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Second-language processing of English mass-count nouns by native-speakers of Korean

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This study deals with the English mass-count distinction and how it cues meaning. 40 native speakers of Korean processed common nouns in their L2 (English) and in Korean. English native speakers performed the same English task. Anglophones individuated both count nouns and mass nouns denoting collections of entities. They were also acutely sensitive to plural-marking as a cue to the meaning of ambiguous "flexible" nouns denoting either bounded entities or substances. Koreans were target-like on 3 classes of English nouns but were insensitive to plural-marking on English flexible nouns. A comparison of English- and Korean-language tasks revealed that Koreans were using the same types of responses on semantically similar Korean and English items, consistent with the hypothesis that they use lexical semantics (not grammar) to arrive at an interpretation. Our study shows that Koreans perform at native-like levels on a judgement task involving the 3 most common classes of English nouns while remaining insensitive to English plural-marking. Learners do not make use of the mass-count syntax of English to interpret common nouns and appear not to have learnt plural-marking.

Keywords: second language processing; number; plurality; mass-count syntax; Korean; English

1 Introduction

Our research examines the relationship between morpho-syntax and semantics in the English mass-count distinction which is, in turn, related to the grammatical expression and interpretation of number. The problem is an interesting one precisely because the boundary between morpho-syntax and semantics is unclear. Accordingly, we cannot know from an examination of transcriptions of grammatical speech or samples of correct writing if a learner of English has acquired the English mass-count contrast and grammatical number. If we cannot decide if the learner is encoding a morpho-syntactic distinction or making a lexical-semantic one, we will not know what acquisition mechanisms are at work, nor will we be able to determine what input a learner requires to learn the distinction.

This study, based on data collected in 2009–2010 for the thesis of the first author, draws on a research methodology originally used in Barner & Snedeker (2005) that allows us to differentiate morpho-syntactic parsing from interpretation. Participants make a judgement about quantity from visual stimuli (line drawings) and accompanying linguistic stimuli that present classes of nouns in a syntactic frame guided by the mass-count status of a given noun. Our study investigates whether Korean learners of English can correctly interpret the meaning of mass and count nouns and asks if they have become sensitive to the morpho-syntax of grammatical number, in particular, to the regular Plural morpheme.

The issue is relevant to L2 acquisition precisely because number is not marked uniformly across languages. Typologists classify languages as either *mass-count* languages

or *classifier* languages (Allen 1980; Chierchia 1998a).[1] In mass-count languages, nouns are divided into two sub-categories: mass nouns (*water* or *sand*) and count nouns (*dog* or *chair*).[2] The traditional assumption has always been that the mass/count distinction is intrinsic to the noun and is specified in its lexical entry (but see Kleiber 2008; Langacker 1987). If we consider the view expressed in traditional grammars and in early semantic work (Quine 1960), we find that the mass-count distinction is treated as a purely semantic contrast: count nouns individuate and therefore can be pluralized while mass nouns do not individuate and cannot be marked for number. This semantic difference is cued by several morpho-syntactic differences that define distinct distributions for the different classes of noun. Count nouns can be marked by a plural suffix (*dogs*). They can also be modified by numbers (**one** *cat*; **five** *apples*), and by certain distinct quantifiers, such as *few* and *many* (**few** *dogs*, **many** *children*). Finally, singular count nouns require a determiner such as *a* or *the* or a quantifier or numeral like *one*.

Mass nouns generally denote substances (such as *water* or *sand*). In English, they cannot be marked by a plural suffix (**sands*, **waters*), nor can they be modified by a numerical adjective (****one** *rice*, ****five** *sands*).[3] Like count nouns, mass nouns can be modified by distinct quantifiers, such as *little* or *much*, but these quantifiers are different from those used to modify count nouns (**little** *water*, **much** *sand*). Unlike count nouns, mass nouns can occur without a determiner (e.g., *We bought water for the picnic*). Useful to our research methods is the fact that both mass and count nouns in English can be modified by the quantifier *more* (e.g., *Does John have* **more** *rice than Jane?* or *Does John have* **more** *apples than Jane?*). It follows that language users cannot use the modifier *more* to determine whether a noun is count or mass.

The traditional assumption of a binary contrast between subsets of nouns has recently come under critical scrutiny. English also has a class of nouns referred to by Barner & Snedeker (2005) as *object-mass nouns*.[4] These nouns have the syntax of mass nouns but denote sets of (non-identical) individuals or aggregates (e.g., *furniture* or *graffiti*) (Jackendoff 1991; Gillon 1999; Barner & Snedeker 2005; 2006; Barner et al. 2008). We see in the examples of (1) that the word *furniture* has the distribution of a mass noun. It cannot be marked with a plural suffix (1a–b) or modified by a number (1c). In (1d) and (1e), we see that it can occur with mass quantifiers, such as *much*, but not with count quantifiers, such as *many*. Finally, in (1f), we see that *furniture* can occur without a determiner. Because object-mass nouns are syntactically mass but denote individuals, they

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[1] We simplify here. There is a view of the plural in mass-count languages in which it functions as a classifier that divides undivided substance into divided stuff (Greenberg 1972; Sanches & Slobin 1973; Doetjes 1997). On the traditional view, the plural counts individuated entities. See Mathieu (2013) for discussion. We normally follow Jackendoff's conventions (1983; 1991) in capitalizing semantic categories throughout to help keep clear the distinction between syntax and meaning; however, we had to change out usual notation to accommodate the journal's editorial practices.

[2] Other distinctions can be made that cut across the count/mass distinction, e.g., *proper names, concrete common nouns, abstract common nouns*. Proper names typically denote individual entities (persons, buildings, streets, etc.). While they can be pluralized and co-occur with numerals (*I know at least two Johns*), they typically do not. In English, they do not normally occur with a determiner. In other languages, a definite determiner may be optional (vernacular German) or obligatory (Demotic Greek). In some theories of grammar, their distributional particularities are considered great enough to treat them as a distinct grammatical category, that is not as a sub-type of noun (Anderson 2003; 2004). Concrete and abstract common nouns exhibit either count or mass syntax.

[3] We are simplifying. It is well-known that some mass nouns denoting substances that occur as conventional consumer products can be pluralized. When so pluralized, *waters* denotes kinds of water (mineral water, sparkling water, demineralized water, etc.) or units (as in, *I bought two waters = two bottles of water*).

[4] Barner & Snedeker's terminology is not standard but clearly is meant to express the idea that these nouns have mass syntax but denote individuals. When focusing on the meaning of these nouns, we prefer the semantically more accurate label aggregate since the sets of individuals are typically from different basic kinds. When focusing on their syntax, we will use Barner & Snedeker's label.

pose a problem for a purely semantic treatment of the count/mass distinction, in particular, Quine's (1960) claim that mass nouns cannot be individuated.

(1)　　a.　There is **furniture** in the room.
　　　　b.　*There are **furnitures** in the room.
　　　　c.　*There are **three furnitures** in the room.
　　　　d.　There is **much furniture** in the room.
　　　　e.　*There is **many furnitures** in the room.
　　　　f.　**Furniture** is in the room.

Korean, unlike English, is a classifier language. One of the main properties of a classifier language is that it lacks the obligatory singular/plural morphology that exists in English; for example, the bare noun 'book' (*chayk*) can refer to either a single entity or to several entities.
　　The Korean sentence *haksayng-un chayl-ul ilkessta* is ambiguous (as we see in (2)).

(2)　　*Korean* (Nemoto 2005: 384)
　　　　haksayng-un　chayk-ul　　ilkessta.
　　　　student-TOP　book-ACC　read
　　　　'A student/Students read a book/books.'

Chierchia (1998a; b) claims that all nouns in classifier languages are inherently mass nouns.
　　Korean and English also differ in the ways that they encode number. In English, plural marking is obligatory when we want to talk about more than one entity.[5] In languages like Korean, in contrast, there is no obligatory plural-marking morpheme corresponding to English -*s*, and a "bare" noun can be used to refer to either a single or a plural individual as (2) shows.[6]
　　Grammatical number is traditionally assumed to express numerical concepts. Number presupposes a more basic concept, namely, that of the ontological categories individual or thing.[7] These ontological categories are entities possessing clear natural perceptual boundaries (Jackendoff 1991). Bounded entities can be counted out and, where relevant, given a numerical value. Individual/things contrast in this way with substances. Bounded entity concepts in mass-count languages typically map to NPs headed by proper names or count nouns. However, as we saw above, they can also map to object-mass nouns like *furniture* or *jewelry*. In classifier languages, bounded entity concepts map to bare NPs or to NPs that include classifiers that cue specific semantic properties or semantic features of the individual (humanness, kinship, social status) or the thing (animacy, shape, size). See Senft (2000). In mass-count languages, substance concepts typically map to NPs headed by mass nouns. In English, aggregates map to object-mass nouns such as *jewellery, furniture, underwear*.

1.1 Previous empirical work on grammatical number

The semantic analyses discussed above that postulate categories of nouns beyond the substance/individual or substance/thing contrast have been submitted to empirical verification in processing studies. Barner & Snedeker (2005) asked how native speakers of English

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[5] This too is a simplification. There are count nouns that denote multiple entities: *bevy, collection, group, herd, side, team, …* A count noun like *cow* denotes an individual so that *cows* typically denotes more than one. A count noun like *herd* denotes a plurality of animals so that *herds* may denote multiple sets of pluralities of animals. Unlike the object-mass nouns, which denote sets of disparate objects (aggregates), the "group" nouns denote entities or persons who are seen to be, from the speaker's communicative perspective, the same.

[6] Korean has a grammatical marker -*tul* often equated to English plural. We return to Korean -*tul* below.

[7] We treat the latter as bearing the features [-animate].

conceptualize and classify three categories of nouns: thing-denoting count nouns (like *shoe*), substance-denoting mass nouns (like *toothpaste*) and object-mass nouns (like *furniture*). By including object-mass nouns in their research, Barner & Snedeker asked: how are object-mass nouns interpreted? Would participants treat them like thing-denoting count nouns or like substance-denoting mass nouns? If mass nouns always refer to substances (as Quine 1960 proposes), then participants should not quantify over number when judging object-mass nouns. If all mass nouns denote sets of atoms and are "inherently plural" as Chierchia (1998a; b) proposed, then all mass nouns and plural-marked nouns denote (sets of) individuals. According to Gillon (1999) mass nouns are unspecified as to whether they individuate. Language learners learn from experience whether they ultimately do. On this view, no speaker of English can know in advance of hearing a mass noun in context whether it will denote a thing or a substance. The classification is therefore ad hoc. Gillon uses the same account for words like *rope* or *stone* that can appear in either mass- or count-syntax contexts (*Bill has some rope/Bill has two ropes*), as well as GROUP-denoting count nouns and aggregate-denoting object-mass nouns. His analysis predicts that we will fail to find cross-linguistic generalizations.

Barner & Snedeker (2005) developed a task where participants looked at pictures of things or substances and were asked to decide "Who has more NP(s)?" The pictures showed different quantities and volumes. Accordingly, participants responded by attending in the pictures to either the numbers of things or to the volume or comparative size of bits of substance.[8] English-speaking participants consistently quantified over volume for substance-denoting mass nouns that occur without plural-marking (like *Who has more toothpaste?*) and over number for thing-denoting count nouns which are marked by the plural (like *Who has more shoes?*). When native speakers of English viewed pictures of object-mass nouns and heard sentences without plural morphology (like *Who has more furniture?*), they quantified over number. These results do not support Quine's view that only count nouns individuate; rather, they confirm that object-mass nouns denote aggregates. They also reveal that English speakers do not rely solely on count-mass syntax to carry out the task. Count noun syntax seems to reliably cue a thing-interpretation, but mass noun syntax does not reliably cue a single interpretation as either a substance or as a plurality of things. English-speakers rely on lexical semantics to decide on an interpretation.

Barner & Snedeker (2005) reported on a second study that looked at the interpretation of so-called "flexible" nouns (like *string/strings*) which are nouns that can appear in either a mass- or count-noun syntax. In this case, participants relied crucially on the syntax to determine the meaning of the questions. They based their judgements of "who has more?" on number when the flexible nouns appeared in a count-syntax context and on volume or size when the nouns were used with mass syntax. We are thus left with an interesting observation: native speakers of English sometimes rely on mass-count syntax to decide on an interpretation and sometimes rely on knowledge of the words. Reliance on morpho-syntax is relevant precisely in those cases where experience shows that the same sound or written form sometimes denotes a substance and sometimes denotes an entity made of that substance.

Inagaki & Barner (2009) asked speakers of Japanese, a classifier language, to make quantity judgements in Japanese. American speakers of English were asked to make quantity

[8] The literature on how we quantify visually shows that we can immediately differentiate small numbers of things, dubbed *subitizing*. We can also differentiate large differences in the magnitudes of substances or piles of things (Dehaene 1992; 1997). We are not able to visually differentiate relatively small differences in numbers above 6 or 7. Thus, without counting out toothpicks, we do not reliably judge that a pile of 30 toothpicks has "more toothpicks" than a pile of 25 toothpicks. The methodology in our study builds on these capacities.

judgements on a task similar to the one mentioned above. This study showed that both groups based their judgments of thing- and aggregate-denoting nouns on number and their judgements of substance-denoting nouns on volume. For these classes of nouns, typological differences in grammar appear to be irrelevant. The study replicated the findings that when asked to judge flexible words (such as *string/strings*) English speakers drew crucially on the morpho-syntactic context in which the stimulus occurred: thing when the noun occurred in a count-syntax context and substance when the noun occurred in a mass-syntax context. Japanese-participants exposed in Japanese to words that occurred only in a bare-noun context treated the words as ambiguous in meaning. The authors conclude that for Japanese-speakers the nouns are inherently ambiguous while for English-speakers a grammatical feature "Ind" (for "individual") is specified in the lexical entry of English object-mass nouns and contributed (in ways which are left unstated) to the count syntax of words like *shoe*.[9]

1.2 The acquisition framework

We are interested in explaining why L2 learners succeed in solving some learning problems but not others. Especially interesting are failures to learn where the input contains plenty of relevant evidence (we assume) to learn a given phenomenon. Obligatory grammatical distinctions are a place to look. Let us spell out our acquisition framework. We use Carroll's Autonomous Induction Theory (AIT). The AIT is innovative in several ways. First, unlike much functionalist or emergentist second language acquisition research (Perdue 1996; Klein & Perdue 1997; Ellis 1998; Ellis & Larsen-Freeman 2009; inter alia), the AIT is a completely formal approach to SLA. We assume that the object of study is the learner's mental grammar, consisting of a variety of different types of mental representations (of sounds, of grammatical structures, of meanings). A commitment to formal linguistic description forces us to be explicit about the initial state of mental representations, as well as providing a "success measure" of target language learning. Vague talk about "language" and "language acquisition" do little to help us explain what gets learned and why, what the learning mechanisms are, how they operate or what input they need.

Second, unlike much generativist L2 research, the AIT is committed to explaining learning as opposed to merely listing post hoc the things that learners have succeeded in acquiring. Carroll (1999; 2001; 2002) examines in detail the role of input in the context of a theory of second language acquisition that is constrained in several different ways. Specifically, there is explicit discussion of a number of learning mechanisms.

Third, assumptions about what learning mechanisms do when given input must be framed in a broader language processing framework that includes explicit assumptions about speech perception, sentence parsing and meaning interpretation, on the one hand, and speech planning and production, on the other. In the AIT, the initial stage of learning

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[9] Much current generative syntactic research proposes that cross-linguistic differences of the sort mentioned in the text result from differences in higher-order functional categories that select nominal lexical heads or other functional categories, e.g., "Div", "Number" etc. (Ritter 1991; 1992; Borer 2005; Mathieu 2013). We adopt a quite different view here, one laid out in the theory of Jackendoff (1983; 1990; 1991; 2010). In this approach, syntax and semantics are related but autonomous and the mechanisms that permit the acquisition of idiosyncratic constructions are also responsible for the acquisition of phrasal syntax. The nominal grammatical system involves not only correspondences to the ontological categories individual or thing, substance, and aggregate, it also involves lexico-grammatical features [+/–bounded, +/–internal structure] that differentiate classes of nouns and license inferences in the semantics. English count nouns are [+bounded]; bare mass nouns and bare plurals are [–bounded]. A separate feature [+/–internal structure] is needed for a more complete characterization. substance-denoting English mass nouns are [–bounded, –internal structure]. Group-denoting nouns like *committee* or *team* are [+bounded, +internal structure], as are Plural count nouns. aggregates like *jewellery* are [–bounded, +internal structure]. The grammatical features may be coded as part of lexical-conceptual structure in memory, or expressed on an inflectional morpheme (English Plural), or be expressed in specific constructions, or not be expressed at all.

is assumed to be L1 knowledge instantiated in terms of the content of mental representations and L1-specific processing procedures. By the "content of mental representations", we mean, for example, that in English the noun *information* is stored in memory with the features [–bounded, –internal structure] while in French it is encoded as a count noun [+bounded, –internal structure]. See note 9. This content maps to the syntactic constructions in which each noun can occur (mass syntax for English *information* → *some information, *two informations*, count syntax for French *information* → *une information*). Similarly, we assume that Koreans interpret some nouns as [+bounded] in cases where Koreans can be shown to individuate entities and interpret them as [–bounded] in cases where they do not. Note that in both cases, the nouns occur in the bare noun phrase construction. In short, meaning and morpho-syntax are connected but autonomous. Constructions can permit an interpretation but do not always guarantee it.

Lexical knowledge plays a critical role. An L1-specific encoding is assumed to be transferrable to L2 production at all stages of L2 acquisition because it can be activated during language processing. When a Korean is speaking English the corresponding Korean noun may become activated and compete for use with whatever English representation the learner has at that stage of acquisition.[10] At the earliest stage of exposure to English, the initial English representation may consist of just a novel sound form (Carroll 2013; 2014; Carroll & Windsor 2015). This L2 sound form may be used alongside the L1 conceptual structure and the L1 morpho-syntax during language planning. (For concreteness, we assume Levelt's (1989) production model.) The ability to use a novel L2 sound form during phonological planning while relying on the morpho-syntax and semantics of the L1 word during message formulation and morpho-syntactic planning is called "relexification" (DeGraaf 2002). Over time, given exposure to appropriate input, the learner will (we hope) encode novel grammatical information about the syntactic contexts that English words appear in, creating L2-target-like morpho-syntactic lexical specifications as they do so. If the Korean learner extracts target-like morpho-syntactic structure, they will encode *book* as a noun occurring after a Determiner and *books* as a noun with the internal structure [[book]$_N$ Plural]$_N$. Moreover, we expect that Plural-marking will not be coded as merely arbitrary information about *books* (the way the plural of *children* must be stored in memory) but rather associated with a productive morpho-syntactic rule. Nonetheless, competition between the L1 and English L2 representations remains possible, an hypothesis that can be used to explain variable performance on plural-marking in advanced learners of the L2 (Lardiere 2007). To sum up: what learners say when they speak the L2 results from a variety of factors: activated L1-mental representations that compete for use during speech planning, developing L2-mental representations which may be incomplete or just non-target-like, L1-specific processing procedures that compete for use during speech planning, and developing L2-specific processing procedures that are not yet target-like.

We do not stipulate that the outcomes of L1 and L2 acquisition *must* be identical simply because, pace White (1989; 2003), Universal Grammar constrains L2. The extent to which L2 grammars deviate from L1 grammars we take to be an empirical question. Accordingly, we have investigated the circumstances under which L2 learners learn from specific forms of highly controlled input. From our findings we draw conclusions about how input has been processed and novel representations created (Carroll 2005; Widjaja 2010; Carroll & Widjaja 2013; Hracs 2011; 2016). We also want to explain why L2 language acquisition, unlike L1 acquisition, is *not* deterministic. One hypothesis we entertain here is that if a

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[10] On the assumption that the bilingual's two languages are simultaneously activated. See discussion on bilingual lexical activation in Marian & Spivey (2003).

Korean L2er can arrive, via L1 lexical representations and L1 processing procedures, at an interpretation that is coherent in the current context, nothing within the system will force restructuring of the L2 grammar. In other words, if a Korean learner of English can correctly interpret noun classes without relying on plural-marking, then there is nothing that will force acquisition of the plural. If, however, the input cannot be correctly parsed and this leads to a failure to interpret it, this failure may lead to explicit attempts to resolve the interpretation problem (by seeking additional input, asking for feedback or correction, etc.) In short, acquisition is "error driven" in precisely the sense that breakdowns in processing within the system are what require solutions provided by the language acquisition mechanisms. L2 acquisition may cease when communicative adequacy is reached, in contrast to L1 acquisition (Bowerman 1985). All L2 acquisition theories address failure to learn in the absence of relevant input. The AIT asks and answers the question: Why do L2ers fail to learn a target L2 distinction when relevant input is present in learner-directed speech, or even explicitly taught? Precisely because L2 learning is not deterministic, this question must be addressed if empirical data shows that such situations arise. Our research provides just such evidence and therefore provides indirect evidence for the hypotheses formulated in Carroll (2001) about failures to learn.[11]

In languages like Korean, where the notion MORE THAN ONE is not marked morpho-syntactically on nouns, Korean learners of English will be expected to transfer not only the morpho-syntactic structures of Korean but also the L1 mappings between those structures and semantic representations. To acquire target-like English representations of count nouns demands of learners that they restructure their lexical representations to encode the relevant morphosyntactic category (Number) as well as its possible feature values. It might be true that mere exposure to plural-marked nouns is sufficient to trigger activation of the right morpho-syntactic features. However, it might also be true that L1 knowledge will make Koreans insensitive to the cues needed to create a target-like morpheme.

Before turning to our study, we must mention that it has been claimed that Korean has an optional plural-marker *-tul* (e.g., Kang 1994; Kwak 2003). See (3).

(3)　　*Korean* (Kang 1994: 6)
　　　　a.　sakwa-ka　　chayksang　wui-ey　issta.
　　　　　　apple-NOM　desk　　　　top-at　exist
　　　　　　'There is an apple on the desk.'
　　　　　　'There are apples on the desk.'

　　　　b.　sakwa-**tul**-i　　chayksang　wui-ey　issta.
　　　　　　apple-PL-NOM　desk　　　　top-at　　exist
　　　　　　'There are apples on the desk.'
　　　　　　# 'There is an apple on the desk.'

For some (Hwang & Lardiere 2013), this morpheme *-tul* is a marker of nominal specificity. Kim (2011) claims it marks definiteness. Park (2008) claims that it is a marker of distributivity or collectivity. Kim (2005) claims that *-tul* can be used with any type of noun if the referent can be individuated (or counted), while Song (1997) claims that while *-tul*

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[11] In a study attempting to explain why adults fail to acquire native-like competence, despite exposure to adequate forms of input, Ellis and Sagarra (2010) claim that earlier learned cues block associative learning of L2 stimuli expressing "the same" meanings. Their study involved training English speakers on Latin temporal adverbs and tense-markers coded on verbs. The results of Carroll and Widjaja (2013) clearly show that beginners can readily learn inflectional markers quite different from those of the L1 and are not attentionally "blocked". Difficulty in learning prosodic clitics has a great deal to do with prosodic parsing preferences determined by the L1 phonology.

can be used with animate and inanimate nouns, it occurs mainly with human nouns. In short, its semantics is in dispute. There are good reasons to view it as transitioning from a marker of focus on nouns denoting pluralities to a grammaticized marker of plurality (MacDonald 2014). However, this innovation is not fully integrated into the grammar of Korean yet and so we stand by our assertion that whatever -*tul* is expressing it is not simply the Korean equivalent of the English plural morpheme as many animate and inanimate nouns without plural morphology in Korean can still elicit a plural interpretation.[12] Accordingly, Koreans must learn that English requires the plural morpheme when the intended meaning is MORE THAN ONE x. In addition, they must learn its distributional constraints. The ability to encode the relevant sound forms, to infer the correct meanings (individual/thing vs. substance) and to make correct form-meaning mappings does not guarantee that learners encode the morpho-syntactic category and its values. Korean learners of English might map from sound forms [kot] *coat* to an appropriate concept but not encode the target morpho-syntactic features ([+bounded, –internal structure]).[13] It is therefore crucial, given our theoretical assumptions, that we choose a research methodology that enables us to differentiate semantics from grammatical encodings, which the Barner & Snedeker (2005) quantity judgment task methodology allows us to do.

2 Motivation for the present study

Barner and Snedeker's (2005) research revealed how speakers of English interpret count and mass nouns. We saw that count nouns are mapped to things, while mass nouns can map to aggregate- or substance-interpretations. Inagaki & Barner (2009) showed us how speakers of Japanese, a classifier language, make quantity judgements on nouns in the absence of mass-count syntax. Inagaki (2014) investigated how native speakers of Japanese make judgments on nouns in L2 English.

As a first step, we ask: can we replicate Barner and Snedeker's (2005) results using different stimuli and oral instead of written stimuli? To do this, we tested 40 native speakers of English on the same 4 categories of nouns that Barner & Snedeker (2005) used in their study.

We also tested native Korean speakers in a two-part study. Participants completed two similar tasks: one in their L1 (Korean) and the second task in their L2 (English). The questions that we asked were: (1) How do native speakers of Korean conceptualize nouns denoting various conceptual categories in the L1? Establishing how Korean native speakers conceptualize nouns in their L1 is a necessary step to examining their performance on the same task in English. If we want to determine whether the properties of the L1 nouns transfer to the learners' interlanguage grammars, we must provide a foundation for Korean-English performance on the task by looking at their L1. (2) Do L2 learners eventually become sensitive to different morpho-syntactic cues (plural marking versus the absence of marking)? Specifically, do they map count syntax to things and quantify by counting? Do they map mass syntax to substances and quantify by volume or size? (3) Since the L1 does not have a grammatical mass/count distinction, will transfer of the contents of Korean lexical entries provide a solution to the English learning problems?

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[12] A full discussion on the properties and the use of -*tul* are outside the scope of this paper. See MacDonald (2014) for a more complete discussion.

[13] For those not familiar with the grammatical assumptions of different L2 acquisition theories, all generative SLA research except the AIT assumes that semantics is derivative of syntax. Therefore, on such views, Korean learners could not arrive at a correct interpretation of English nouns in the absence of a correct morpho-syntactic analysis of the count and mass noun syntax. Jackendoff's theory of the functional architecture of language assumes conceptual structures are created by rules that are independent of the rules that create syntax. Each level of encoding is autonomous. Hence our prediction in the text (and the *autonomous* in the Autonomous Induction Theory).

To answer the L2 questions, an analysis of the mass-count flexible nouns will be revealing since these are the nouns whose interpretation as thing or substance is crucially cued by plural-marking or its absence. If Korean native-speakers have learnt English plural-marking, their patterns of responses should be like those of English native speakers. In other words, they should quantify over number in the count syntax context (*Who has more stones?*) and quantify over volume in the mass syntax context (*Who has more stone?*). If they have not learnt the English Plural morpheme and rely solely on their L1 grammar to interpret the stimuli, they should not perform well on any of the nouns. If instead they are transferring L1 noun conceptual structures and these express the same semantics as the English nouns, Koreans should ignore the morpho-syntactic cues and still perform well. Only on the flexible nouns, which denote things in a count syntax frame and substances in a mass noun frame, will they have to show sensitivity to the English Plural morpheme. If they have not learnt it, they should perform poorly.

3 The study

To test our questions, we designed a study based on the methodology used in Barner & Snedeker (2005).

3.1 Stimuli

Participants were asked to classify four categories of words: nouns that denote things or individuals (e.g., *gae* 'dog'), nouns that denote non-solid substances (e.g., *mul* 'water'), nouns that denote aggregates and whose English-language translations are object-mass nouns (*kago* 'furniture'), and nouns which can appear with either mass or count syntax in English and are ambiguous between a thing and a substance interpretation (*jong* 'paper'). Native English speakers made judgments on 40 nouns (10 for each category) while Korean L1 speakers made judgments on 20 nouns in the Korean L1 part of the study (5 for each category) and 20 nouns for the English L2 part of the study (5 for each category) The subset of 20 nouns which appeared in the Korean part of the study was randomly chosen from the list of English count nouns, substance-mass nouns, and object-mass nouns. For the

Table 1: Stimuli – English L1 study. (See Appendix II for the complete set of stimuli.)

Count nouns[14]	Substance-mass nouns	Object-mass nouns	Mass-count flexible nouns[15]
bees	*butter*	*cattle*	*cake(s)*
butterflies	*coconut*[16]	*clothing*	*chocolate(s)*
candles	*confetti*	*cutlery*	*paper(s)*
caterpillars	*cream cheese*	*footwear*	*pie(s)*
erasers	*ketchup*	*furniture*	*ribbon(s)*
flowers	*lotion*	*jewelry*	*rock(s)*
horses	*mustard*	*luggage*	*rope(s)*
paperclips	*salt*	*mail*	*salad(s)*
trees	*sugar*	*stationary*	*string(s)*
whistles	*toothpaste*	*underwear*	*wire(s)*

[14] Animate nouns made up approximately 10% of our stimuli. Given that plural-marking in Korean occurs more readily on animate nouns in Korean, we probably should have controlled for animacy in creating out stimuli. However, participants did not respond any differently to animate nouns then to inanimate nouns in the count noun category.

[15] In this study, we only considered nouns which are flexible in English (as opposed to nouns which are mass in English but flexible cross-linguistically). See Cheung, Li & Barner (2010) for a full discussion of the two types of flexible nouns.

[16] *Coconut* can be both a substance-mass noun (as in *shredded coconut*) and a count noun (if referring to an entire *coconut*). We used the substance-mass noun interpretation in this study.

Table 2: Stimuli – English L2 study (Korean L1). (See Appendix III for the complete set of stimuli.)[17]

Count nouns	Substance-mass nouns	Object-mass nouns	Mass-count flexible nouns
bees	*coconut*	*cattle*	*chocolate(s)*
candles	*confetti*	*clothing*	*pie(s)*
caterpillars	*cream cheese*	*cutlery*	*ribbon(s)*
paperclips	*ketchup*	*jewelry*	*string(s)*
trees	*lotion*	*luggage*	*wire(s)*

Table 3: Stimuli – Korean L1 study. (See Appendix IV for the complete set of stimuli.)

Count nouns[18]	Substance-mass nouns	Object-mass nouns	Mass-count flexible nouns
got 'flower'	*beoteo* 'butter'	*chimbal* 'footwear'	*jong* 'paper'
hogak 'whistle'	*chiyak* 'toothpaste'	*kago* 'furniture'	*keikheu* 'cake'
jiugae 'eraser'	*gyeoja* 'mustard'	*hyyongpul* 'stationary'	*pai* 'rock'
mal 'horse'	*seoltang* 'sugar'	*sogot* 'underwear'	*pakjul* 'rope'
nabi 'butterfly'	*sogeum* 'salt'	*upyeonmul* 'mail'	*salleodeu* 'salad'

flexible nouns, two items pertaining to food were put in the Korean L1 part of the study (*keikheu* 'cake' and *salleodeu* 'salad') and two were kept in the English part of the study. The rest of the items from this category were randomized. The complete list of the English (L1 and L2) nouns and Korean nouns are provided in Tables 1, 2, and 3 respectively.

For the English data elicitation phase, all count nouns were cued by the plural morpheme – count syntax (Who has more flowers?).   Substance-mass nouns and object-mass nouns were cued by lack of plural-marking on nouns – mass syntax (Who has more juice? or Who has more furniture?). Mass count flexible nouns were presented to half of the participants with count syntax and to half of the participants with mass syntax (e.g., Who has more string? or Who has more strings?). The English oral stimuli were recorded by a female native speaker of Canadian English.

Korean nouns were presented in the Korean carrier sentence (*nwugwu te*[19] _____*k a j i g o isseyo?*). This phrase has the same meaning as the English carrier sentence 'Who has more_____?'. This sentence is glossed in (4). All nouns occurred without plural morphology in the Korean carrier sentences. The Korean stimuli were recorded by a female native speaker of a standard Seoul dialect of Korean.

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[17] Stimuli items were taken from Korean elementary and middle school English-language textbooks. We assume that L2 speakers of Korean are familiar with these lexical items.

[18] While all the nouns are morphologically unmarked for plurality in Korean, we have chosen to put them into this table using the same terminology as for the English nouns in order to make the cross-language comparisons clearer. The reader should take these labels as a short-form for "Korean nouns that translate as count nouns in English", "Korean nouns that translate as substance-mass nouns in English" etc.

[19] The word *te* is the Korean equivalent of the English modifier "more". Like, English "more", *te* can be used on all categories of Korean nouns.

(4) nwugwu te   _____ kajigo isseyo?
     who   more _____ has
     'Who has more _____?'

To create visual stimuli to accompany the linguistic stimuli, a professional photographer prepared 80 digital pictures: two pictures for each test item. The pictures used in the training stimuli showed 4 entities of the same size. The pictures used in the test items showed 2 large entities on the left side of the picture and 6 small entities on the right side of the picture. The overall volume of the two large entities was clearly greater than the overall volume of the six small entities.

   Sample visual stimuli can be found in Appendix 1.

3.2 Design

Our study tested two independent variables, the first of which is language, the second of which is noun type. The language variable has three values (English L1, Korean L1, and English L2). We used a mixed between-subjects design. The English L1 participants completed the study in English to establish baseline data with which to compare the Korean subjects on the English L2 study. Languages (English and Korean) were manipulated within subjects for the Korean participants.

   As for noun type, as shown in Table 4, for the English language part of the study (English L1 and L2) half the participants received the flexible nouns in a count syntax context and half received the flexible nouns in a mass syntax context. For the Korean L1 subpart of the study, all nouns were presented without the plural-marker -*tul*.

   The dependent variable of interest in this paper is the response variable. For the statistical analysis, responses were coded as either 1 (judgement by number) or 0 (judgement by volume or size). If a participant selected the six small items as being "more" than the two large items, the response was coded as 1. If a participant selected the two larger items as being more than the six smaller items (judgment by volume), the response was coded as 0. Response times were also collected, although they are not analyzed in this paper.

3.3 Participants

40 native speakers of English and 40 native speakers of Korean were recruited from the student body at the University of Calgary.

3.3.1 English subjects

Of the 40 participants whose data are included in the study,[20] all but two were born and raised in Canada. One participant stated that he was born in the US and one in the

Table 4: Study design.

Noun type	English L1	Korean L1	English L2 (Korean L1)
Individual	Participants = 40	Participants = 40	Participants = 40
Substance	Participants = 40	Participants = 40	Participants = 40
Object	Participants = 40	Participants = 40	Participants =40
Flexible (count syntax)	Participants = 20	✘	Participants = 20
Flexible (mass syntax)	Participants = 20	✘	Participants = 20
Flexible	✘	Participants = 40	✘

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[20] We tested 43 English L1 participants. Of these 43 participants, three claimed to have spoken two languages from birth. All of the bilingual participants were bilingual speakers of a classifier language (Chinese, Japanese, and Thai), so we did not analyze the results from these participants and neither their personal information nor their data will be presented here.

Philippines. 14 participants were male and 26 were female; the age ranged from 18 to 30 with a mean age of 21. All participants reported that the language they spoke at home with their families when they were children and as adults was English.

3.3.2 Korean subjects

40 native speakers of Korean were tested. All of them completed high school in Korea, and were speakers of a Seoul dialect of Korean. 17 were male and 23 female. Their ages ranged from 18 to 26 with a mean age of 23. All participants reported that the language they spoke at home with their families when they were children and as adults was Korean. The participants had lived in Canada for varying lengths of time (range: 1 month to 72 months, with a mean of 9.4 months). To establish their proficiency levels in English, they completed a standardized English grammar test which included a grammar component and a listening component (Oxford English Grammar Placement Test). The range of scores on this test was between 124 (Mid-Intermediate User) and 192 (Near Native Speaker) out of a possible 200 with a mean score of 150 (Post-Intermediate User). Summary data is shown in Table 5.

3.4 Procedures

All testing was done in a psycholinguistics laboratory located in the University of Calgary. Participants were given a brief description of the experiment and signed an ethical consent form. They also filled in a questionnaire answering questions seeking personal data (sex, age), and the languages that they spoke. Korean participants were given an English placement test (Oxford English) which consisted of both a listening and a grammar component to establish their level of English proficiency. Following this the English L1 participants completed the experiment in English and the Korean L1 participants completed the experiment in both Korean and English. For the Korean participants, the order of experiment was counter-balanced.

The tasks were computer-controlled using the E-prime platform 1.2. Instructions were presented on screen in writing in English (for the English-speaking participants) and in Korean (for the Korean-speaking participants), and also orally through earphones. Stimuli were presented in two phases. In a vocabulary-familiarization (training) phase, participants were told that a picture would appear on the computer screen and they would hear a sentence naming the item. Thus, participants looked at pictures of items on a screen and were told e.g., *Here we see____ / ____iss-im-nida*). They did not need to respond. This part of the procedures was designed to ensure that the participants were familiar with all the words in their L2.

In the second part of the study they were asked to look at two pictures and to make a judgment, based on the picture they saw combined with the sentence they heard, as to, "Who has more _____?" Participants saw one picture with two "big" objects and one picture with six "small" objects. Each of the two "big" objects was designed to have a clearly larger volume then the six "small" objects combined. Participants were asked to imagine that one person owned the two "big" objects and that another person owned

Table 5: Korean participants.

Age	Sex	Place of birth	Time in Canada	English Grammar Test
Range: 18–26 Mean: 23	Male: 17 Female: 23	Korea: 40	Range: 1–72 months Mean: 9.4 months	Range: 124–192/200 Mean: 150/200

the six "small" objects. Then they were asked to decide *Who has more____?* The assumption behind the design is that participants would make their judgement by comparing quantities in the two pictures. To compare quantities of individuals, they would have to count the members of a set. To compare magnitudes of substances, they would need to assess the volume or size of the substance. In each case, the participant would be able to make a decision only after a particular interpretation had been assigned to the NP contained in the question *Who has more NP(s)?*

Participants could go through the instructions at their own pace. The speed at which the test stimuli were presented was experimenter-controlled. Participants had 2.5 seconds to enter their answer on a computer keypad by pressing one of two buttons after the offset of each stimulus.[21]

4 Results

We used a repeated measure design with binomial outcome data. Data were analyzed using a Generalized Estimating Equation (GEE),[22] a mixed-effects logistic regression model, under GENLIN procedures in SPSS v. 22. This particular model was chosen as not all groups were the same size (the flexible mass and count noun categories had half the number of responses as the other categories) and because the same Korean participants were tested on the Korean L1 and the English L2 study (Feddag et al. 2003). Alpha level of .05 was applied for all tests.

4.1 English L1 results

The estimated marginal mean summary by group is presented in Figure 1 for the English L1 speakers. The closer the mean is to 1, the more likely the participants are to quantify the noun by number rather than by volume.

As we can see from the graph, the English native speakers judged count nouns, object-mass nouns, and flexible nouns presented in count syntax by quantifying over number and they judged substance-mass nouns and flexible nouns presented in mass syntax by quantifying over volume.

Pairwise comparisons were conducted between the 5 groups (count nouns, substance-mass nouns, object-mass nouns, flexible nouns in count syntax, and flexible nouns in mass syntax). There was no significant difference found between the count nouns, object-mass
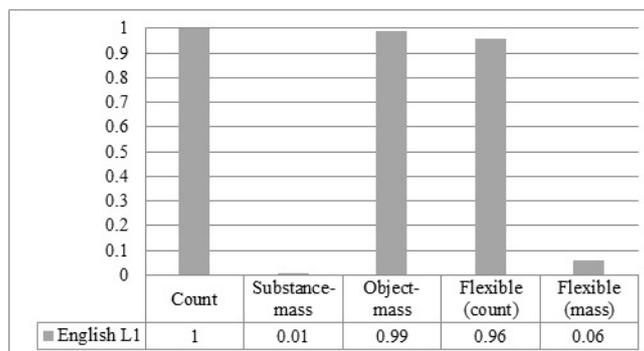

	Count	Substance-mass	Object-mass	Flexible (count)	Flexible (mass)
English L1	1	0.01	0.99	0.96	0.06

Figure 1: Estimated marginal means by group (English L1).

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[21] L2 research shows different patterns of responses when learners have to respond quickly as opposed to when they have enough time to think about "rules of grammar" that they've been taught. Participants had no difficulty with the time limit we imposed. Only 4 out of 3,200 responses exceeded the time limit.

[22] GEE is a statistical method used to deal with unbalanced longitudinal panel data. It is used to determine the within subject factor-item controlling for the correlated nature of the individual subject. It is a population-averaged model which is more appropriate for making predictions for the whole population. See Hu et al. (1998) for further discussion about the model.

nouns, and flexible nouns presented in count syntax and no significant difference found between substance-mass nouns and flexible nouns presented in mass syntax.[23] All other pairwise comparisons were found to be significant. Table 6 summarizes the pairwise comparisons conducted on the English L1 data (significant differences are bolded).

4.1.1 English L1 discussion

The English native speakers used number in quantifying over count nouns, and used volume in quantifying over substance-denoting mass nouns, as expected. They used number to quantify over object-mass nouns. They were also acutely sensitive to mass/count syntax when tested on flexible nouns. Our English L1 results thus replicate the findings of Barner & Snedeker (2005). It is worth emphasizing here, that we used oral stimuli rather than written stimuli as was used in the Barner & Snedeker (2005) study and that the results that we obtained using this slight variation in methodology elicited similar results. In short, the modality of presentation of stimuli does not significantly affect the results, a useful finding.

4.2 Korean L1 results

The estimated marginal means summary for each stimuli type is presented in Figure 2 for the Korean native speaker results. As can be seen in this figure, in 99% of cases the Korean native speakers used number to quantify those items that denote things (and were chosen to be like English count nouns); they used number only 2% of the time to quantify items denoting substances; they used number 98% of the time to quantify nouns denoting aggregates (chosen to be like English object-mass nouns). For the nouns chosen to correspond to English flexible nouns, the Korean native speakers judged this group of nouns by using number to quantify 45% of the time.

Pairwise comparisons were conducted between the four groups of Korean nouns. There was no significant difference found between nouns denoting things (=English count nouns) and nouns denoting aggregates (=English object-mass nouns). All other pairwise

Table 6: English L1 pairwise comparisons by group. "Sub-mass" = substance-denoting mass nouns; "Flex-count" = flexible noun appearing in count syntax", "Flex-mass" = flexible noun appearing in mass syntax, "Obj-mass" = Object-denoting mass noun.

Group a	Group b	Difference	Std. Error	df	Significance
Count	**SUB-mass**	**(–).99**	**.008**	**1**	**.000**
Count	Obj-mass	(–).01	.007	1	.249
Count	Flex-count	(–).03	.017	1	.107
Count	**Flex-mass**	**(–).94**	**.019**	**1**	**.000**
SUB-mass	**Obj-mass**	**(–).98**	**.009**	**1**	**.000**
SUB-mass	**Flex-count**	**(–).95**	**.017**	**1**	**.000**
SUB-mass	Flex-mass	(–).05	.020	1	.087
Obj-mass	Flex-count	(–).03	.015	1	.135
Obj-mass	**Flex-mass**	**(–).93**	**.021**	**1**	**.000**
Flex-count	**Flex-mass**	**(–).91**	**.024**	**1**	**.000**

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[23] There is a marginal difference observed between the flexible categories (flex count vs. count) and (flex mass vs. substance mass); that may merit a closer look in a follow-up analysis; however, the focus of our research is on the L2 acquisition and investigating this question further is outside of the main scope of this paper.
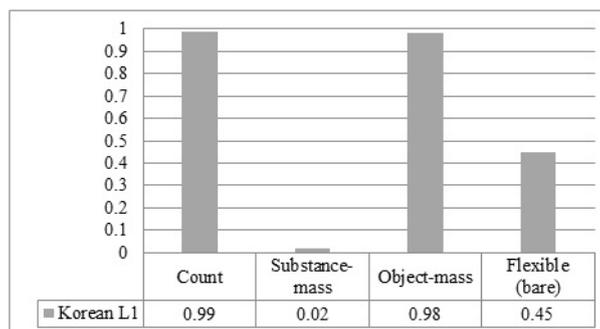
Figure 2: Estimated marginal means by group (Korean L1).

Table 7: Korean L1 pairwise comparisons by group. "Sub-mass" = substance-denoting mass nouns; "Flexible" = flexible noun appearing with no plural-marking, "Obj-mass" = Object-denoting mass noun.

Group a	Group b	Difference	Std. Error	df	Significance
Count	**Sub-mass**	**(–).96**	**.012**	**1**	**.000**
Count	Obj-mass	.00	.013	1	.705
Count	**Flexible**	**(–).53**	**.050**	**1**	**.000**
Sub-mass	**Obj-mass**	**(–).96**	**.013**	**1**	**.000**
Sub-mass	**Flexible**	**(–).43**	**.048**	**1**	**.000**
Obj-mass	**Flexible**	**(–).53**	**.049**	**1**	**.000**

comparisons were found to be significant. Table 7 summarizes the pairwise comparisons conducted on the Korean L1 data (significant differences are bolded).

Our study thus shows that when judging Korean nouns that denote things, Koreans consistently quantified over number. When judging Korean nouns that denote substances they consistently quantified over volume. When judging nouns that denote aggregates, they consistently quantified over number. For these categories of nouns, the Korean response patterns are almost identical to those of the English-speakers in the English L1 study. The one category of noun where the Korean judgments differed from those of the English speakers was the flexible nouns. For this class of nouns, Korean were as likely to quantify using number as volume.

4.2.1 Korean L1 discussion

In Korean, nouns that denote things and substances can occur in the same syntactic context. Despite this fact, Koreans clearly conceptualized the two types of noun differently. The different patterns of quantification reveal that Koreans do not treat nouns occurring in bare noun contexts in the same way and, moreover, they do not conceptualize substances as pluralities, contra Chierchia (1998a). On the contrary, the behaviour of the Korean-speakers in Korean is indistinguishable from that of English-speakers in English on these categories of nouns. With respect to the flexible nouns, Korean-speakers quantified using both number and volume. What would appear to distinguish English-speakers and Korean-speakers is simply that English grammar provides disambiguating cues for the ambiguous nouns (=English flexible nouns) while Korean grammar does not. Thus, the native speakers of Korean appear to be using noun semantics, not morpho-syntactic cues, to carry out the judgement task as no morpho-syntactic cues are available

in the Korean input. These results are consistent with the findings of Inagaki and Barner (2009) in their study of quantification in Japanese and support their claim that such nouns are ambiguous.

4.3 English L2 results

As can be seen from Figure 3, the Korean native speakers judged English count nouns by relying on number 99% of the time; they judged substance-denoting mass nouns by using number 1% of the time; and they judged object-mass nouns by using number 98% of the time. With respect to the English flexible nouns, the Korean participants who were presented with the flexible nouns in count syntax judged these nouns 51% of the time over number, while the participants who were presented with the nouns in mass syntax used number 44% of the time.[24]

Pairwise comparisons were conducted between the five groups. No significant difference was found between count nouns and object-mass nouns, nor was any significant difference observed between the flexible nouns presented in mass syntax or the flexible nouns presented in count syntax. All other pairwise comparisons were significant and are summarized in Table 8 below (significant differences are bolded).

Figure 4, presents a comparison of the English L1, the Korean L1, and the English L2 results.

Comparisons between language groups were conducted on the English L1 and English L2 results. No significant differences were found between the two groups on the count noun judgments (B = .70, SE = .98, $\chi^2(1)$ = .51, p = .477), the substance-denoting mass noun judgments (B = –7.54E, SE = 1.16, $\chi^2(1)$ = .00, p = .1), or the object-mass noun
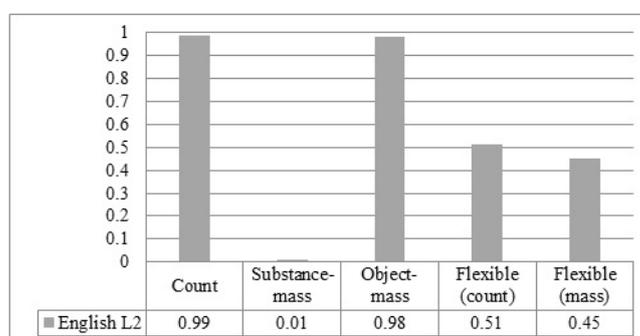
	Count	Substance-mass	Object-mass	Flexible (count)	Flexible (mass)
English L2	0.99	0.01	0.98	0.51	0.45

Figure 3: Estimated marginal means by group (English L2 – Korean participants).

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[24] It was pointed out by a reviewer that since Korean does not allow consonant clusters at the end of a syllable it may be the case that the Korean L2 speakers are simply not perceiving the plural -s at the end of the words. This would prove problematic for the flexible nouns since the perception of the plural marker in these cases would be essential for arriving at a correct interpretation in English. Lardiere (1998a; b) and Goad & White (2004) have discussed prosodic properties of the L1 and its influence on production in L2. We did not consider this issue before designing our experiment. However, there are a few reasons to believe that Koreans did not have difficulty perceiving the English plural-marker -s (note that, unlike the studies mentioned above, we did not look at production of the lexical items). First, *pies* was the one lexical item which did not have a word-final consonant cluster preceding -s. However, there was no significant difference between Korean responses on this item and on the other items where a consonant cluster preceded the -s. Second, Inagaki (2014) conducted a similar study with Japanese speakers (which is another classifier language). The results in this study were collected using written stimuli and the results for the flexible nouns were similar to the ones presented here. This speaks against the effect of prosody. Finally, when English loanwords are borrowed into Korean, word-final consonant clusters are not simply reduced to a single consonant; rather epenthetic vowels are inserted to allow the loanwords to be borrowed. The English word *mint*, with a sonorant + stop consonant cluster, is borrowed into Korean as /min.tʰɨ/ (Kang 2003). If Koreans are not able to perceive consonant clusters word finally, we would not expect this type of loanword adaptation.

Table 8: English L2 (Korean L1) pairwise comparisons by group. "Sub-mass" = substance-denoting mass nouns; "Flex" = flexible noun, "Obj" = object-mass noun.

Group a	Group b	Difference	Std. Error	df	Significance
Count	**Sub-mass**	**(–).98**	**.012**	**1**	**.000**
Count	Obj-mass	(–).01	−0.13	1	.436
Count	**Flex-count**	**(–).48**	**.082**	**1**	**.000**
Count	**Flex-mass**	**(–).54**	**.062**	**1**	**.000**
Sub-mass	**Obj-mass**	**(–).97**	**.017**	**1**	**.000**
Sub-mass	**Flex-count**	**(–).50**	**.081**	**1**	**.000**
Sub-mass	**Flex-mass**	**(–).44**	**.058**	**1**	**.000**
Obj-mass	**Flex-count**	**(–).47**	**.082**	**1**	**.000**
Obj-mass	**Flex-mass**	**(–).53**	**.064**	**1**	**.000**
Flex.count	Flex-mass	(–).06	.101	1	.554

	Count	Substance-mass	Object-mass	Flexible (count)	Flexible (mass)	Flexible (bare)
English L1	1	0.01	0.99	0.96	0.06	
Korean L1	0.99	0.02	0.98			0.45
English L2	0.99	0.01	0.98	0.51	0.45	
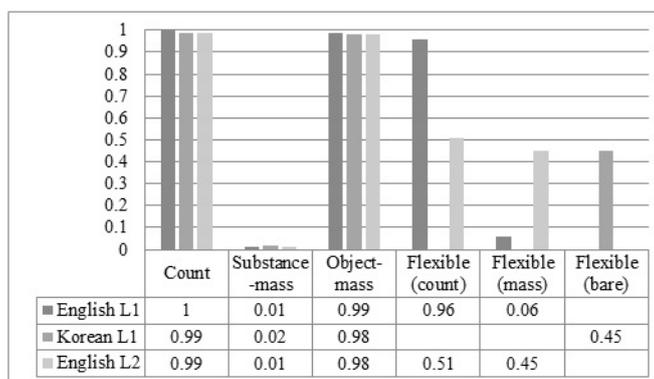
Figure 4: Estimated marginal means by group.

judgments (B = .71, SE = .67, $\chi^2(1)$ = 1.12, p = .290). However, for mass-count flexible nouns that appeared in count syntax contexts, a statistically significant difference was found (B = –2.64, SE = .43, $\chi^2(1)$ = 38.50, p < .001), due to the fact that native English speakers were at ceiling in judging over number for this category (96%) while only 51% of the Korean participants responded in this way. For the flexible nouns that appeared in mass syntax contexts, a significant difference was also found, (B = 3.14, SE = .54, $\chi^2(1)$ = 34.40, p < .001). For this category, only 6% of the English speakers judged over number while 44% of the Korean native speakers did so. These results are particularly striking because they reveal that the Korean participants appear to be insensitive to the plural marker, not using it appropriately as a cue to quantify over individuals. On the other hand, they appear to be quantifying over individuals when the plural-marker is lacking, which in English is the morpho-syntactic cue to the presence of substances.

We designed our study to use our Korean L2ers as their own controls, a feature we think should be used more often in second language acquisition studies. Accordingly, we also compared the Korean L1 and English L2 data.[25] There was no significant difference found between the count nouns (B = –.41, SE = .92, $\chi^2(1)$ = .197, p = .657), the substance-mass nouns (B = .70, SE = 1.13, $\chi^2(1)$ = .386, p = .534), the object-mass nouns (B = .23, SE = .69, $\chi^2(1)$ = .111, p = .739), or either category of flexible noun:

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[25] Both the L2 categories flexible (count) and flexible (mass) were compared to the Korean category flexible.

(B = −.241, *SE* = .25, $\chi^2(1)$ = .941, p = .332) for the flexible nouns presented in count syntax and (B = −7.35E, *SE* = .40, $\chi^2(1)$ = .00, p = 1.00) for the flexible nouns presented in mass syntax.[26]

Since the object of study is the individual knowledge systems of learners, group data are suggestive only. Explanation must be based on information about individual learners. Accordingly, an analysis of individual speaker data was conducted to help us decide if the participants were performing randomly when they were making judgments of the flexible nouns or if some of the subjects have acquired the mass-count distinction. We compared Korean participants' responses in their L1 with their responses in their L2 on the flexible items. There was no significant difference found for any of the participants. This shows us that the Korean participants are mirroring in their L2 what they did in their L1. One participant, for example, judged all 5 of the Korean nouns over volume, and in the L2 study, despite being prompted by the plural morpho-syntactic cues, she judged all but one of the nouns to be mass nouns. The English data of this participant alone reveal that she is not sensitive to the plural marker, and her Korean data suggest that she is using the same response strategy in both languages. If we look at another participant's results, he judged all the English count nouns accurately. On the basis of the English results alone, we might have concluded that he has learnt the function of the plural marker, but such a conclusion is unwarranted. This is because he also judged all 5 Korean nouns over number. This participant has a response bias that favours quantification over number. From these findings, there is no evidence that they are responding in a target-like way.[27]

Individual Korean participants responded in a uniform way, but despite this pattern there was a large amount of variability among participants. Some participants judged all the flexible nouns by number, while others judged them all by volume. Many participants responded somewhere between these patterns. Figure 5 (Korean participant responses on flexible items) shows the participants' cumulative scores on the flexible nouns in Korean and in English. There is a strong positive correlation (r(38) = 0.82, p < 0.01) observed between L2 and L1 responses on the flexible nouns.
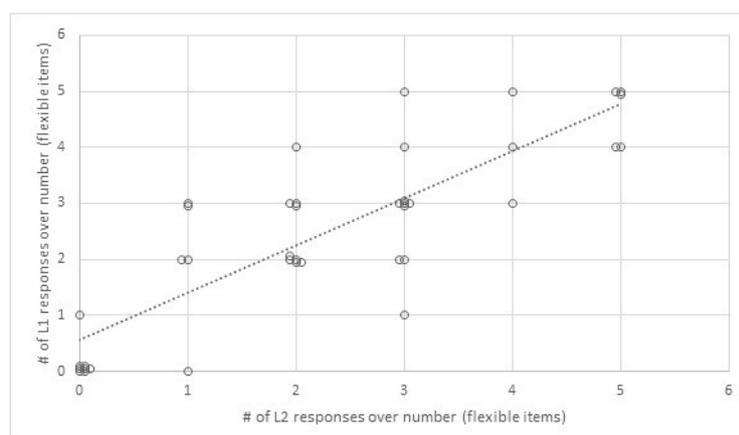

Figure 5: Korean participant responses on flexible nouns.

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[26] The methodology we used tested Korean participants on their L1 and L2 one after the other on the same day. A reviewer pointed out that this could create a confound as the participant could be keeping their L1 active during the L2 stage of the study (or vice versa). We conducted a t-test for 2 independent means to compare responses from participants who completed the task in English first to responses from participants who completed the task in Korean first. There was no significant difference in the scores for English first (M = 0.48, SD = 0.25) and Korean first (M = 0.42, SD = 0.25) on the English task; t(198) = 0.81, p = .42.

[27] We also feel that these results warrant the conclusion that there is more to the learners' behaviours than the contents of their lexical entries. While our data cannot be used to claim that the Koreans were activating L1 processing procedures when completing the tasks, they are at least consistent with that claim.

In addition to investigating individual responses on the flexible items, we investigated whether different response rates were observed for certain items. Figure 6 shows the response rates for the nouns presented in the Korean L1 study.

Overall, there was a significant difference among items ($\chi^2(4) = 13.306$, p = .010), so we conducted pairwise comparisons between individual items. The only items which showed a significant difference in this comparison were the items *rock* and *cake*. The pairwise comparisons are summarized in Table 9 (significant differences are bolded).

Figure 7 shows the response rates for the nouns without plural-marking presented in the L2 study. Overall, there was no significant difference amongst items for nouns presented in count syntax ($\chi^2(4) = 3.529$, p = .473), nor for items presented in mass syntax ($\chi^2(4) = 1.025$, p = .906). Pairwise comparisons were conducted and likewise there was no significant difference between any of the groups.

One final question is: Is there is a correlation between the participants' proficiency level in English, and their scores on the English L2 experiment? Given the obligatory nature of the count/mass syntax in English, one would predict that as the native speakers of Korean become more proficient in English, their sensitivity to such marking should increase. We ran a coefficient of correlation statistical analysis to compare the participants' scores on the Oxford English Placement Test with their accuracy scores on the flexible English nouns. In this case r = 0.05, meaning there was no correlation between their accuracy on the placement test and their results on the L2 part of the study. This is consistent with the claim that even more advanced Korean learners of English are processing English nouns semantically but not morpho-syntactically.
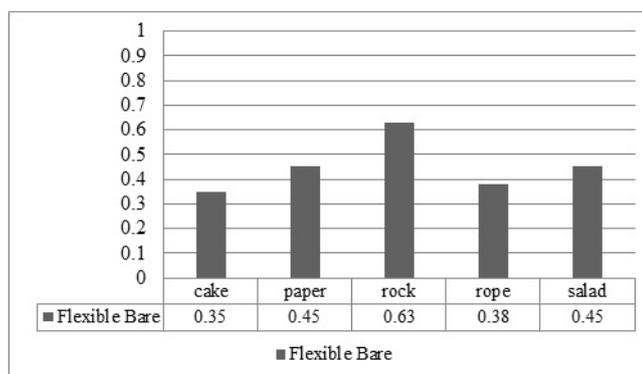

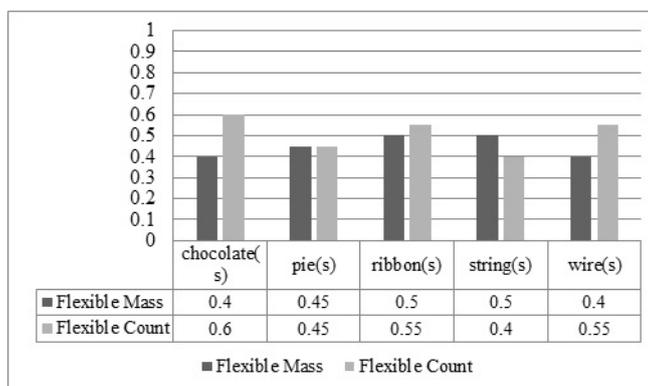**Figure 6:** Summary of estimated marginal means by item (flexible items – Korean L1).

	cake	paper	rock	rope	salad
Flexible Bare	0.35	0.45	0.63	0.38	0.45

Figure 7: Summary of estimated marginal means by item (flexible items L2 study).

	chocolate(s)	pie(s)	ribbon(s)	string(s)	wire(s)
Flexible Mass	0.4	0.45	0.5	0.5	0.4
Flexible Count	0.6	0.45	0.55	0.4	0.55

Table 9: Korean L1 flexible nouns pairwise comparisons by item.

Group a	Group b	Difference	Std. Error	df	Significance
Cake	paper	(−).10	.111	1	1.000
Cake	**rock**	**(−).28**	**.087**	**1**	**.015**
Cake	rope	(−).03	.097	1	1.000
Cake	salad	(−).10	.085	1	1.000
Paper	rock	(−).18	.099	1	.780
Paper	rope	(−).07	.074	1	1.000
Paper	salad	.00	.094	1	1.000
Rock	rope	(−).25	.092	1	0.065
Rock	salad	(−).18	.099	1	.780
Rope	salad	(−).08	.089	1	1.000

4.3.1 English L2 discussion

Recall our research questions: Are Korean L2 learners of English sensitive to the syntactic cues of the mass-count contrast? Any study focusing solely on the correct interpretation of English count nouns marked by plural would likely be interpreted as showing that Koreans have acquired number. This is because they were indistinguishable from the English native speakers on the count nouns and the substance-mass nouns. The use of mass-count flexible nouns, whose interpretation is cued critically by the plural marker in English, revealed, however, that English L1 and L2 speakers responded quite differently to this class of words. The Korean speakers did not respond enough to the plural marker in the count syntax contexts, and they quantified over things too much in the mass syntax contexts.

Inagaki (2014) investigated native speakers of Japanese and the acquisition of the mass-count distinction in English. The methodology used in Inagaki's (2014) was similar to the methodology we used; however, the two studies differed as Inagaki (2014) used written stimuli and our study used oral stimuli. With respect to language, Korean and Japanese, while both classifier languages, differ in their use of plural-marking. Japanese has an optional plural marker -*tati*, which can attach to nouns with a human referent to elicit an associative or additive reading. See Nakanishi and Ritter (2008) for a complete discussion. Korean has a plural marker -*tul* which can optionally attach to human, animate, and inanimate nouns. See MacDonald (2014) for further discussion. The results of Inagaki (2014) are similar to what we found in our study, namely learners made correct interpretations for count nouns and object-mass nouns (they judged them based on number) as well as substance-mass nouns (they judged them based on volume). For nouns that were ambiguous (i.e. nouns such as *string(s)* which could appear in either mass or count syntax), participants failed to respond according to the syntactic cues in the sentence. The similarity in findings strongly suggests that number-marking systems are difficult to learn for speakers of languages that do not have a similar system in their L1.

Our study, however, permits us to say more. Because we used Koreans as their own controls on tasks using the same semantic classes of nouns in Korean and English, we were able to show that they responded identically to the category of flexible nouns in both languages. Without comparative Korean L1 data, one might conclude (wrongly) that the Koreans have acquired plural-marking. Instead, with such comparative data permitting comparison of responses based on the semantics of individual words, we were able to pinpoint responses as rooted in lexical semantics, not grammar.

What role does lexical transfer play in this task? Are the Korean participants simply making use of their knowledge of Korean words (translation-equivalents) when asked to

make judgments on English mass-count flexible nouns? Our analysis showed no significant difference between the Korean participants in the L1 and the L2 study (either on a category comparison or a comparison conducted on individual participants). While the Korean native speakers that we tested appear to use different strategies with the flexible nouns in their L1, these same strategies were also observed on a different set of lexical items within the flexible category in their L2. This was shown by the strong positive correlation between response patterns by the Korean native speakers in their L1 and L2 (see Figure 5). A transfer story seems plausible. However, we prefer not to draw definitive conclusions about lexical transfer because we did not test the Korean participants on the same translation-pairs. We found a clear response bias taking place in some participants, but to confirm that there is in fact lexical transfer taking place (that is to say, transfer of the exact encoding of word-specific information in lexical entries) we would have to test participants on the same group of words in their L1 and their L2. We leave this for future research.

5 General discussion and conclusion

Barner & Snedeker's (2005) ground-breaking study provided us with a means to tease apart morpho-syntactic and semantic processing of sentences illustrating the mass-count contrast and number. As in their study, our participants were asked to make quantity judgements on four categories of words: nouns that denote individuals (*dog*) or things (*eraser*), nouns that denote non-solid substances (*water*), nouns that denote aggregates and which are expressed by object-mass nouns in English (*furniture*), and nouns which can appear with either mass (substance-interpretation) or count syntax (individual-interpretation) in English (*rope/ropes*). We replicated Barner & Snedeker's results: English native speakers judged count nouns by quantifying over number, substance-denoting mass nouns by quantifying over volume, and object-mass nouns by quantifying over number. With respect to the flexible nouns, plural-marking guided the English native speakers' judgments of these nouns.

The Korean results showed that Korean speakers map nouns to meanings based on lexical semantics, not based on morpho-syntactic cues. The absence of morpho-syntactic cues to mass-count in Korean does not prevent Koreans from counting over individual- or thing-denoting nouns or assessing substance-denoting nouns in terms of magnitudes of volumes. For the flexible nouns, the Korean native speakers responded as if the sentences were ambiguous. Our data show that Koreans respond similarly to the Japanese participants in the Inagaki and Barner (2009) study, as well as the Japanese participants in Inagaki (2014). We thus have confirmed their findings with speakers of a different classifier language. In addition, the fact that Koreans provide the same kinds of interpretations to nouns as English-speakers shows clearly that cross-linguistic differences in number syntax are not a sound basis for inferring (as Chierchia 1998a; b does) differences in number semantics. Target-like performance on count nouns is also not a sound basis for inferring that speakers of a classifier language have acquired plural marking in English. While Korean has a plural marking morpheme *-tul*, if it is developing into an inflectional marker, it is either not transferring to the current task (an hypothesis we regard as ad hoc and implausible) or else it is not expressing plurality (in the same way that English plural-marking does). If it were, we would have expected it to help the Koreans to correctly interpret the flexible nouns, which it clearly did not do.

Do Koreans pay attention to morpho-syntactic cues to the mass-count contrast when processing English input? On the English count nouns, substance- and object-mass nouns, the answer appears to be "yes". However, Korean participants responded quite differently from the English L1 speakers on the flexible nouns where plural-marking was the critical cue to the correct interpretation. Not only did Koreans seemingly ignore the significance

of the presence of phonological exponents of the Plural-marker, they also quantified over things when parsing flexible nouns occurring without plural-marking (which should in English be a cue to quantifying over volume). Our data clearly undermine any claim that advanced Korean learners of English are sensitive to English count nouns marked by the Plural. We believe that our participants have not yet learnt the English plural morphology. This conclusion is supported by the additional finding of a strong positive correlation between the English flexible nouns and the corresponding morphologically unmarked nouns in Korean, which might be due to lexical transfer.

The Autonomous Induction Theory (AIT) (Carroll 1999; 2001; 2002) predicts transfer of lexical content, which explains what the Korean participants are doing on the English task. Clearly, if participants are transferring their lexical representations it follows that they are transferring the grammatical content of Korean representations which, by hypothesis, lack number. But how do learners move beyond lexical transfer of L1 words and morphemes? In the tri-partite functional architecture of language the AIT adopts (Jackendoff 1990; 1991; 2010), words and morphemes consist of triplets of representations across autonomous representational systems. It is plausible, indeed we predict it to be true, that L2 learners incrementally form representations of morphemes based on their exposure to relevant input. A learner may hear the sound form [kæts] or read the written form *cats* and store their representations in episodic memory. It does not follow that they will simultaneously form morpho-syntactic or semantic representations of the word. Nor does it follow that learners will analyse the forms into component parts $((\text{kæt})_{\text{Prosodic Word-i}} (\text{s})_{\text{Affix-j}})_{\text{Prosodic Word-k}}$ or systematically map this prosodic analysis to the morphosyntactic structure $[[\text{Noun}]_{\text{-i}} [\text{Plural}]_{\text{-j}}]_{\text{Noun-k}}$. One obvious conclusion of our study is that mere exposure to meaningful input in the form of such exemplars is insufficient.[28] The AIT imputes this to the fact, clearly demonstrated here, that speakers of classifier languages can arrive at the correct interpretation of most classes of English nouns, including count nouns, without relying on the morpho-syntax of number. L2ers are not driven to analyse structures "bottom-up". Indeed, topdown processing effects occur, especially involving word forms (Carroll 2012; Carroll & Windsor 2015) and may impede L2 learning. The obvious question is: What input would necessarily lead to the creation of the target generalization involving the abstraction of the morpho-syntactic structure as in (5) from individual exemplars?[29]

(5)   a. $((\ldots)_{\text{Prosodic Word-i}} (\text{s})_{\text{Affix-j}})_{\text{Prosodic Word-k}}$ ⟷ $[[\text{Noun}]_{i} [\text{Plural}]_{j}]_{k}$
       b. $((\ldots)_{\text{Prosodic Word-i}} (\text{z})_{\text{Affix-j}})_{\text{Prosodic Word-k}}$ ⟷ $[[\text{Noun}]_{i} [\text{Plural}]_{j}]_{k}$
       c. $((\ldots)_{\text{Prosodic Word-i}} (\text{əz})_{\text{Affix-j}})_{\text{Prosodic Word-k}}$ ⟷ $[[\text{Noun}]_{i} [\text{Plural}]_{j}]_{k}$

It is possible that systematic training on precisely the flexible nouns might lead to grammatical restructuring. We think it unlikely that mere exposure to flexible nouns would do the trick. This is because flexible nouns will normally be used in a single, unambiguous interpretation in a given context (denoting either a thing or a substance, but not both). They are likely as well to be infrequent in comparison to the other classes of nouns. Infrequent too will be contexts which draw learners' attention to the fact that flexible nouns shift meaning based on the syntactic context they occur in. We also note that most

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[28] Our input claim is based on the assumption that English words are familiar to Koreans and that they are not novel words. When the stimuli were designed we looked at teaching materials used in Korean schools and chose stimuli consistent with the instructed vocabulary. While *confetti* may not be a high frequency word in English, it was a word that Korean speakers should be familiar with from their English textbooks. Additionally, in the experimental design we made sure that all lexical items were presented to Koreans before the experiment (in the form "Here you see_____.").

[29] We set aside the quite distinct learning problem of abstracting the information that the regular Plural morpheme involves an underspecified Vowel + /z/ whose surface pronunciation depends on the phonological properties of the final timing unit of the Prosodic Word the Affix attaches to, surfacing as [s] when that timing unit is a voiceless consonant and [z] otherwise.

Koreans (including our participants) do receive instruction on the English plural. That instruction is apparently not enough to induce the ability to morpho-syntactically represent plural-marking. The unresolved question is whether speakers of classifier languages can, in principle, learn plural marking in English or if they will always exhibit "representational deficits" (Hawkins & Chan 1997; Hawkins 2000; Franceschina 2001).

Future studies focusing on input should provide an answer.

Abbreviations

ACC = accusative, NOM = nominative, PL = plural, TOP = topic

Additional Files

The additional files for this article can be found as follows:

- **Appendix I:** Sample stimuli and pictures. DOI: https://doi.org/10.5334/gjgl.363.s1
- **Appendix II:** Complete stimuli (English L1). DOI: https://doi.org/10.5334/gjgl.363.s1
- **Appendix III:** Complete stimuli (English L2). DOI: https://doi.org/10.5334/gjgl.363.s1
- **Appendix IV:** Complete stimuli (Korean L1). DOI: https://doi.org/10.5334/gjgl.363.s1

Ethics and Consent

Approval for this study (Second language acquisition of English mass-count nouns by Korean (file #6344) was obtained from the Conjoint Faculties Research Ethics Board.

Competing Interests

The authors have no competing interests to declare.

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