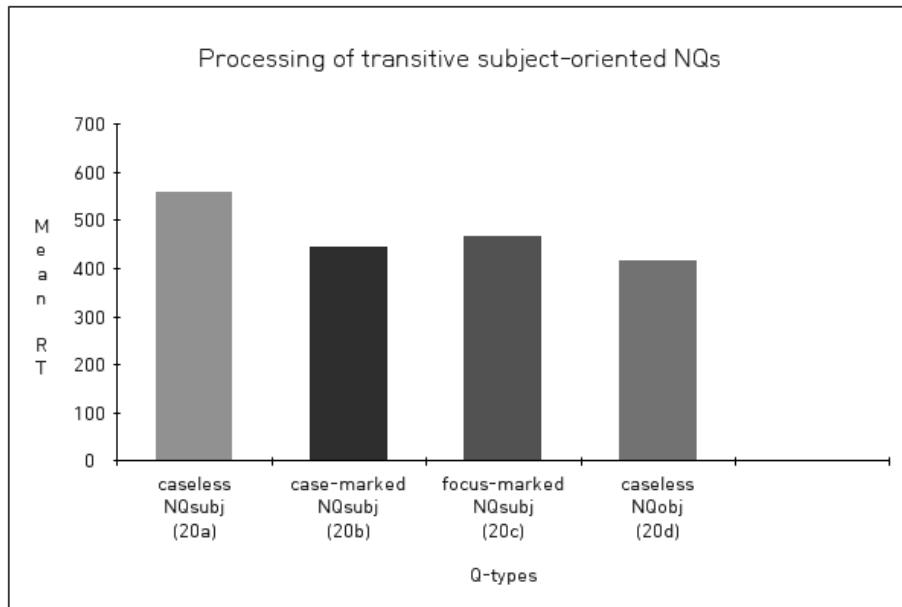
In our data analysis, we filtered out the trials with wrong answers to check-up questions and responses that took more than 2500ms as errors. Consequently, results from 70 subjects were analyzed after filtering. We found statistically significant processing effects in verb position, but not in quantifier position. We assume that this is because the processing delay is observed after the subject tried to integrate the syntactic and semantic information of the quantifier into the sentence. The verb always appeared right after the floating quantifier in the experiment, and thus it is expected that significant processing effects due to Q-types are obtained in verb position.⁷ The mean Response Time (RT) on verb position is summarized in (20) and plotted in (21)-(24). For statistical analysis, a paired sample t-test was conducted.

(20) Results: mean processing time for each stimulus item

Q types \ Verb	Transitive Verb		Intransitive Verb	
	Subject-NQ	Object-NQ	Unergative	Unaccusative
caseless NQ	a. 556.17ms S-O-NQ _{subj}	d. 413.97ms O-S-NQ _{obj}	g. 501.30ms S-adv-NQ	j. 461.30ms S-adv-NQ
case-marked NQ	b. 444.54ms S-O-NQ _{subj} -NOM	e. 481.15ms O-S-NQ _{obj} -ACC	h. 437.72ms S-adv-NQ-NOM	k. 550.79ms S-adv-NQ-NOM
focus-marked NQ	c. 467.02ms S-O-NQ _{subj} -FOC	f. 495.45ms O-S-NQ _{obj} -FOC	i. 443.39ms S-adv-NQ-FOC	l. 553.78ms S-adv-NQ-FOC

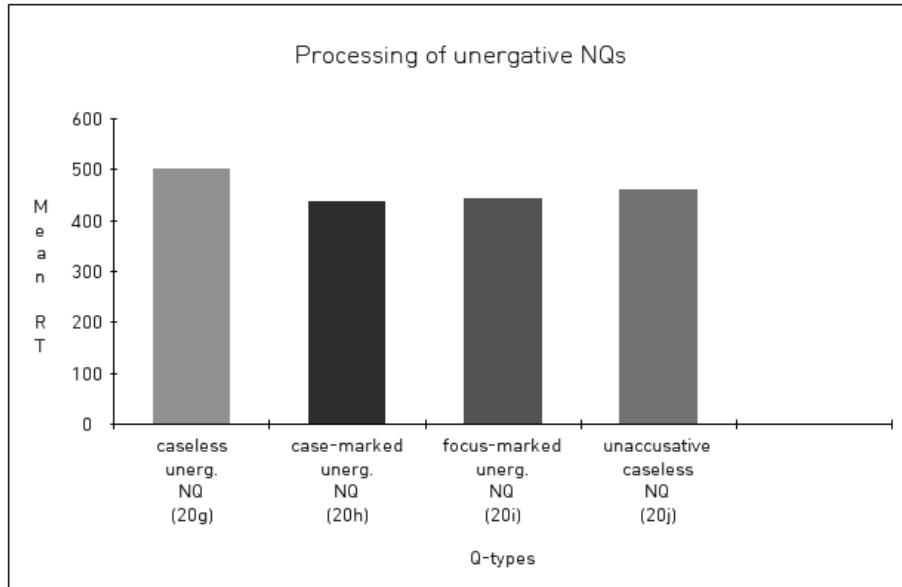
⁷ A reviewer points out that it is a general tradition of processing research that the target of the analysis is not the sentence-final element. We agree with this point in that there might be complex wrap-up effects at the end of the sentence. When we designed the stimuli, we expected that the processing delay would occur at the quantifier position, but in fact, the effect was observed in the next word, in the verb position, which happens to be the sentence-final position. To filter out wrap-up effects, a follow-up experiment is needed in which the stimuli sentences are embedded under a matrix predicate or followed by an adverbial. We note, however, that even though there might be some noise due to wrap-up effects, the point still holds that there were significant effects correlated with Q types and host noun in processing.

- (21) Mean RT (ms) for transitive subject-oriented NQs (cf. caseless object-oriented NQs)



Consider first the mean RT for the transitive subject-oriented NQs in (20a-c). As shown in (21), the mean RT for caseless NQ constructions (20a) was much slower than the corresponding case-marked NQs (20b) or focus-marked NQs (20c). The contrast between (20a) and (20b) was significant [$t(69)=4.371$, $p<.0001$]. Similarly, the contrast between (20a) and (20c) was also significant [$t(69)=3.853$, $p<.0001$]. We also found a contrast due to the grammatical function of the host noun. As seen in the contrast between (20a) and (20d) in mean RT, the subject-oriented NQs slowed down the processing, in comparison to the object-oriented NQs, and this difference was also significant [$t(69)=4.928$, $p<.0001$]. This shows that there was a significant difference in processing due to the Q-type and host noun, as predicted by the hybrid approach.

- (22) Mean RT (ms) comparisons for unergative subject-oriented NQs (cf. unaccusative subject NQs)



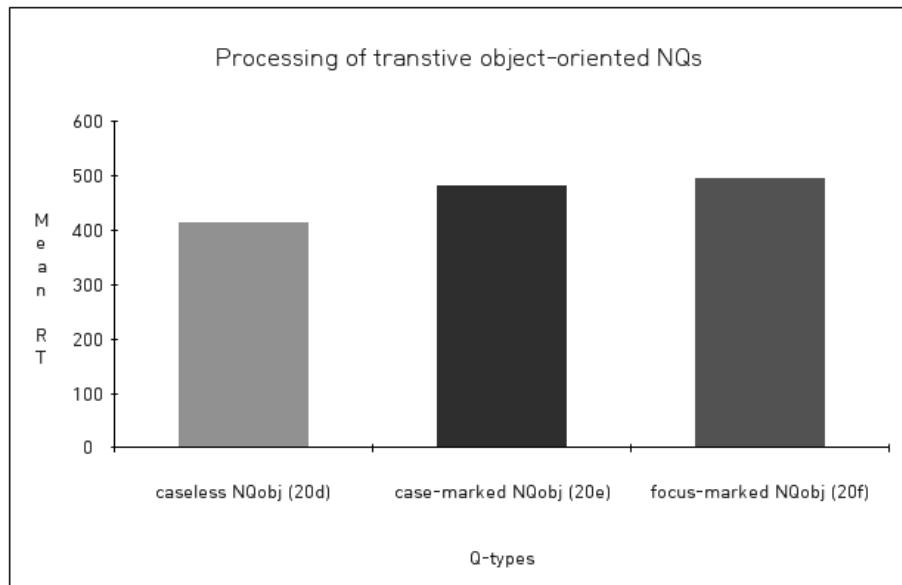
Consider next the RT contrasts among the unergative subject-oriented NQs, reported in (20g-i). The results are plotted in (22). Similar to the transitive subject patterns seen above, the mean RT for caseless NQ constructions (20g) was much slower than the corresponding case-marked (20h) or focus-marked NQs (20i). The mean RT difference between the unergative subject-oriented caseless NQ (20g) and the case-marked NQ (20h) was statistically significant [$t(69)=3.032$, $p=.003$], and the RT difference between the caseless NQ (20g) and the focus-marked NQ (20i) also [$t(69)=2.423$, $p=.018$] reached the significance. We also found that the unergative subject-oriented caseless NQs (20g) slowed down the processing in comparison to the unaccusative subject-oriented caseless NQs (20j), but the difference did not reach the statistical significance [$t(69)=1.757$, $p=.083$, approaching significance].⁸

Turning to the object-oriented NQs in (20d-f), we found a very interesting

⁸ We note that unlike other predicted contrasts, the mean RT difference between unergative subject-oriented NQs and unaccusative subject-oriented NQs did not reach the statistical significance though the mean RT was in the direction as predicted by the hybrid approach. We expect that with a larger sample size, the difference between the two conditions will reach the significance, but we leave it for a future research topic.

inhibition effect due to morphological marking. The relevant data are plotted in (23).

(23) Mean RT (ms) for transitive object-oriented NQs



As demonstrated in (20d) and (20e), caseless object-oriented NQs were processed faster than case-marked NQs, and this difference was statistically significant [$t(69)=-3.048$, $p=.003$]. The same pattern was observed with the contrast between caseless object-oriented NQs (20d) vs. focus-marked object-oriented NQs (20f): caseless object-oriented NQs were processed faster than the focus-marked NQs and the difference between the two conditions was statistically significant [$t(69)=-3.965$, $p<.0001$]. This is surprising given that we have obtained the exactly opposite effects of case/focus marking for the subject-oriented NQs. Recall that in the case of transitive subject-oriented NQs, caseless NQs were processed *slower* than the case-marked or focus-marked NQs, as described in (21). In sharp contrast to this, our experiment shows that the caseless object-oriented NQs were processed *faster* than case-marked or focus-marked NQs.

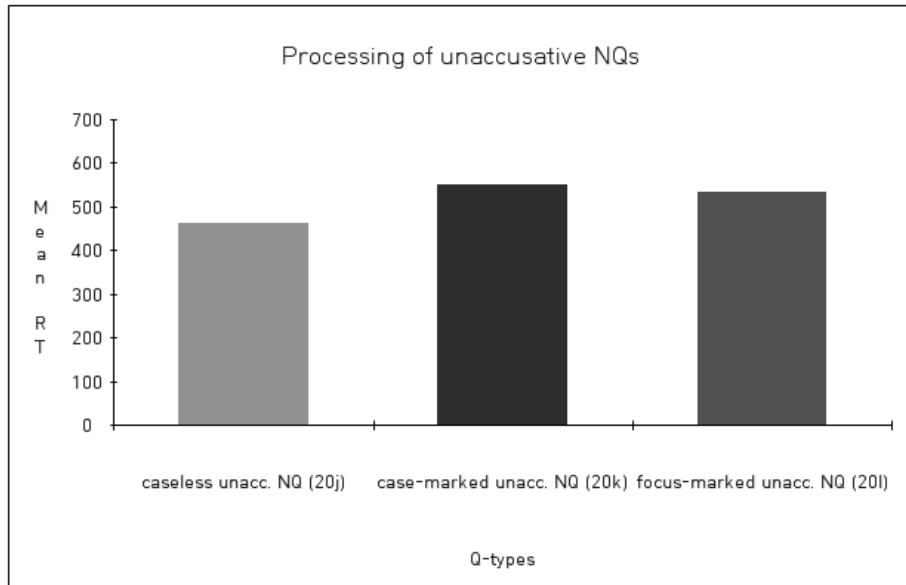
Moreover, the same type of puzzling inhibition effects was also observed with unaccusative subject-oriented NQs, summarized in (20j-l). The relevant data are presented with the graphs in (24). As seen in the transitive object-oriented NQ

conditions, caseless NQs were processed much *faster* than case-marked or focus-marked NQs. The difference between the unaccusative subject-oriented caseless NQs vs. case-marked unaccusative NQs was statistically significant [$t(69)=-3.183$, $p=.002$]. Likewise, the difference between the unaccusative subject-oriented caseless NQs vs. focus-marked unaccusative NQs was also significant [$t(69)=-2.828$, $p=.006$]. This is also the exactly opposite pattern of what we have obtained with the unergative subject NQs. As reported in (22), the unergative subject-oriented NQs were processed *slower* when they are caseless. By contrast, the unaccusative subject-oriented NQs were processed *faster* when they are caseless.⁹

⁹ We also tested universal Qs (e.g. *motwu* ‘all’) in on-line tests. Overall, the universal Qs were processed in the similar way as case-marked or focus-marked NQs, but we also found some interesting difference between universal Qs vs. case/focus-marked NQs in processing. When the universal Qs are associated with the object, they showed inhibition effects as other types of adverbial Qs. Interestingly, however, processing of universal Qs was more delayed than case-marked or focused NQs when they are associated with the transitive subject. This means that universal Qs trigger some sort of inhibition effects regardless of the host noun. We leave it for future research whether it reflects some fundamental difference between universal Qs vs. other types of NQs, or a defect of our experimental stimuli. We are inclined to pursue the latter possibility, however. Unlike other stimuli types, there was a double-association in the condition which employed transitive subject-oriented universal Qs, as in (i). Because universal Qs lack a classifier, it was not feasible to force the association between the universal Q and the dislocated subject. Thus, it was inevitable to impose such double association to block the possibility that universal Qs are interpreted with the adjacent object. We speculate that this double-association resulted in overall processing delay related to universal Qs. We also note that universal Qs were judged in the same way as case-marked and focus-marked Qs in off-line judgment tests.

- (i) Haksayng-tul-i kongchayk-ul han-kwon-ul motwu-tul patassta
 student-Pl-Nom note-Acc one-Cl-Acc all-Pl received
 ‘All the students received one notebook.’

(24) Mean RT (ms) for the unaccusative subject-oriented NQs



Overall, the current experimental results support the hypotheses of the hybrid approach. As predicted by the hybrid approach, the types of the host noun, argument structure, and Q-types matter in processing floating NQs. In particular, *the subject-oriented adnominal NQs were processed slower than subject-oriented adverbial NQs or object-oriented NQs.*

Very interestingly and surprisingly, we also found inhibition effects due to morphological marking, which has not been observed in any of the previous studies (to the best of our knowledge). When an NQ is associated with a (deep) object, the caseless NQ is processed faster than the case-marked or focus-marked NQ. Note, crucially, that in exactly those environments, we expect that there will be no Edge Effects with caseless NQs (recall (8) and (9b)) and that those sentences will be grammatical. Put differently, the result shows that when both adnominal (caseless) Qs and adverbial (case-marked/focus-marked) Qs are grammatical, adnominal Qs are processed faster than adverbial Qs. By contrast, when adnominal Qs are ungrammatical, case-marked or focus-marked Qs are processed faster. We speculate that this is due to the additional information conveyed by the morphological marker attached on the NQ. All things being equal, less semantic information is processed

faster than semantically rich material. If morphological marking carries the semantics of focus and exhaustivity, it is expected that NQs with case or focus marking will be processed slower than caseless NQs. Crucially, this inhibition effect is observed only in the context where both adnominal and adverbial Qs are grammatical, as in the case of object-oriented NQs.¹⁰

3.2 Off-line Study

To test how the grammaticality judgment holds at the off-line level, we also tested 64 native speakers of Korean (35 males; 29 females) with the same types of stimuli as in the on-line study. The participants were asked to judge a sentence with a floating Q with respect to 3 other types of floating Q constructions (scale of 1-4). There were 24 quadruple set of sentences, and the test order was randomized. The results from the scaled judgment test are summarized in (25), and plotted in (26)-(29).¹¹

(25) Results: judgment data [“4” means absolutely grammatical]

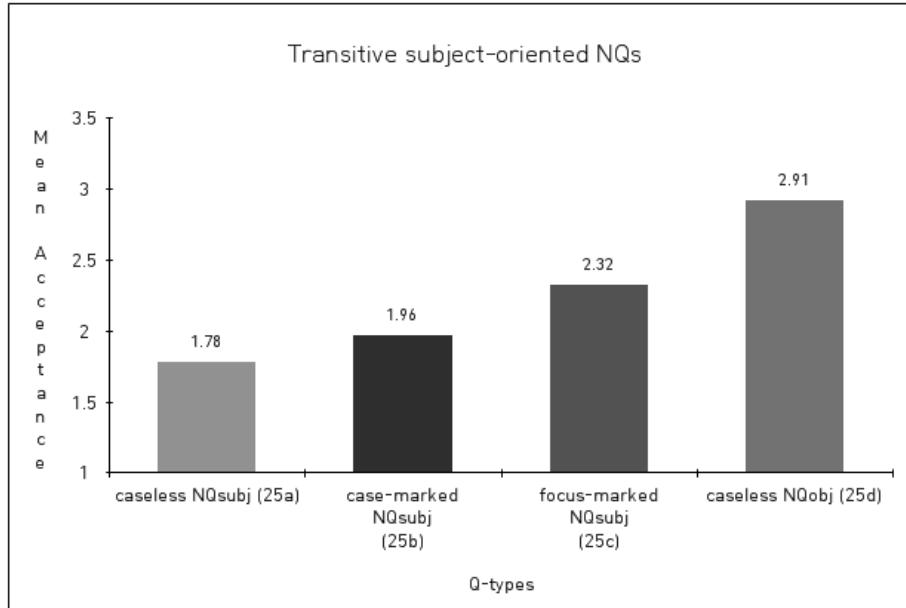
Q types \ Verbs	<i>Transitive Verb</i>		<i>Intransitive Verb</i>	
	Subject- NQ	Object-NQ	Unergative	Unaccusative
caseless NQ	a. 1.78 S-O-NQ _{subj}	d. 2.91 O-S-NQ _{obj}	g. 2.14 S-adv-NQ	j. 2.65 S-adv-NQ
case-marked NQ	b. 1.96 S-O-NQ _{subj} -NOM	e. 2.75 O-S-NQ _{obj} -ACC	h. 2.37 S-adv-NQ-NOM	k. 2.55 S-adv-NQ-NOM
focus-marked NQ	c. 2.32 S-O-NQ _{subj} -FOC	f. 2.97 O-S-NQ _{obj} -FOC	i. 2.66 S-adv-NQ-FOC	l. 2.52 S-adv-NQ-FOC

¹⁰ As William O’Grady (p.c.) pointed it out, it would be interesting to test whether case-marking in general (without an NQ) would trigger the same processing delay. Since Korean allows case drop, it would be interesting to test whether case-dropped sentences are processed faster than case-marked ones.

¹¹ Recently, a growing number of studies discuss whether grammaticality judgment is categorical or gradient, how the variability of grammaticality of judgment can be evaluated (e.g. magnitude estimation, scaled judgment), and how grammaticality judgment is related to a processing theory. I refer the reader to the series of research by Jon Sprouse and his colleagues for general discussion (see in particular Sprouse (2007, 2008, 2011)).

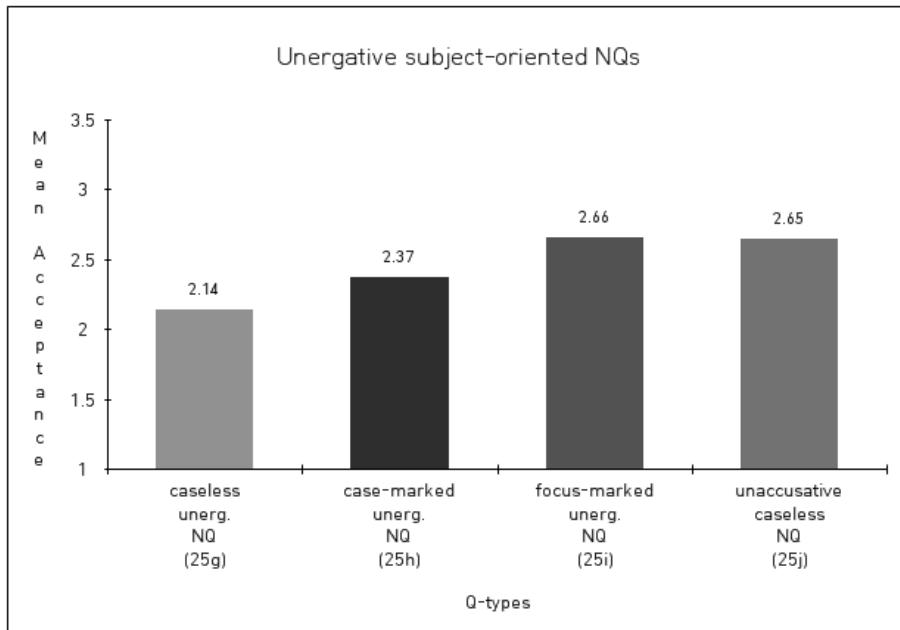
Let us first consider the judgment concerning the transitive-subject oriented NQs, and the relevant data are also plotted in (26). Most notably, consider the subject-object asymmetry in licensing floating NQs. The relevant comparison is the difference between the subject-oriented NQs in (25a) and object-oriented NQs in (25d). As shown in (26), the caseless subject-oriented NQs were much less acceptable than the caseless object-oriented NQs, and this difference was statistically significant [$t(63)=-15.493$, $p<.0001$]. Note also that the subject-oriented caseless NQs in (25a) were also less acceptable than the subject-oriented case-marked NQs in (25b), and this difference was also statistically significant [$t(63)=-2.254$, $p=.028$]. The judgments for the subject-oriented caseless NQs in (25a) and focus-marked NQs in (25c) were also significantly different from each other [$t(63)=-8.078$, $p<.0001$], and as the mean acceptance rate shows, the subject-oriented caseless NQs were judged significantly worse than the other conditions in (25b-d). This is exactly what we predict from the hybrid approach - a difference due to the host noun and Q-types.

- (26) Judgments for transitive subject-oriented NQs [cf. object-oriented NQs]



The same types of patterns were obtained with intransitive verbs in (25g-j). The data regarding unergative subject-oriented NQs are plotted in (27), in comparison to unaccusative subject-oriented NQs. As described in (27), caseless unergative subject-oriented NQs were judged much less acceptable than caseless unaccusative subject-oriented NQs, and the difference was statistically significant [$t(63)=-9.836$, $p<.0001$]. Moreover, the caseless unergative NQs were judged less acceptable than case-marked unergative NQs [$t(63)=-3.683$, $p<.0001$]. The caseless unergative NQs were judged significantly less acceptable than focus-marked NQs [$t(63)=-5.336$, $p<.0001$] as well. The data again confirm the prediction that there is a significant effect of the argument structure and Q-types in licensing floating NQs, as argued by the hybrid approach.

- (27) Judgments for unergative subject-oriented NQs [cf. unaccusative subject NQs]

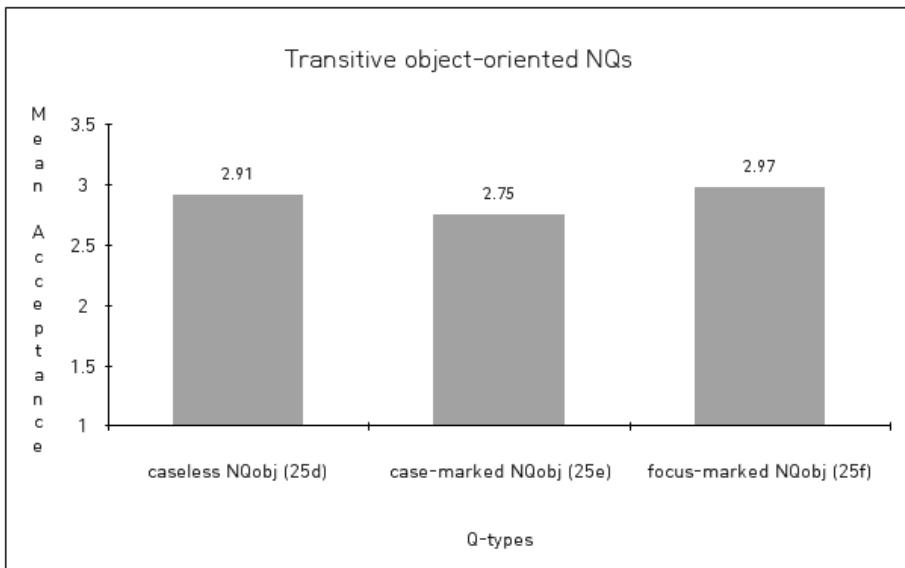


Let us now turn to judgments for transitive object-oriented NQs in (25d-f). Recall that in our on-line study, the caseless object-oriented NQs were processed *faster than* the case-marked or focus-marked NQs, and suggested that this may be

due to the processing delay imposed by the semantics of morphological marking. Interestingly, however, such processing delay due to Q-types (or morphological marking) associated with the object-oriented NQs disappeared in off-line judgment tests.

As plotted in (28), caseless NQs, case-marked NQs, and focus-marked NQs were all judged grammatical. The mean difference between the caseless NQs and case-marked NQs was not statistically significant [$t(63)=1.116$, $p=.269$], and the difference between the caseless NQs and focus-marked NQs was not significant, either [$t(63)=-1.053$, $p=.296$]. The paired-sample t-test results show that the numerical differences among the three conditions are not significant, and they are judged grammatical to the same degree.

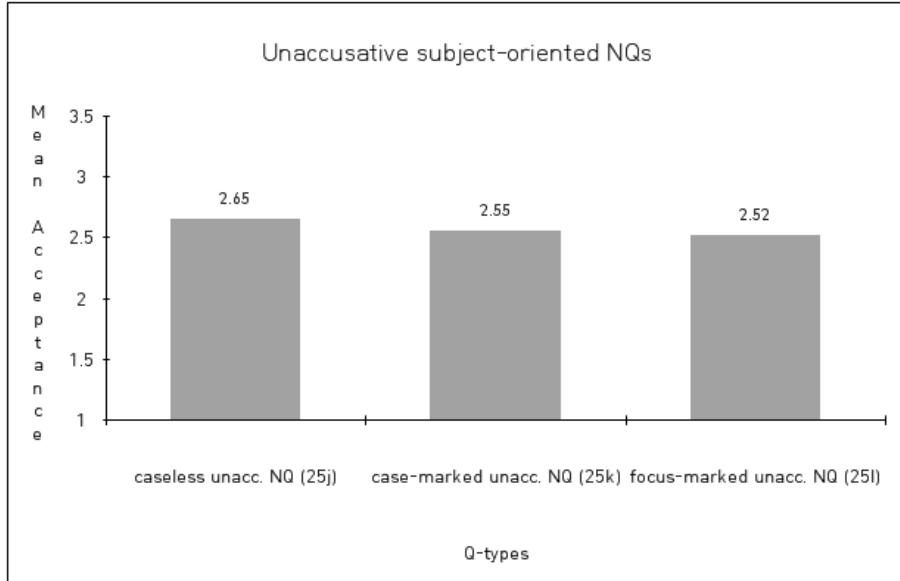
(28) Judgments for transitive object-oriented NQs



A similar type of results was obtained with unaccusative subject-oriented NQs, as presented in (29). The caseless unaccusative NQs and case-marked unaccusative NQs were judged grammatical to the same degree [$t(63)=1.471$, $p=.146$]. One thing to note is that the mean difference between caseless unaccusative NQs and focus-marked unaccusative NQs was marginally significant [$t(63)=2.140$, $p=.036$],

and we speculate that some pragmatic effects are involved here, but we cannot answer why and how such effects arise now.

(29) Judgments for unaccusative subject-oriented NQs



Overall, however, our results suggest that unlike on-line tests, case-marking for object-oriented NQs or unaccusative subject-oriented NQs does not make a significant difference in off-line judgments. This sharply contrasts with the results from the transitive/unergative subject-oriented NQs - for which morphological marking such as case or focus plays a great role in both on-line test and off-line judgment tests. The data in (28) and (29) show that there is a surprisingly interesting difference between on-line test and off-line tests due to morphological marking when it comes to object-oriented NQs. We will come back to the implication of the issue in the next discussion section.

4. Discussion

The on-line experimental results support the hypotheses of the hybrid approach in

three ways. First, the experiment shows *that the type of host noun matters* in processing floating adnominal Qs. The transitive subject-oriented NQ triggered slower RTs than the object-oriented NQs. Second, the result also confirms the prediction that *Q-type matters in processing*: caseless subject-oriented NQs (adnominal Qs) showed slower RTs than case-marked or focus-marked Qs (adverbial Qs) in the environment where the Edge Effects are expected. Third, the result also shows that *the type of argument structure matters*. The unergative subject-oriented NQs triggered slower RTs than the unaccusative subject-oriented NQs, approaching significance. All of these effects were predicted by the hybrid approach proposed by Ko (2005, 2007). Note that the results reported here are not expected either by the across-the-board adnominal approach or adverbial approach. On the adnominal approach, we would not expect differences due to Q-types, contrary to facts. On the adverbial approach, we would have no principled reasons to expect subtle differences reported here.

We also found a previously unnoticed fact that when a sentence is grammatical, adnominal floating Qs trigger faster RTs than adverbial floating Qs in processing. In particular, when an NQ is associated with a (deep) object, a caseless NQ is processed faster than a case-marked or focus-marked NQ. In exactly those environments, we expect that both adnominal and adverbial NQs will be grammatical. We suggested that this is due to the additional information conveyed by the morphological marker attached on the NQ. All things being equal, less semantic information is processed faster than semantically rich material. Crucially, this effect is observed only in the context where both adnominal and adverbial Qs are predicted to be grammatical. More interestingly, this inhibition effect in processing was only temporary and disappeared in off-line tests.

We have also evaluated whether the predictions of the hybrid approach are borne out in the off-line judgment test. We have seen significant effects of grammatical function, argument structure and Q-types in judging floating quantifiers, exactly in the direction expected by the hybrid approach. First, we obtained a significant effect of the host noun in licensing floating adnominal (caseless) NQs. The subject-oriented caseless NQs were significantly less acceptable than the object-oriented caseless NQs when separated from its host noun by a vP-domain-mate. Second, a significant effect of Q-types was also obtained. Caseless subject-oriented floating NQs (adnominal Qs) were judged significantly less acceptable than adverbial Qs (e.g. case-marked Qs,

focus-marked Qs) when the Edge Effects are expected. Third, the predictions on verb types were also borne out. The unergative NQs showed Edge Effects and were judged significantly less acceptable than unaccusative NQs when separated from its host by a vP-domain-mate. Under the hybrid approach, it is also expected that there will be no difference between adnominal and adverbial Qs when they are associated with the object. Since the object is not merged on the edge of a Spell-out domain, we expect that both types of floating Q constructions would be grammatical. This is in fact what we have observed in the off-line test. The off-line data confirm the predictions of the hybrid approach and the overall results provide empirical support for the *Edge Generalization* advanced by Ko (2005).

We also found an interesting asymmetry between processing and judgment data due to the host noun. The processing delay obtained with transitive/unergative subject-oriented Qs was also observed with off-line data (*i.e.* they are ungrammatical sentences with *Edge Effects*). In contrast, the inhibition effects associated with object-oriented case-marked or focus-marked NQs in processing disappeared in the off-line test (*i.e.* they are grammatical sentences with temporary processing delay). Hence, the current results provide some interesting challenges to the claim that the Edge Effects obtained with the subject-oriented NQs reflect mere processing difficulty, but not ungrammaticality (cf. Miyagawa and Arikawa 2007).

In particular, Miyagawa and Arikawa (2007) argue that sentences like (9a) (in Japanese) is basically a grammatical structure but due to the lack of a prosodic break, the subject-oriented NQ is mis-analyzed as if it forms a constituent with the preceding object, which causes unacceptability. They argue that when a prosodic break is signaled properly, (9a) is judged to be grammatical. In essence, this amounts to saying that the ordering, $S < O < NQ_{subj}$ in (9a) is perfectly grammatical in syntax, but judged degraded due to an incorrect parse, diagnosed by a lack of prosodic break between the object and NQ_{subj} .

Our experimental results show that this claim is not upheld by empirical data. The temporary processing delay associated with subject-oriented NQs was strongly maintained in the off-line test as well as in the on-line test. By contrast, temporary processing delay associated with object-oriented NQs was not maintained in the off-line tests. This suggests that there is a qualitative difference between the two cases. If “unacceptability” of floating NQs can be subsumed under the processing theory, the difference between Q-types and host noun, correlated with on-line and

off-line tests will remain a mystery. Furthermore, Miyagawa and Arikawa (2007) argue that a focus marker attached to an NQ helps the speakers to insert a phonological break between the NQ and the preceding argument in processing, and thus sentences like (3b) (in Japanese) are judged grammatical. Note, however, that our experimental results show the opposite pattern when it comes to the object-oriented NQs. The object-oriented NQs were processed *slower* when a focus-marked is attached to the NQ. This surprising inhibition effects would remain puzzling for a prosodic approach proposed by and Arikawa (2007) as well.

Going back to the overall picture, the results reported in this paper challenge the “across-the-board” adnominal or adverbial approaches, which do not predict such intricate interactions among syntactic factors in processing and judging floating Q constructions. Korean speakers find both processing difficulty and ungrammaticality where we expect *Edge Effects under the hybrid approach*. Under the adnominal approach, we expect that there would be no differences associated with Q-types. Hence, the differences attributed to Q-types cannot be explained. This result also poses some serious challenges to the adverbial approach since there is no obvious reason why the NQ_{subj} and unergative NQ_{subj} are not qualified as an event modifier.

We acknowledge, however, that this does not mean that there is no way of saving adnominal or adverbial approach in the light of the current experimental data. For instance, in defense of a purely adnominal approach, one can pursue the idea that so-called adverbial NQs are in fact adnominals but somehow do not form a constituent with the host noun. Doetjes (1997) suggests such a possibility. If case-marked or focus-marked NQs are a sister of null pronoun *pro*/PRO, which are licensed by the host noun, the difference due to Q-types is in fact predicted (Ko 2005 in fact hinted this possibility but does not pursue it in any detail). If such an approach is successful, the theory of floating Qs proposed by Ko (2005, 2007) would be made compatible with a simpler adnominal approach. The crucial issue would be then semantic - whether there is a semantic difference between adverbial NQs vs. *pro*-associated adnominal NQs. It is beyond the scope of our paper whether a truly hybrid approach is superior to such a modified adnominal approach. The opposite direction can also be taken in defense of adverbial approaches. Since a purely event-based approach cannot predict the differences reported in the paper, one can develop a theory of adverbial Qs, which is sensitive to the host noun and argument structure, and morphological marking. What we want to stress here is,

however, that the current experimental results are best explicable by the hybrid approach which embeds the syntactic differences mentioned above.

Turning to a more general issue, our study supports the claim that the experimental syntax not only provides a large-scale empirical data but also provide a useful probe into theoretical concern. A controlled experiment helps us to sort out various factors that underlie one phenomenon. Statistical analysis helps us to investigate subtle distinctions. In our case, by conducting a structured experimentation, we were able to evaluate various predictions by competing theories on floating Q constructions. Through experimentation, we may also uncover new patterns which lead to new theoretical questions. Our results suggest that the role of particles attached to a numeral quantifier is a new area of research in processing. In the offline-test, future studies are duly needed on discourse effects such as distributivity and exhaustivity in licensing floating Qs. We hope that the current study provides a useful background to deepen our understanding of the processing and grammar of floating quantifier constructions.

5. Conclusion

In this paper, we evaluated three major approaches to floating quantifiers, with special attention to Korean numeral quantifier constructions. Our experimental results provide new empirical support for the hybrid approach from quantifiable psychological data. The on-line and off-line tests show that there are considerable effects of a host noun, argument structure, and Q-types in licensing floating Qs, as predicted by the hybrid approach. The “across-the-board” adnominal or adverbial approaches to floating Qs cannot capture such intricate interactions predicted under the hybrid approach.

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Appendix

The stimuli were presented in Korean, so is presented in Korean in this appendix. The data structure is summarized in Table A1.

Table A1. The structure of the stimuli

Q types Verbs	<i>Transitive Verb</i>		<i>Intransitive Verb</i>	
	Subject-NQ	Object-NQ	Unergative	Unaccusative
caseless NQ	S-O-NQ _{subj} (1,2,3,4)	O-S-NQ _{obj} (5,6,7,8)	S-adv-NQ (33,34,35,36)	S-adv-NQ (37,38,39,40)
case-marked NQ	S-O-NQ _{subj} -NOM (9,10,11,12)	O-S-NQ _{obj} -ACC (13,14,15,16)	S-adv-NQ-NOM (41,42,43,44)	S-adv-NQ-NOM (45,46,47,48)
focus-marked NQ	S-O-NQ _{subj} -FOC (17,18,19,20)	O-S-NQ _{obj} -FOC (21,22,23,24)	S-adv-NQ-FOC (49,50,51,52)	S-adv-NQ-FOC (53,54,55,56)
Universal Q	S-O-NQ _{obj} -Q _{subj} (25,26,27,28)	O-S-Q _{obj} (29,30,31,32)	S-adv-Q (57,58,59,60)	S-adv-Q (61,62,63,64)
Fillers	(65-80): classifier mismatch			

- (1) 학생들이 공책을 네 명 샀다.
- (2) 노인들이 벽돌을 두 분 받았다.
- (3) 친구들이 맥주를 세 놈 마셨다.
- (4) 탱크가 한옥을 한 대 부셨다.
- (5) 공책을 학생들이 한 권 샀다.
- (6) 벽돌을 노인들이 세 장 받았다.
- (7) 맥주를 친구들이 네 병 마셨다.
- (8) 한옥을 탱크가 두 채 부셨다.
- (9) 학생들이 공책을 네 명이 샀다.
- (10) 노인들이 벽돌을 두 분이 받았다.
- (11) 친구들이 맥주를 세 놈이 마셨다.
- (12) 탱크가 한옥을 한 대가 부셨다.
- (13) 공책을 학생들이 한 권을 샀다 ‘
- (14) 벽돌을 노인들이 세 장을 받았다.
- (15) 맥주를 친구들이 네 병을 마셨다.
- (16) 한옥을 탱크가 두 채를 부셨다.
- (17) 학생들이 공책을 두 명만 샀다.

- (18) 노인들이 벽돌을 세 분만 받았다.
- (19) 친구들이 맥주를 네 놈만 마셨다.
- (20) 탱크가 한옥을 한 대만 부셨다.
- (21) 공책을 학생들이 한 권만 샀다.
- (22) 벽돌을 노인들이 네 장만 받았다.
- (23) 맥주를 친구들이 세 병만 마셨다.
- (24) 한옥을 탱크가 두 채만 부셨다.
- (25) 학생들이 공책 한 권을 모두들 받았다.
- (26) 노인들이 벽돌 한 장을 모두들 버렸다.
- (27) 친구들이 백두산 정상을 모두들 올랐다.
- (28) 부자들이 탱크 한 대를 모두들 기증했다.
- (29) 공책을 정호가 모두 샀다.
- (30) 벽돌을 영희가 모두 받았다.
- (31) 맥주를 철수가 모두 마셨다.
- (32) 한옥을 부시가 모두 부셨다.
- (33) 학생들이 즐겁게 네 명 웃었다.
- (34) 노인들이 서럽게 두 분 우셨다.
- (35) 친구들이 일부러 세 명 전화했다.
- (36) 아이들이 신나게 두 명 놀았다.
- (37) 학생들이 조용히 네 명 들어왔다.
- (38) 노인들이 어렵게 두 분 도착했다.
- (39) 친구들이 다시 세 명 죽었다.
- (40) 아이들이 갑자기 두 명 넘어졌다.
- (41) 학생들이 즐겁게 네 명이 웃었다.
- (42) 노인들이 서럽게 두 분이 우셨다.
- (43) 친구들이 일부러 세 명이 전화했다.
- (44) 아이들이 신나게 두 명이 놀았다.
- (45) 학생들이 조용히 네 명이 들어왔다.
- (46) 노인들이 어렵게 두 분이 도착했다.
- (47) 친구들이 다시 세 명이 죽었다.
- (48) 아이들이 갑자기 두 명이 넘어졌다.
- (49) 학생들이 즐겁게 세 명만 웃었다.
- (50) 노인들이 서럽게 네 분만 우셨다.
- (51) 친구들이 일부러 두 명만 전화했다.
- (52) 아이들이 신나게 세 명만 놀았다.
- (53) 학생들이 조용히 세 명만 들어왔다.
- (54) 노인들이 어렵게 네 분만 도착했다.
- (55) 친구들이 다시 두 명만 죽었다.

- (56) 아이들이 갑자기 세 명만 넘어졌다.
- (57) 학생들이 즐겁게 모두 웃었다.
- (58) 노인들이 서럽게 모두 우셨다.
- (59) 친구들이 일부러 모두 전화했다.
- (60) 아이들이 신나게 모두 놀았다.
- (61) 학생들이 조용히 모두 들어왔다.
- (62) 노인들이 어렵게 모두 도착했다.
- (63) 친구들이 다시 모두 죽었다.
- (64) 아이들이 갑자기 모두 넘어졌다.
- (65) 학생들이 공책을 열 장 샀다.
- (66) 학생들이 연필을 두 권 샀다.
- (67) 영희가 벽돌을 세 병 깼다.
- (68) 정호가 탱크를 한 채 샀다.
- (69) 노인들이 소주를 네 장 샀다.
- (70) 노인들이 한옥을 두 대 방문했다.
- (71) 친구들이 라디오를 세 권 받았다.
- (72) 친구들이 컴퓨터를 한 병 고장 냈다.
- (73) 학생들이 열 장 정호를 만났다.
- (74) 학생들이 두 권 선생님을 좋아한다.
- (75) 노인들이 세 병 백두산에 올랐다.
- (76) 노인들이 한 대 연필을 샀다.
- (77) 친구들이 네 장 학교를 방문했다.
- (78) 친구들이 열 대 벽돌을 깨트렸다.
- (79) 아이들이 두 권 학교를 결석했다.
- (80) 아이들이 한 병 컴퓨터를 받았다.

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