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Scope of Lexical Access in Spoken Sentence Production: Implications for the Conceptual–Syntactic Interface

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Building on P. H. Allum and L. Wheeldon (2007), the authors conducted 5 experiments to investigate the scope of lexical access during spoken sentence production in Japanese and English. Speakers described pairs of pictured objects, and on critical trials, 1 object was previewed. In Japanese, sentence onset is speeded by the preview of each of the 2 pictures used to elicit a sentence initial coordinated noun phrase (Experiment 1). When the same displays are used to elicit an alternative Japanese listing structure, onset latencies are speeded only by the preview of the first picture to be named (Experiment 2). The findings of Experiment 1 were therefore not the result of stimulus design. Experiment 3 replicated the findings of Experiment 1 in English. Experiments 4 and 5 tested a subject phrase consisting of a noun phrase modified by a prepositional phrase in English and Japanese. In both languages, only preview of the first picture to be named speeds responses, irrespective of whether it occurs in the head phrase (English) or not (Japanese). These results suggest that prior to utterance onset, only access to the nouns for the first phrase to be produced is required, even if this is not the head phrase. The implications for speech production models are discussed.

Keywords: speech production, lexical access, planning scope

In a previous article (Allum & Wheeldon, 2007), we investigated the relationship between two levels of representation in speech production, the thematic or conceptual and the grammatical, by looking at scope of planning. Identification of such a scope allows constraints to be placed on theories about the processes involved in mapping from a conceptual to a grammatical representation (cf. Schriefers, Teruel, & Meinshausen, 1998). In particular, an understanding of the scope used in grammatical encoding has consequences for understanding the relationship between lexical access and syntactic structure building and can help to decide between a lexically mediated approach to the generation of syntax (e.g. Bock & Levelt, 1994) and one that allows representations at the thematic or conceptual level to interact directly with syntactic processes, such as word ordering prior to lexical access (e.g. Chang, Dell, & Bock, 2006). In our previous article (Allum & Wheeldon, 2007), we used the contrasting characteristics of a head-initial language, English, and a head-final language, Japanese, to investigate this relationship. We found a scope that we tentatively defined as a *functional phrase* (defined more clearly later in the present article). Given that such a phrase is an initial subordinate phrase in Japanese, we concluded that this likely provided evidence for syntactic-ordering processes interacting with conceptual-level processes in order to manage order of lexical access. However, we could not be sure to what level this scope applied. In this article, we continue that investigation by examining the role played by lexical access in our earlier results. First, however, we give a brief summary of the main theoretical arguments and findings from Allum and Wheeldon (2007), which provide the rationale for the work reported here.

Our basic reasoning in that previous article was as follows: If the scope of grammatical planning is a phrase, and such a scope controls lexical access in advance of utterance onset (Martin & Freedman, 2001; Martin, Miller, & Vu, 2004; Smith & Wheeldon, 1999), then there is a need to explain how the conceptual message, which is presumably nonlinear, ensures that lexical access occurs in the correct order. In traditional, lexically driven models (e.g. Bock & Levelt, 1994), this process is often seen as mediated by means of the thematic marking of lexical concepts affecting the grammatical role marking of lemmas, for example, agent to subject, such assignment being affected by conceptual weighting on the lexical concepts in the thematic representation (e.g. Bock, Loebell, & Morey, 1992). Conceptual weighting may result in a particular lexical item being most highly activated, assigned to the role of agent, and consequently assigned to nominative and thus the subject. In a configurational language like English (subject–verb–object), the grammatical system could recognize that the first element of the utterance is available, and thus utterance could be initiated prior to access of later lexical items in the clause. Thus, the process of ensuring that lexical items are accessed in the correct order, given that processing, in particular lexical access, is incremental, can possibly be explained within models like the one described by Bock and Levelt (1994) as resulting from conceptual weighting assigning elements to thematic and thus grammatical roles in the required order (e.g. McDonald, Bock, & Kelly, 1993).

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However, we reasoned that such conceptual weighting cannot explain the order of activation of lexical items when a clear conceptual weighting factor, such as focus, animacy, or salience, is not involved. Such a situation occurs when the required order of activation and assignment is based on a purely grammatical factor, such as the convention that modifying phrases come before or after the head phrase. In this case, ordering of constituents is unlikely to be susceptible to conceptual influences in the same way that assignment to major thematic roles may be. Thus, if an initial modifying phrase is processed at the grammatical level more thoroughly than the following head phrase, we argue that this suggests an interaction between syntactic ordering information and the thematic representation of the message in order that the former can activate the latter in the appropriate order for the associated lexical items to also be activated in the correct order.

In Allum and Wheeldon (2007), we used the head-final characteristic of Japanese to investigate whether such an initial phrase, a subordinate phrase, is in fact more thoroughly processed than its subsequent head phrase. For example, in the sentence "The dog above the table is red," for the subject phrase "The dog above the table," the message level can create a thematic representation including a "theme" (dog) and a "modifier" (above the table). In Japanese, this subject[1] could be represented by the phrase "*Tee-buru no ue no inu*" [Table $_{\text{GEN}}$[2] above $_{\text{GEN}}$ dog]. The order of head phrase and modifier phrase is reversed. If scope of higher level processing such as lexical access is limited to the initial modifier phrase, then the abstract thematic representation must interact with a syntactic sequencing system that can indicate that a modifier comes before the concept it modifies and so influence activation and consequent selection of the modifier and its associated lexical concept *table* before that of *dog*. In such a model, then, sequencing of lexical access for the initial word could occur without access to the lexical item for the head of the phrase, thus allowing incremental lexical access that is not based solely on conceptual weighting (e.g., Chang et al., 2006).

In Allum and Wheeldon (2007), we argued that a certain level of phrase within the syntactic hierarchy was a planning unit. We provisionally named it the *functional phrase*. This level of phrase was defined as the unit within the conceptual or event role representation (cf. Chang, Bock, & Goldberg, 2003) that serves a single function and that cannot be broken down into lesser functions. Thus, in a sentence such as "The flower above the house is red," the phrase "The flower" is one functional unit (it represents the theme) and the phrase "above the house' is another functional unit, a modifier (it defines which flower is being discussed). These two elements cannot be reduced to smaller functions. Our conclusion was based on differences in reaction time to utterances in which the overall utterance length was kept constant, but the subject phrase, while constant in terms of the number of open-class words, varied in terms of the combination of grammatical units it contained. Sentence onset latencies varied systematically in relation to these different combinations. Specifically, in English, onset was faster to a sentence like "The flower above the house is red" (referred to hereafter as prepositional[3] phrase subject, or PP for short) compared with one such as "The flower and the house are red" (referred to hereafter as coordinated noun phrase subject, or CNP for short). The same difference in onset to the two subject phase types (CNP, PP) was found with Japanese, in which the prepositional phrase precedes the head phrase, and this was taken to indicate that even a phrase that is not a major element in the utterance, in so far as it is not part of the basic verb argument structure, is processed more thoroughly than the head of the phrase prior to utterance onset. This was confirmed in Allum & Wheeldon (2007, Experiment 3). In that experiment, a PP subject consisted of four open-class nouns grouped into two elements, the prepositional phrase and the head phrase. The relative length of these was varied while the overall length was kept constant. Sentences were as follows:

(1) [*Zubon no ue no*] [*budou to kagi to hebi wa*] *aka desu*.

[trousers $_{\text{GEN}}$ above $_{\text{GEN}}$ grapes $_{\text{CONJ}}$ key $_{\text{CONJ}}$ snake $_{\text{TOP}}$ red are.]

[The grapes and key and snake above the trousers are red.]

(2) [*Zubon to budou no ue no*] [*kagi to hebi wa*] *aka desu*.

[trousers $_{\text{CONJ}}$ grapes $_{\text{GEN}}$ above $_{\text{GEN}}$ key $_{\text{CONJ}}$ snake $_{\text{TOP}}$ red are.]

[The key and snake above the trousers and grapes are red.]

(3) [*Zubon to budou to kagi no ue no*] [*hebi wa*] *aka desu*.

[trousers $_{\text{CONJ}}$ grapes $_{\text{CONJ}}$ key $_{\text{GEN}}$ above $_{\text{GEN}}$ snake $_{\text{TOP}}$ red are.]

[The snake above the trousers and grapes and key are red.]

As the initial prepositional phrase was extended, onset became longer. We considered this manipulation critical. As mentioned earlier, we argued that if an initial subordinate phrase that does not represent a major element in the thematic representation is processed more thoroughly than a head phrase that does represent such an element, this provides strong support for models of speech production that posit direct links between the conceptual or thematically represented message and syntactic ordering processes (e.g. Chang, Dell, & Bock, 2006).

On the basis of previous related experiments (Martin & Freedman, 2001; Martin, Miller, & Vu, 2004; Smith & Wheeldon, 1999), it was hypothesized that the main cause of this effect was differences in the extent of lexical access prior to utterance onset. In other words, prior to utterance onset, speakers prefer to access all the open-class words to be found in the initial functional phrase. Nevertheless, it was not possible to rule out the possibility that the effect was a result of the costs involved in the creation of syntactic structure rather than lexical access. Such an explanation in the case of a head-final language would result in a rather forced explanation of the relationship between lexical access and the creation of syntactic structure, at least in models that posit lexical access prior to the creation of syntactic structure (e.g., Bock & Levelt, 1994). Defining the identified processing scope in terms of syntactic structure building alone would appear to require access of the lemma that is within the second phrase, the head phrase, while

[1] We use the term *subject phrase* when referring to both our English and Japanese sentences to avoid repetitious use of *subject or topic phrase*. The initial Japanese phrase in our experiments was a topic phrase.

[2] The following subscript abbreviations are used in Japanese sentences: $_{\text{GEN}}$–genitive, for the particle *no*; $_{\text{CONJ}}$–conjunctive, for the particles *to* and *mo*; $_{\text{TOP}}$–topic, for the particle *wa*; $_{\text{PART}}$–particle, for the particle *hoo*.

[3] We have used the term *preposition* to refer both to Japanese postpositions and English prepositions. In some cases, we had to use one term to refer to the *prepositional phrases* in both languages and felt it was easier to maintain one term throughout the article.

limiting the creation of syntactic structure to the initial phrase, a subordinate phrase.

In order to clarify what level of processing was controlled by this scope and whether our tentative definition was appropriate, we conducted five experiments to test more vigorously whether, as hypothesized, lexical access is the cause of the effect reported in the earlier article. In order to do this, we used a different technique, preview. First, therefore, we provide a short review of previous use of the technique along with a pre-experiment to test the basic supposition behind this technique.

Picture Preview

The preview technique we used is similar to that used by Smith and Wheeldon (1999) in their Experiment 5. This consists of displaying in advance one or more of the pictured objects that will appear in the upcoming picture stimulus display. The aim is to activate lexical information associated with that object in advance of utterance planning in order to investigate how such information affects planning. The basic premise is that the preview of information that is required for planning prior to speech onset will expedite those planning processes and result in faster speech onset latencies. Alternatively, the previewing of information that is not required prior to utterance onset will have little or no influence on pre-utterance planning and thus little effect on speech onset latencies. Preview can, therefore, be used as a means of testing the scope of the planning that occurs prior to speech onset. These assumptions are similar in nature to those made for interfering stimuli.

In previous use, the picture preview technique has been shown to reduce the time used in planning prior to speech onset. Schriefers, de Ruiter, and Steigerwald (1999) showed that preview of either the color or the object in a picture leads to facilitation when a colored picture is used to elicit a phrase consisting of determiner–color adjective–noun (e.g., *der rote Tisch* [the red table]) or adjective–noun (e.g., *roter Tisch* [red table]). This suggests that preview has removed or reduced the processing costs associated with accessing the adjective or noun prior to utterance onset and thus that accessing both is part of planning prior to speech onset. It can therefore be claimed that the scope of planning prior to utterance onset includes some processing of both items in the phrase.

Smith and Wheeldon (1999) used the preview technique in two experiments that formed part of a series in which they investigated the scope of planning in speech production. In an experiment in which different picture movements were used to stimulate different utterances, Smith and Wheeldon (1999) previewed all three objects in the stimulus display for 2,000 ms prior to onset of movement. The movement was designed to stimulate utterance of either a simple–complex sentence such as "The dog moves up and the foot and the kite move down" or a complex–simple sentence such as "The dog and the foot move up and the kite moves down" (Experiment 4). The same sentences had been compared in an experiment in which preview was not used (Experiment 2), and a substantial difference in onset latencies had been found.

The picture preview led to greatly decreased speech onset latencies overall compared with those in their Experiment 2, suggesting that the pictured objects had received substantial processing during the preview interval. It is more interesting, however, that they found that the difference in sentence onset latencies they had previously observed between the same sentence types (Experiment 2) was greatly reduced when all the pictured objects were previewed. In their Experiment 1, they had shown that difference in onset was sensitive to the size of the subject phrase by showing that onset to a phrase such as "The dog and the foot move above the kite" was slower than to "The dog moves above the foot and the kite." They had concluded from this experiment that the subject phrase is more thoroughly processed than later parts of the sentence. This suggested that the difference in onset for the two sentence types used in Experiments 2 and 4 also resulted from the difference in length of subject phrase. Thus, the reduction in difference in the onset between these two types of sentences is likely related to pre-utterance onset accessing of the conceptual and lexical information associated with the pictures of the subject phrase.

The assumption made in the experiments reviewed has been that preview results in lexical access of the word associated with that picture. Given the importance of this assumption in the interpretation of results, we conducted a pre-experiment to find more support for this assumption.

Pre-Experiment

Aim

The aim of this experiment was to ascertain whether preview in the form of a written word would engender the same or different effects than preview in the form of a picture. The assumption was that the word preview would engender lexical access and thus conceptual access as well. If both types of preview speeded onset and there was no difference in effect, this would constitute evidence that preview of pictured objects results in lexical access of the name associated with the picture. If that were not the case, a lesser effect for the picture preview could be expected on the basis that the word preview would at least cause access to the phonological, lemma, and conceptual levels, but a picture preview might only affect the conceptual level.

Method[4]

A CNP sentence pattern (Sentence 4) was tested. On all trials, only the first picture to be named was previewed. Preview consisted of either the printed word or the picture itself for the object that elicited the first word in the sentence.

(4) *Inu to kasa wa aka desu.*

[Dog and umbrella $_{\text{TOP}}$ red are.]

[The dog and the umbrella are red.]

Materials. Simple black and white drawings of familiar objects were used. The pictures were mainly taken from Snodgrass and Vandervart's (1980) picture norms, with the remainder being free drawn in a similar style. All had been extensively tested in a simple picture-naming paradigm in English (cf. Wheeldon, 1989; Wheeldon & Monsell, 1992), but none of the pictures had, to our

[4] The experimental design used in the five main experiments was the same as that used in the pre-experiment. We therefore report details of that methodology here but only report significant variations in later experiments.

knowledge, been used with Japanese subjects before. Therefore, an initial norming session, simple naming of the pictures, was conducted with 26 subjects to establish average naming latencies and error rates. The results were used in the selection and matching of items for Japanese experiments. We calculated word frequencies using the Nippon Telegraph and Telephone corpus (Amano & Kondo, 2000), which is based on all the words appearing in 10 years of newspaper articles in the *Asahi Shimbun*. The kanji (Chinese character) and kana (syllabary) tokens for any one word were totaled, and that total was divided by the total number of tokens in the corpus. The log of this figure was used for matching purposes. While this corpus is far from ideal, extensive inquiries revealed that, at that time, there was no better corpus publicly available. The word length for Japanese words was based on the number of moras.

A total of 48 pictured objects were used. We divided 32 of these into two balanced sets of 16 that were then combined into three unique sets of 16 pairs. In order to create each stimulus pair, we divided the names of the respective pictures into matching sets consisting of 16 words each. These sets were matched for naming latency, standard deviation of naming latency, frequency (log frequency), word length, and error rate. Table 1 shows the data.

Stimulus pairs were made by combining items from each of these different sets, as described in the *Design* section. All pictures had a very high naming reliability as reflected in the average percentage of naming error rates. Due to NESU display limitations, objects were portrayed as black outline drawings against either a white (blank screen color) background or against a colored background. The picture area for each picture was approximately 3.5 cm × 3.5 cm. This area formed a white or colored "box" within an overall default black screen. Pictures with a colored background are hereafter described as "colored" and those with the default screen blank color as "white." Four colors were used: red, blue, green, and brown.

The remaining 16 pictured objects were used to make 48 fillers of the type shown in Sentence 5. This filler type used only the color gray. There were 48 more fillers of the type shown in Sentence 6.

(5) *Ryoo hoo no kitsune wa haiiro desu.*
[Both $_{\text{PART GEN}}$ foxes $_{\text{TOP}}$ gray are.]
[Both foxes are gray.]
(6) *E wa arimasen.*
[Picture $_{\text{TOP}}$ is not.]
[There are no pictures.]

The word preview consisted of the word either in kanji or kana form, depending which was the norm. The word was displayed inside a white box the same size as the pictures, black text on a white background.

Table 1
Matched Data Sets for the Japanese Pre-Experiment

Data	Set 1	Set 2
Naming latency (ms)	790.0	790.0
Standard deviation (ms)	162.0	169.0
No. of moras	2.8	2.7
Error rate (%)	2.1	0.7
Log frequency	2.6	2.6

Apparatus. Subjects were tested individually, seated in a sound-attenuating booth and facing a 17-inch (43.18-cm) Eizo Flexscan monitor (Eizo Corp., Hokuriku, Japan) positioned approximately 90 cm away. A Sennheiser e825s microphone (Sennheiser Electronics, Wedemark, Germany) placed in front of the participant was connected to a NESU-2 box (HASOMED, Magdeburg, Germany), which, in turn, was connected to a Compaq DeskPro Pentium II computer (Hewlett-Packard, Palo Alto, CA) running DOS 6.2 on which reaction time was recorded and to a Sony DTC-55 ES DAT recorder (Sony Corp., Tokyo, Japan) on which the sentence spoken was recorded. The experimenter was seated outside the booth in front of two monitors, one of which showed in real time the same display as the participant was viewing and the other of which displayed progress though the experiment and reaction times. Sound in the booth was monitored from the participant's microphone through earphones. The experiment was controlled by the computer in tandem with the NESU-2 box.

Design. A counterbalanced design was used to enable main comparisons to be made within subjects and within items. Using the balanced sets described in the *Materials* section, we created three unique but equivalent sets. These sets were made by recombining the original matching sets in three different ways. No single word was ever combined with another word twice. As the original set was balanced for naming latency, standard deviation of naming latency, word frequency, word length, and naming error rate, each of these recombined sets was also balanced for these variables. Care was taken that as far as possible any two adjacent items did not share phonological similarity or have any obvious semantic relation. For example, words that shared onset or offset were not placed adjacent nor were words that came from the same semantic category, for example, two animal names. This was to minimize possible interword phonological or semantic priming or inhibitory effects that might differentially affect conditions (cf. Costa, Navarette, & Alario, 2006; Smith & Wheeldon, 2004). In addition, to keep conditions as close as possible to those of Smith and Wheeldon (1999), short words were used as far as possible.

This design meant, of course, that any single word appeared more than once in experimental items, though never in the same combination of words and, for any one subject, never in the same condition. Given the overall design, it was considered unlikely that such reuse could have any significant effect on naming latency, in particular on differential naming latency dependent on condition. Thus, the combinations were considered unrelated items, and the unit used in the items analysis was picture set (i.e., picture pairs). The assignment of set to condition was rotated across subjects so that, for example, in the case of three conditions, 3 subjects would be needed to provide a complete set of data covering all conditions for all sets. Thus, each subject contributed equally to each condition, and the different stimuli sets were treated as equivalent.

We used fillers that differed in syntactic structure and display from experimental items and from each other to ensure that subjects had to process each stimulus thoroughly and create the appropriate syntactic pattern afresh for each stimulus appearance and also to prevent potential repetition priming effects both for syntactic patterns (cf. Smith & Wheeldon, 2001; Wheeldon & Smith, 2003) and individual words. Each picture appeared in the "both" filler form (Sentence 5) three times. In 32 cases, there was either a picture (16 cases) or word

(16 cases) preview for this type of filler. There were 48 more fillers of the type shown in Sentence 6.

In order to prevent participant fatigue, we divided the 48 stimuli pairs and 96 fillers into four blocks, allowing a rest between each block. Trial items and fillers were apportioned equally to these blocks. Both assignment of items to block and the order of items were pseudorandom. An equal number of items from each set and filler type were randomly assigned to each block, and order was randomly assigned to them with the following restrictions: Trial items did not appear as the first item in any block, two trial items of identical type did not appear consecutively, and two trial items that shared a noun had another, intervening trial item that did not share any nouns with either of them. The first of these restrictions was to avoid possible effects of the break on reaction time, the second to avoid intertrial syntactic priming, and the last to avoid intertrial word priming. There was an average of two fillers between trial items. Finally, where the utterance required the subject to state the color of a picture, use of the same color in consecutive items was avoided.

There were two practice blocks in which each trial picture appeared once in the both filler pattern, the 16 filler pictures combined three ways to make the stimuli for 24 coordinated noun phrases, and 16 blank fillers, making a total of 72 practice trials divided into two blocks of 36 trials. The independent variable was preview (picture, word, none). Preview was confined to the picture stimulus for the first word in each utterance.

Procedure. Prior to the experiment, subjects were informed which picture displays they would see and which sentences they should make in response to each. Printed instructions including picture displays along with the sentences patterns to be made to each display were given to subjects to read before the experiment began. The experimenter then went through the instructions and made the subject speak out the required sentence in response to the printed display. Subjects were informed that there was only one correct sentence pattern for each stimulus. Further, they were informed that each picture had only one correct name. If, in the practice blocks, subjects used an alternative name, this was pointed out to them so they could use the correct name.

The possible picture displays were as follows: for trial items, the coordinated noun phrase, two different pictures of the same color; for quantifier fillers, two identical pictures colored gray; for no picture fillers, two blank squares. These generated the three sentence types shown respectively in Sentence 4, Sentence 5, and Sentence 6.

The timing of each trial was as follows: First, a fixation point appeared on the screen for 1,000 ms. This was followed by either the preview or a blank square of the same size for 1,000 ms in the center of the screen. The vertically aligned stimulus or filler pair then appeared in the center of the screen for 3,500 ms. There was a 1,500 ms gap before the next trial began.

Reaction time was automatically recorded by the voice trigger built into the NESU box and the accompanying software installed on the controlling computer. Errors were coded in real time by the experimenter who monitored subject performance through earphones while watching the same display as the subject on one monitor and monitoring the recording of reaction time and progress through the experiment on a second monitor. All experiments were recorded on digital audiotape to allow later checking or further analysis.

Subjects. All subjects were students at Rikkyo University who were native speakers of Japanese and had normal or corrected-to-normal vision. All subjects were paid ¥1000 (approximately $10.70) per experiment. In all the experiments reported, no subject took part more than once. We tested 24 subjects, 9 men and 15 women.

Results

Data were excluded in the following cases: Latencies of less than 300 ms or longer than 3,000 ms were regarded as outliers. With latencies of less than 300 ms, it is highly likely that a technical error, premature triggering of the voice key, was missed by the experimenter. With latencies over 3,000 ms, it is possible that some kind of strategy is being used, that the subject simply has a lapse in concentration, or that the voice key has failed to trigger appropriately and the experimenter has missed it. Errors were also excluded. These were categorized into four types: technical errors such as voice key failures or false triggers caused by extraneous noise; use of the wrong picture name; use of incorrect syntax; and nonfluent production, such as repair or hesitation. The latter three were concatenated into one factor, production error, for the analyses explained later. Missing values were replaced with the mean for that condition.

Outliers and technical errors accounted for 0.7% of the data. Production errors accounted for another 3.9% of the data, making a total loss of 4.6% from the reaction time analyses. The means by condition and error rate are shown in Table 2.

Separate analyses were carried out with subjects and items as a random variable, yielding F_1 and F_2 statistics respectively. The units of analysis in the items analysis were picture pairs. The main analysis had the condition preview (picture/word/none) as the independent variable and utterance onset latency and error rate as the dependent variables. Where there were significant main effects, we carried out post hoc pairwise comparisons using the

Table 2
Production Latencies and Error Rates for Target Sentence in the Japanese Pre-Experiment: Inu To Kasa Wa Aka Desu

Condition (preview type)	Latency (ms)	Difference from no preview (ms)	Error rate (%)	Difference from no preview (%)
No preview	1,088		6.5	
Picture (*Inu*)	878	210	3.1	3.4
Word (*Inu*)	863	195	2.1	4.4

Note. *Inu To Kasa Wa Aka Desu* = Dog and Umbrella $_{\text{TOPIC}}$Red Are.

Bonferroni test to identify where the difference lay. Further analyses were carried out to check for effects of strategy or practice with block and condition as the independent variables and utterance onset latency as the dependent variable. Similar analyses of error rate were also performed to check for strategy use with condition as the independent variable and error as the dependent variable.

As can be seen, there was a clear effect of both word and picture preview on utterance latency but no difference between these two types of preview. This pattern was confirmed by the analyses. An analysis of variance (ANOVA) on latencies featuring the variable preview (picture, word, none) showed a main effect for preview, $F_1(2, 46) = 102.4$, $MSE = 3{,}722$, $p < .05$; $F_2(2, 94) = 75.4$, $MSE = 10{,}103$, $p < .05$. Post hoc Bonferroni pairwise comparisons showed that in comparison with the none condition, the 210-ms facilitation for the picture and the 195-ms facilitation for the word conditions were significant in both subject and item analyses, $p < .05$. However, the 15-ms difference between the word and picture conditions was not significant.

Percentage error rates are also given in Table 2. As can be seen, they varied in line with the latency data. An ANOVA on error rates featuring the variable preview (picture, word, none) showed a main effect by subjects and by items, $F_1(2, 46) = 6.3$ $MSE = .00$, $p < .05$; $F_2(2, 94) = 4.6$, $MSE = 0.1$, $p < .05$. Post hoc Bonferroni pairwise comparisons showed that in comparison with the none condition, the error rate for picture was not significant in either analysis, but the error rate for word was significant in both analyses, $p < .05$. The 1% difference between the word and picture conditions was not significant in either analysis.

In order to determine whether subjects' performance remained consistent across the experiment, we conducted an ANOVA including the variables block position (1 to 4) and preview (picture, word, none). This analysis yielded neither a main effect of block position, F_1 and $F_2 < 1$, nor any interaction with preview, F_1 and $F_2 < 1$.

Discussion

The results of the pre-experiment show clearly that previewing the name of an item shown in a picture facilitates sentence onset latency to the same degree as previewing the picture itself. Given the fact that written word preview results in full activation of the lexical representation, and most likely the conceptual representation, the most probable interpretation is that picture preview also activates the lexical level.

Main Experiments

In this section, we describe the five main preview experiments, which were designed to test the scope of lexical access in sentence structures similar to those tested in our earlier article (Allum & Wheeldon, 2007). Experiment 1 tested the extent of lexical access in sentences with a subject phrase that consists of a CNP in Japanese. Experiment 2, conducted in conjunction with Experiment 1, ruled out a visual grouping explanation of the results through use of the same display to test an alternative structure available to Japanese speakers, one that has a different conceptual and syntactic structure and that is typically considered a "listing" structure. Experiment 3 tested the same sentence structures as Experiment 1 in English. Experiments 4 and 5 tested sentences with subject phrases consisting of a noun phrase modified by a prepositional phrase in both English and Japanese. Scope of lexical access was shown to be a function of the relationship between the two phrases that form the subject or topic phrase.

Experiment 1

Aim

Our aim in Experiment 1 was to investigate whether lexical access for both items in a CNP is part of pre-utterance planning.

Method

We investigated the extent of lexical access prior to utterance onset by looking for an effect of preview of each of these two nouns on utterance onset latency. Experiment 1 was conducted in conjunction with Experiment 2, which was designed to ensure that any results were not a result of the visual display used as the stimulus. Experiment 2 is described in a later section followed by a comparison of both experiments.

Materials. Materials were drawn from the set of pictures described in the pre-experiment.

Apparatus. Apparatus was the same as for the pre-experiment.

Design. Two balanced sets of 16 pictured objects were made following the principles described in the pre-experiment. Data for these sets are in Table 3. The sets were recombined into three sets making 48 trial pairs altogether. The trial sentence pattern had a CNP subject phrase (Sentence 7).

(7) [*Inu to*] [*kabin wa*] *aka desu*.
[Dog $_{\text{CONJ}}$ vase $_{\text{TOP}}$ red are.]
[The vase and the dog are red.]

There were 96 fillers made from the 48 pictured objects other than those used on experimental trials. Each picture appeared in three fillers, once in a quantifier sentence and twice in PP sentences, but in a different position, above or below, each time and in a different pairing. The fillers consisted of the patterns in Sentence 8 and Sentence 9.

(8) [*Uma no ue no tokei wa*] *aka desu*.
[Horse $_{\text{GEN}}$ above $_{\text{GEN}}$ clock $_{\text{TOP}}$ red is.]
[The clock above the horse is red.]
(9) [*Ryoo hoo no tokei wa*] *ao desu*.
[Both $_{\text{PART GEN}}$ clocks $_{\text{TOP}}$ blue are.]
[Both clocks are blue.]

Table 3
Matched Data Sets for Experiments 1, 2 and 5: Japanese Coordinated Noun Phrase Subject, Listing Construction (MOMO), and Prepositional Phrase Subject

Data	Set 1	Set 2
Naming latency (ms)	789.0	790.0
Standard deviation (ms)	168.0	163.0
No. of moras	2.7	2.7
Error rate (%)	1.4	1.5
Log frequency	2.6	2.6

Note. MOMO = *mo . . . mo*.

The possible picture displays were as follows: for trial items, CNPs, two colored pictures; for PP fillers, a colored picture above or below a white picture; and for quantifier fillers, two identical pictures of the same color. All pictures were vertically aligned at the center of the screen.

Procedure. The timing of each trial was as follows: First, a fixation point appeared on the screen for 1,000 ms. This was followed by either the preview picture or a blank square of the same size for 1,000 ms in the center of the screen. The vertically aligned stimulus or filler pair then appeared in the center of the screen for 3,500 ms. There was a 1,500 ms gap before the next trial began.

Subjects read an explanation of the experimental procedure before beginning. This contained printed pictures of the displays for each sentence type, which the experimenter used to check whether the subjects had the right response to each display.

Subjects. In order to allow a strong comparison to be made between Experiments 1 and 2, we conducted the experiments in tandem, and subjects were randomly assigned to each experiment. Subjects assigned to Experiment 1 were 11 men and 13 women.

Results

Outliers and technical errors accounted for the loss of 0.3% of the data. Production errors resulted in the exclusion of a further 7.3% of the reaction time data, making a total loss of 7.6%. Production latencies and error rates are displayed in Table 4.

There was a clear effect for preview of both nouns, though that for preview of the second noun was smaller. The main effect of preview was significant, $F_1(2, 46) = 28.16$, $MSE = 3{,}253$, $p < .05$; $F_2(2, 94) = 53.41$, $MSE = 3{,}430$, $p < .05$. Post hoc Bonferroni pairwise comparisons showed that the 74-ms difference in latency to the Noun 1 and Noun 2 preview conditions was significant, $p < .05$, as was the 122-ms difference in latency between the Noun 1 and no preview conditions, $p < .05$. The 48-ms difference in latency between the Noun 2 and no preview conditions was also significant, $p < .05$. Analysis of percentage error rates yielded no significant results.

Subjects' latencies reduced as the experiment progressed as shown by a main effect of block order, $F_1(3, 141) = 2.94$, $MSE = 12{,}565$, $p < .05$; $F_2(3, 141) = 2.81$, $MSE = 26{,}302$, $p < .05$ (Block 1: 1,057 ms; Block 2: 1,031 ms; Block 3: 1,004 ms; Block 4: 1,017 ms). However, there was no interaction of this variable with the preview condition, F_1 and $F_2 < 1$.

Discussion

Experiment 1 shows that preview of the first and second noun in a CNP subject sentence reduces latencies, with the effect of second noun preview being significantly less than that for the first noun. This result indicates that both nouns in a CNP subject are processed to some degree before utterance onset. The difference in effect between preview for first and second nouns appears to indicate that a greater degree of processing occurs for the first noun than for the second noun before sentence production is initiated. This finding is taken up in more detail in the General Discussion section.

However, it is also possible that the scope of processing adopted by speakers in Experiment 1 was determined by the visual grouping of the pictures by color rather than by the linguistic properties of the sentences to be produced. In other words, grouping by color may have induced subjects to retrieve the names of both items. We provided some evidence against this in a pre-experiment in which we showed that there was no difference in onset to a CNP phrase that was stimulated by a visual display consisting of two pictures of the same color and one stimulated by a display consisting of one white and one colored picture. In this case, the trigger for a CNP phrase was horizontal as opposed to vertical alignment of the pictures. However, we designed Experiment 2 to further test this possibility by using the same visual displays to elicit an alternative "coordinating" construction that is available to speakers of Japanese as well as to look at other factors that might define the type of phrase that affects scope of lexical access. The structure used may be best described as a listing structure, one in which the relationship between the two nouns is both syntactically and semantically different from that in the coordination used in Experiment 1. These differences are discussed in detail later. We predicted that this structure would yield different results to those observed in Experiment 1, with an effect of preview to the first noun in the list but not to the second. Thus, there should be a difference in effect for second noun preview compared with that in the CNP sentences. As identical visual displays were used to elicit the sentences in both experiments, any differences could not be explained by the strategic grouping of pictures by color.

Experiment 2

Aim

The main aim was to see whether the use of a different sentence structure stimulated by the same display as Experiment 1 would allow us to rule out a visual grouping explanation of the pattern of results observed so far. A secondary aim was to see whether factors other than function alone might be involved in defining the identified scope of planning.

As mentioned earlier, Japanese has an alternative construction that allows the issue of visual grouping and locus of the effect

Table 4
Production Latencies and Error Rates for Target Sentence in Experiment 1 for Japanese Coordinated Noun Phrase: Inu To Kabin Wa Aka Desu

Preview condition	Latency (ms)	Difference from no preview (ms)	Error rate (%)	Difference from no preview (%)
No preview	1,084		8.0	
Noun 1 (*Inu*)	962	122	7.0	1.0
Noun 2 (*Kabin*)	1,036	48	7.5	0.5

Note. *Inu To Kabin Wa Aka Desu* = Dog $_{\text{CONJUNCTIVE}}$ Vase $_{\text{TOPIC}}$ Red Are.

found in the CNP phrases to be investigated further. This is "coordination" using the particle *mo*, which can be seen as a listing structure. This structure has subtle conceptual and syntactic differences from the coordinating structure *to . . . wa*. The coordination effected by *to* typically binds the two items closely as a set. The use of *wa* in this structure is often contrastive. Thus, the coordinated items are bound as a unit and contrasted with other items that have the potential to be grouped in the same set. The *mo . . . mo* listing is open ended in the sense that the two items grouped are not seen as being so closely bound and there is no strong sense of them having a single identity that can be contrasted with other possible members of the set. Instead, the items in this structure are seen as sharing a commonality with each other and with other possible members of the set that have not been mentioned but could just as easily have been. The items in such a set play the same thematic role in the sentence as items bound in the *to . . . wa* coordinating construction, but the concept is different. For example, if the topic was the quality of private universities in the Tokyo area, we might say *Keio daigaku to Waseda daigaku wa sugurete imasu* [Keio University and Waseda University are excellent]. This could easily imply that Keio and Waseda universities are excellent in contrast to others in the same area. The listener would often expect a contrast, spoken or implied. If we said *Keio daigaku mo Waseda daigaku mo sugurete imasu* [Keio University and Waseda University are excellent universities (as well)], the implication is that there may well be others that are equally excellent.

Another sentence that points up the contrast between these two sentences is *Akai isu mo tsukue mo ki de dekite iru* [The red chair and the desk are made of wood]. In this structure, the color adjective (*akai*) does not extend to the second noun in the listing phrase. In contrast, if the same two items were conjoined by the *to . . . wa* construction, the word *akai* [red] could modify both, just as in the English coordinating construction. Thus, the scope of application of adjectives differs between the two constructions.

There are two potentially interesting points of contrast between these two structures. The first is the contrast in semantics explained previously. The *mo . . . mo* construction may be seen as a looser binding, a listing; there is, therefore, a conceptual difference. The second is the syntactic structure (see Figure 1). It has been suggested that *mo . . . mo* can be seen as more of a listing structure. Whereas in the *to . . . wa* structure, the two noun phrases within the CNP are bound together under one noun phrase node, in the *mo . . . mo* construction, the two noun phrases that form a conjunction can be seen either as two noun phrases subsumed under the noun phrase node but not bound as a unit or as separate noun phrase nodes that are directly attached to the clause structure as individual noun phrases, as represented in Figure 1.

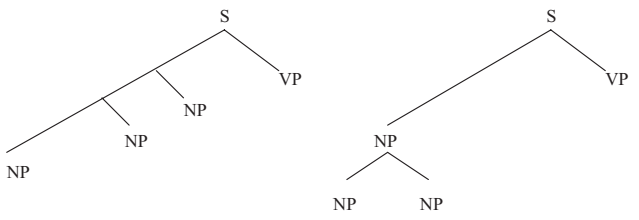

Figure 1. Syntactic structure of *mo . . . mo* listing structure (left) and *to . . . wa* coordinating structure (right). NP = noun phrase; S = sentence; VP = verb phrase.

The conceptual and syntactic differences between *mo . . . mo* listing and *to . . . wa* coordination suggest that they may behave differently. Given the greater conceptual and syntactic separation of the two items in the *mo . . . mo* listing, we could predict that the two units could behave as independent units as far as controlling lexical access is concerned. However, the visual grouping used to elicit *mo . . . mo* coordination would remain the same as that for *to . . . wa*.

Method

Experiment 2 was identical to Experiment 1 except that subjects (9 men and 15 women who were randomly assigned to the experiment) were instructed to use the listing construction *mo . . . mo* (MOMO) as in Sentence 10. If visual grouping by color or thematic role is a critical factor in defining planning scope, then the effects of preview would be similar to those for the coordinated noun phrase. If degree of either semantic or syntactic binding is important, then with the MOMO structure, no effect would be expected for second noun preview, in contrast to the effect in the CNP sentences.

(10) *Inu mo kabin mo aka desu.*
[Dog $_{\text{CONJ}}$ vase $_{\text{CONJ}}$ red are].
[The dog and the vase are red.]

Results

Examination of Experiment 2 findings. Outliers and technical errors accounted for the loss of 0.6% of the data. Production errors resulted in the exclusion of a further 6.0%, making a total loss of 6.6% of data from the reaction time analyses. Production latencies and error rates are shown in Table 5. The results are very different from those in Experiment 1. There was a clear facilitatory effect for preview of the first noun, but the effect for preview of the second noun was inhibitory in direction.

An ANOVA on latencies featuring the variable preview (Noun 1, Noun 2, no preview) showed a main effect for preview, $F_1(2, 46) = 38.91$, $MSE = 1{,}775$, $p < .05$; $F_2(2, 94) = 14.65$, $MSE = 8{,}914$, $p < .05$. Post hoc Bonferroni pairwise comparisons showed that the 102-ms difference in latency to the Noun 1 and Noun 2 preview conditions was significant both by subjects and items, $p < .05$, as was the 72-ms difference in latency between the Noun 1 and no preview conditions, $p < .05$, for subjects and items. The 30-ms difference in latency between the Noun 2 and no preview conditions was not significant in either analysis.

An analysis on block position showed a main effect in both analyses, $F_1(3, 69) = 2.51$, $MSE = 12{,}935$, $p < .05$; $F_2(3, 141) = 3.65$, $MSE = 17{,}773$, $p < .05$. Subjects got faster as they progressed through the experiment. However, there were no interactions with preview, F_1 and $F_2 < 1$.

An analysis of error rates showed a significant effect of phrase type by items, $F_2(2, 94) = 3.22$, $MSE = .01$, $p < .05$, but not by subjects, $F_1(2, 46) = 2.66$, $MSE = .00$. This reflects the fact that subjects were approximately twice as likely to make an error in the no preview condition.

Comparison of results of Experiments 1 and 2. We compared results from Experiments 1 and 2 by putting data from both into an ANOVA with the independent variables phrase type (CNP, MOMO) and preview (Noun 1, Noun 2, no preview). There was no main effect for phrase type by subjects, $F_1(1, 46) = 0.64$, $MSE = 69{,}706$, $p < .05$, but there was by items, $F_2(1, 94) = 235.76$,

Table 5
Production Latencies and Error Rates for Target Sentence in Experiment 2 for Japanese Listing Construction (MOMO): Inu Mo Kabin Mo Aka Desu

Preview condition	Latency (ms)	Difference from no preview (ms)	Error rate (%)	Difference from no preview (%)
No preview	1,006		8.6	
Noun 1 (*Inu*)	934	72	4.9	3.7
Noun 2 (*Kabin*)	1,036	−30	4.4	4.2

Note. *Inu Mo Kabin Mo Aka Desu* = Dog $_{\text{CONJUNCTIVE}}$ Vase $_{\text{CONJUNCTIVE}}$ Red Are; MOMO = *mo . . . mo*.

MSE = 5,159, $p < .05$. Subjects in the MOMO experiment were a little faster. Unsurprisingly, there was also a main effect of preview in both analyses, $F_1(2, 92) = 42.05$, *MSE* = 3,285, $p < .05$; $F_2(2, 188) = 44.75$, *MSE* = 6,172, $p < .05$. Most important, there was a clear interaction between phrase type and preview, $F_1(2, 92) = 5.73$, *MSE* = 18,807, $p < .05$; $F_2(2, 188) = 6.09$, *MSE* = 37,616, $p < .05$.

We did planned comparisons to find the locus of the interaction. In a comparison of effect of first noun preview in relation to no preview, there was a main effect of phrase type by items but not by subjects, $F_1(1, 46) = 1.43$, *MSE* = 46,687; $F_2(1, 94) = 21.60$, *MSE* = 6,163, $p < .05$. Mean onset latencies to the MOMO construction were a little faster overall. The effect of preview was significant, $F_1(1, 46) = 86.71$, *MSE* = 2,611, $p < .05$; $F_2(1, 94) = 91.78$, *MSE* = 4,934, $p = < .05$. There was also an interaction of phrase type and preview, $F_1(1, 46) = 5.97$, *MSE* = 15,594; $F_2(1, 94) = 6.32$, *MSE* = 31,190, $p < .05$. The 122-ms reduction in onset in the CNP construction was significantly greater than the 72-ms reduction in the MOMO construction.

A comparison of second noun preview with no preview again showed a main effect for phrase type by items but not by subjects, $F_1(1, 46) = 0.71$, *MSE* = 52,124; $F_2(1, 94) = 9.01$, *MSE* = 8,174, $p < .05$. There was no main effect for preview, F_1 and $F_2 < 1$, but the interaction of phrase type and preview was significant, $F_1(1, 46) = 9.43$, *MSE* = 36,461, $p < .05$; $F_2(1, 94) = 10.37$, *MSE* = 72,927, $p < .05$.

Discussion

Experiment 2 showed that preview of the second noun in a subject phrase with the MOMO listing structure leads to no latency benefit. It seems, then, that lexical access for the second noun does not take place before utterance onset. This is in strong contrast with preview of the second noun in a CNP.

The results from Experiment 2 ruled out the possibility that the effect in the CNP resulted from the nature of the display. This experiment also provided further evidence concerning the nature of the phrase that determines the scope of lexical access. In an earlier article (Allum & Wheeldon, 2007), we suggested that the reason a CNP is processed as a unit is that it represents a minimal single functional unit within the thematic or conceptual representation of the utterance. However, the results of Experiment 2 may indicate that closeness of conceptual or syntactic binding, not thematic role alone, affects the scope of planning, in particular the scope of lexical processing. This issue is discussed in more detail in the General Discussion.

Experiment 3

Aim

Our aim in the next experiment was to confirm that a similar planning scope held for English CNP sentences as for Japanese, thus supporting the claim that the results in Allum & Wheeldon (2007) were largely a result of the process of lexical access in both languages. We also wished to compare the CNP structure with the PP structure in both languages, so a contrast could be made between a phrase with two heads (the CNP phrase) and one that had a head phrase and a subordinate phrase, and, a further contrast could be made between a sentence in which the head phrase was initial (English PP; Experiment 4) and one in which the head phrase was final, (Japanese PP; Experiment 5).

Method

The effect of preview on the production of CNP sentences such as Sentence 11 was tested.

(11) The duck and the spanner are green.

As argued earlier, these sentences start with a verb argument phrase that contains two phrases that are both head phrases and that, therefore, forms one functional unit representing the theme in the conceptual plan. In addition, given the comparison between Japanese MOMO and CNP phrases, they may be thought of as two phrases that are both syntactically and conceptually closely bound. In Allum and Wheeldon (2007), we showed that latency to a subject phrase consisting of a head noun phrase modified by a PP is faster than that to a CNP, whether in Japanese or English. The prediction was that preview to the second noun should have a substantial effect.

Materials. As with the Japanese experiments, simple black and white drawings of familiar objects were used. The pictures were mainly taken from Snodgrass and Vandervart's (1980) picture norms, with the remainder being free drawn in a similar style. All had been extensively tested in a simple picture naming paradigm (cf. Wheeldon, 1989; Wheeldon & Monsell, 1992). The naming latencies and percentage error rates used in the selection and matching of pictures were based on this data. Word frequencies were calculated by averaging the orthographic token and stem frequency count for noun uses in Kucera and Francis (1967), the orthographic token count from Hofland and Johansson (1982), and the same count summed with the count for any orthographic tokens that could be considered the stem noun plus suffix. Word length was calculated on the basis of number of syllables.

Eighty of these pictures were used, 32 of which were used as experimental trial pictures. One experimental stimulus consisted of

two pictures. Set creation and matching followed the same principles as those described in the pre-experiment. Data for the sets are displayed in Table 6. We made stimulus pairs by combining items from each of these different sets as described in the *Design* section of the pre-experiment. We used 48 different pictures to make 96 filler sentences (Sentence 12 and Sentence 13).

Displays for the coordinated noun phrases were aligned horizontally and those for the fillers, vertically. It was thought that this would enable easier distinction between the quantifier filler displays, in which the color was the same for both pictures and the pictures were the same, and the coordinated trials, in which the color was the same but the pictures were different. It also bought the target display closer to the display used in Smith and Wheeldon (1999) and, arguably, provided a stronger impetus to always name the pair from the left, as left-to-right processing is part of English reading processes.

Apparatus. The apparatus set-up was the same as that for the pre-experiment with the following minor hardware differences: The display for subjects was a Gateway 2000 15-inch (38.1-cm) monitor (Gateway, Inc., Irvine, CA). A Sennheiser e825s microphone was used; the controlling computer was a Gateway G6-266.

Design. The 96 fillers were made from 48 different pictures. Each picture appeared in 3 fillers, twice in a PP sentence (Sentence 12) and once in a quantifier sentence (Sentence 13). In the former case, they appeared in a different position, above or below, each time and in a different pairing.

(12) The horse above the clock is brown. (PP)

(13) The two babies are blue. (quantifier)

The 48 stimuli pairs and 96 fillers were divided into four blocks following the same principles used in the pre-experiment. In addition to experimental blocks, there were two practice blocks. In these blocks, all the trial pictures appeared, once as a quantifier filler (Sentence 13) and once as a PP filler (Sentence 12) but in a different pairing than when they appeared in the trial condition. All filler pictures appeared twice but in the trial experiment structure (CNP) and were paired differently each time. This made 96 practice trials altogether, divided into two blocks of 48. Conditions were first noun preview, second noun preview, or no preview.

Procedure. The possible picture displays were as follows: for trial items, two different pictures of the same color horizontally aligned; for the PP filler, a colored picture above or below a white picture; for quantifier fillers, two identical pictures of the same color vertically aligned. These generated the three sentence types shown respectively in Sentence 11, Sentence 12, and Sentence 13.

The timing of each trial was as follows: First, a fixation point appeared on the screen for 1,000 ms. This was followed by either the preview picture or a blank square of the same size for 1,000 ms in the center of the screen. The stimulus or filler pair then appeared in the center of the screen for 3,500 ms. There was a 1,500 ms gap before the next trial began.

Subjects. There were 11 men and 19 women.

Table 6
Matched Data Sets for Experiments 3 and 4: English Coordinated Noun Phrase and Prepositional Phrase Subjects

Data	Set 1	Set 2
Naming latency (ms)	566.0	567.0
Standard deviation (ms)	180.0	181.0
No. of syllables	1.6	1.7
Error rate (%)	0.2	0.5
Log frequency	2.3	2.3

Results

Outliers and technical errors accounted for a loss of 1.2% of the data. Production errors resulted in the exclusion of a further 8.0% of the data, making a total loss of 9.2%. Production latencies (see Table 7) show a substantial effect of preview for both the first noun and second noun.

The main effect of preview was significant, $F_1(2, 58) = 33.72$, $MSE = 3{,}197$, $p < .05$; $F_2(2, 94) = 25.69$, $MSE = 6{,}715$, $p < .05$. Post hoc Bonferroni pairwise comparisons showed that the 120-ms difference in latency between the Noun 1 and no preview conditions was significant, $p < .05$ for both subjects and items analyses. The 60-ms difference in latency to the Noun 1 and Noun 2 preview conditions was also significant both by subjects and items, $p < .05$, as was the 60-ms difference in latency between the Noun 2 and no preview conditions, $p < .05$.

Percentage error rates also showed a significant main effect of preview, $F_1(2, 58) = 4.83$, $MSE = 0.00$, $p < .05$; $F_2(2, 94) = 4.43$, $MSE = 0.01$, $p < .05$. Post hoc Bonferroni pairwise comparisons showed that the difference in error rate between the Noun 1 and Noun 2 preview conditions was not significant. However, the difference in error rate between the Noun 1 and no preview condition was borderline significant by subjects, $p = .08$, and by items, $p = .06$. The difference in error rate between Noun 2 and no preview conditions was significant by subjects, $p < .05$, and borderline by items, $p = .06$. This indicates that subjects found it more difficult to produce utterances in the slowest condition, no preview. An analysis including block position showed a main effect by subjects, $F_1(3, 87) = 2.87$, $MSE = 14{,}042$, $p < .05$; $F_2(3, 141) = 3.31$, $MSE = 27{,}656$, $p < .05$. Subjects speeded up in the second half of the experiment. However, there were no interactions.

Discussion

Experiment 3 indicated that in English, as in Japanese, the second noun in a CNP is accessed and processed to a substantial degree before utterance onset. The results again show that the effect of preview of the second noun is not as great as that of the first noun.

Experiment 4

Aim

In Allum & Wheeldon (2007), we showed that onset to a PP subject phrase was faster than that to a CNP subject phrase. Here, we tested whether lack of lexical processing in the second phrase within the subject phrase contributes to this difference by investigating PP subject phrases and then contrasting the results with those from the sentences with CNP subject phrases.

Method

We used preview to probe extent of lexical processing prior to utterance onset in sentences like Sentence 14 and Sentence 15.

Table 7
Production Latencies and Error Rates for Target Sentence in Experiment 3 for English Coordinated Noun Phrase Subject: The Duck and the Spanner Are Green

Preview condition	Latency (ms)	Difference from no preview	Error rate (%)	Difference from no preview
No preview	955		11.2	
Noun 1 (Duck)	835	120	6.7	4.5
Noun 2 (Spanner)	895	60	6.9	4.3

(14) The dog above the table is green.

(15) The fish below the hat is blue.

We previewed the pictures that stimulated utterance of the nouns in the subject phrase (e.g., either *dog* or *table* in Sentence 14 or *fish* or *hat* in Sentence 15) to look for differential effects on speaking latency. If lexical access for the whole subject phrase occurs before utterance onset, significant facilitation effects for preview of either *dog* or *table* would be expected. However, if as predicted, it is necessary to fully access the words only in the initial functional phrase or a phrase that forms a closely bound syntactic and semantic unit, a substantial effect for the preview of *dog* would be expected but little or no effect for the preview of *table*.

Materials. The materials were the same as those in Experiment 3. We converted the CNP trials by altering the coloring and orientation of the pictures so that a white picture appeared above or below a colored one. The PP fillers were converted to CNP fillers. We did not continue with horizontal display of the CNP stimuli as this had little effect on error rate and would not affect processing of the trial stimuli, which were clearly distinct.

Apparatus. Apparatus was the same as for Experiment 3.

Design. Design was the same as that for Experiment 3, except that, as mentioned earlier, fillers for this experiment consisted of CNP or quantifier sentences such as Sentence 16 and Sentence 17.

(16) The horse and clock are brown. (CNP)

(17) The two babies are blue. (quantifier)

Procedure. Procedure was the same as for Experiment 3.

Subjects. There were 12 men and 18 women who participated in the experiment.

Results

Examination of Experiment 4 results. Outliers and technical errors accounted for 0.3% of the data. Production errors accounted for another 7.9% of the data, making a total loss of 8.2%. The units of analysis in the items analysis were picture pairs. Mean production latencies are given in Table 8. There is a large facilitation effect for preview of the first noun but no facilitation for preview of the second noun.

An ANOVA on latencies featuring the variable preview (first noun, second noun, none) showed a main effect for preview, $F_1(2, 58) = 13.87$, $MSE = 5{,}950$, $p < .05$; $F_2(2, 94) = 24.75$, $MSE = 5{,}335$, $p < .05$. Post hoc Bonferroni pairwise comparisons showed the effect of first noun preview was significant in both subject and item analyses, $p < .05$. The effect of second noun preview was not significant in either analysis. Finally, the 92-ms difference in latency between the first noun and second noun preview conditions was significant both by subjects and items, $p < .05$.

Error rates varied in line with the latency data, providing no evidence of a speed–accuracy trade-off. An analysis of percentage error rates yielded no significant effects. An analysis including the variable block position also yielded no significant main effect or interactions with preview.

Comparison of English CNP and PP results. To investigate the difference in pattern between the English CNP and English PP experiments, we put data from both into an ANOVA. There was a main effect for phrase type by subjects and items, $F_1(1, 58) = 17.57$, $MSE = 63{,}190$, $p < .05$; $F_2(1, 94) = 181.56$, $MSE = 9{,}784$, $p < .05$. Response times were on average 197 ms slower in the PP condition. There was also, naturally, an effect for preview, $F_1(2, 116) = 38.25$, $MSE = 4{,}574$, $p < .05$; $F_2(2, 188) = 46.46$, $MSE = 6{,}025$, $p < .05$. It is important to note that there was an interaction, $F_1(2, 116) = 3.36$, $MSE = 15{,}364$, $p < .05$; $F_2(2, 188) = 4.08$, $MSE = 24{,}584$, $p < .05$.

Planned comparisons were made. In a comparison of the effect of Noun 1 preview versus no preview, there was a main effect of phrase type, $F_1(1, 58) = 13.87$, $MSE = 42{,}945$, $p < .05$; $F_2(1, 94) = 90.82$, $MSE = 10{,}492$, $p < .05$, and preview $F_1(1, 58) = 68.03$, $MSE = 4{,}806$, $p < .05$; $F_2(1, 94) = 76.84$, $MSE = 6{,}808$, $p < .05$, but no interaction, $F_1(1, 58) = 1.50$, $MSE = 4{,}806$, $p = .23$; $F_2(1, 94) = 1.69$, $MSE = 6{,}808$, $p = .20$. Comparing Noun 2 preview versus no preview, we found there was a main effect of phrase type, $F_1(1, 58) = 16.88$, $MSE = 44{,}027$, $p < .05$; $F_2(1,$

Table 8
Production Latencies and Error Rates for Target Sentence in Experiment 4 for English Prepositional Phrase Subject: The Dog Above the Table Is Green

Preview condition	Latency (ms)	Difference from no preview	Error rate (%)	Difference from no preview
No preview	1,080		8.3	
Noun 1 (Dog)	992	88	6.7	1.6
Noun 2 (Table)	1,084	–4	8.7	–0.4

94) = 163.34, MSE = 7,282, $p < .05$, and preview, $F_1(1, 58) = 7.85$, MSE = 3,055, $p < .05$; $F_2(1, 94) = 6.25$, MSE = 6,136, $p < .05$, and a clear interaction, $F_1(1, 58) = 10{,}06$ $MSE = 3.055$, $p < .05$; $F_2(1, 94) = 8.01$, $MSE = 6.136$, $p < .05$. There was, then, no difference in the effect of preview of first nouns in these two sentence types. However, the 60-ms effect of Noun 2 preview in the CNP sentences was significantly different from the 4-ms effect in PP sentences. Therefore, the difference in effect of preview between these two sentence types lies in the different effect of preview on Noun 2.

Discussion

Experiment 4 showed that preview of the first noun in a subject phrase consisting of two phrases, a noun phrase followed by a modifying prepositional phrase, has a significant effect on latencies while that of the second noun has none. This supports the claim that the results reported in Allum and Wheeldon (2007) derive substantially from lexical access processes and that such processes are controlled by the first phrase (though the MOMO result forces us to redefine this phrase, an issue taken up in the General Discussion). Clearly, there is a difference in how the second noun is processed in these two types of subject phrase.

The comparison shows that onset to the CNP phrases was faster than that to the PP phrases. This anomaly can be explained by the difference in visual display: For the CNP phrases, we used horizontal alignment and for the PP, vertical. The original intention had been to try to reduce error rates. However, horizontal alignment allowed subjects to more quickly apprehend the display as the contrast was greater between target and fillers.[5] This difference was removed in the final experiment.

Experiment 5

It would seem counterintuitive to think there is no lexical access for the word that plays the role of head of the structural phrase while there is for a subordinate phrase; however, in our earlier article (Allum & Wheeldon, 2007), we found that faster onset occurred to a subject or topic phrase consisting of a noun phrase modified by a PP than to one consisting of a CNP phrase in both English and Japanese, though the head is the second noun in Japanese. Head-final languages obviously allow lengthy premodification of the subject head noun. If lexical access prior to utterance onset is seen as limited—that is, if lexical access for all words in a clause is not necessarily equally completed before utterance onset—then it may well also be the case that, in head-final languages at least, lexical access for subordinate elements occurs while that for the relevant head element does not. We tested this idea in our final experiment.

Aim

The aim was to investigate whether pre-utterance lexical processing of the head element of a two-phrase topic phrase could be less thorough than that for the subordinate element that precedes it.

Method

While the sentences used in Japanese maintain a similar hierarchical structure to the English PP sentences in Experiment 4, the linear order is reversed, with the modifying prepositional phrase coming before the subject noun phrase (Sentence 18).

(18) [*Inu no ue no*] [*kabin wa*] *aka desu*.
[Dog $_{\text{GEN}}$ above $_{\text{GEN}}$ vase $_{\text{TOP}}$ red is.]
[The vase above the dog is red.]

If lexical access for the head of the subject phrase is needed in order to plan the first phrase, then a substantial preview effect would be expected for *vase* as well as for *dog*; if there was lexical access for the first phrase alone, the prepositional phrase, then a preview effect for *dog* but none or very little for *vase* would be expected, similar to that obtained in Experiment 4 with English.

Materials. The materials were the same as for Experiment 1. Conversion of the CNP stimuli and fillers was effected in the same way as conversion of stimuli and fillers from Experiment 3 to Experiment 4 in English. The fillers consisted of the patterns in Sentence 19 and Sentence 20.

(19) [*Uma to tokei wa*] *aka desu*.
[Horse and clock $_{\text{TOP}}$ red are.]
[The horse and the clock are red.]
(20) [*Ryoo hoo no tokei wa*] *ao desu*.
[Both $_{\text{PART GEN}}$ clocks $_{\text{TOP}}$ blue are.]
[Both clocks are blue.]

Design and procedure. The design and procedure were the same as those used in Experiment 1, including the design of the practice blocks.

Subjects. Thirty-six subjects were tested: 20 men and 16 women.

Results

Examination of the results of Experiment 5. Outliers and technical errors accounted for a loss of 0.4% of the data. Production errors resulted in the exclusion of a further 6.8% of the data, making a total loss of 7.2%. Condition means are shown in Table 9.

As with the English data, there was a substantial preview effect for the first noun but none for the second. An ANOVA on latencies featuring the variable preview (Noun 1, Noun 2, no preview) showed a main effect for preview, $F_1(2, 70) = 112.30$, MSE = 2,461, $p < .05$; $F_2(2, 94) = 134.19$, MSE = 2,745, $p < .05$. Post hoc Bonferroni pairwise comparisons showed that the 168-ms difference in latency to the Noun 1 and Noun 2 preview conditions was significant both by subjects and items, $p < .05$, as was the 176-ms difference in latency between the Noun 1 and no preview conditions, $p < .05$ for subjects and items. The 8-ms

[5] Evidence supporting this interpretation of the anomaly comes from an earlier Japanese comparison of CNP and MOMO phrases. In work not reported here, we conducted two experiments with exactly the same design as Experiments 1 and 2 except they were conducted separately and the stimuli in the CNP condition were horizontal, whereas those in the MOMO condition were vertical. Onset to CNP phrases was faster. However, as can be seen in the comparison of Experiments 1 and 2 in this article, when the CNP stimuli are vertically aligned, onset to the two types is almost the same but with a tendency for onset to the CNP to be slower. The effects of preview do not change whether the onset is faster or slower, however. Also, in our earlier article (Allum & Wheeldon, 2007), we showed that in a direct comparison within subjects of unpreviewed PP and CNP phrases in English, in which both stimuli were vertically aligned, onset to PP phrases was faster.

Table 9
Production Latencies and Error Rates for Target Sentence in Experiment 5 for Japanese Prepositional Phrase Subject: Inu No Ue No Kabin Wa Aka Desu

Preview condition	Latency (ms)	Difference from no preview	Error rate (%)	Difference from no preview
No preview	916		5.21	
Noun 1 (*Inu*)	740	176	5.47	−0.26
Noun 2 (*Kabin*)	908	8	7.03	−1.82

Note. *Inu No Ue No Kabin Wa Aka Desu* = Dog $_{\text{GENITIVE}}$ Above $_{\text{GENITIVE}}$ Vase $_{\text{TOPIC}}$ Red Is.

difference in latency between the Noun 2 and no preview condition was not significant in either analysis. The difference in percentage error rates across conditions was small, and a similar analysis of percentage error rates yielded no significant effects. An ANOVA on block position featuring the variable preview (Noun 1, Noun 2, no preview) showed no main effect by subjects or items, nor was there any interaction.

Comparison of Japanese CNP and PP results. There was a main effect for phrase type by subjects and items, $F_1(1, 70) = 0$, $MSE = 63{,}190$, $p < .05$; $F_2(1, 94) = 181.56$, $MSE = 9{,}784$, $p < .05$. Response to CNP sentences was 172 ms slower on average. Unsurprisingly, there was also an effect for preview, $F_1(2, 116) = 38.25$, $MSE = 4{,}574$, $p < .05$; $F_2(2, 188) = 46.46$, $MSE = 6{,}025$, $p < .05$. Most important, there was an interaction, $F_1(2, 116) = 3.36$, $MSE = 15{,}364$, $p < .05$; $F_2(2, 188) = 4.08$, $MSE = 24{,}584$, $p < .05$.

Planned comparisons for Noun 1 preview versus no preview showed there was no effect for phrase type by subjects, $F_1(1, 70) = 1.57$, $MSE = 30{,}854$, $p = .21$, but there was by items, $F_2(1, 94) = 16.88$, $MSE = 3{,}834$, $p < .05$. There was an effect for preview, $F_1(1, 70) = 259.84$, $MSE = 2{,}602$, $p < .05$; $F_2(1, 94) = 402.87$, $MSE = 2{,}238$, $p < .05$, and an interaction, $F_1(1, 70) = 5.06$, $MSE = 2{,}602$, $p < .05$; $F_2(1, 94) = 7.84$, $MSE = 2{,}238$, $p < .05$. Comparing Noun 2 preview versus no preview, we found there was no main effect of phrase type, $F_1(1, 70) = 0.00$, $MSE = 29{,}212$; $F_2(1, 94) = 0.00$, $MSE = 0.00$. There was an effect of preview $F_1(1, 70) = 15.84$, $MSE = 1{,}609$, $p < .05$; $F_2(1, 94) = 15.15$, $MSE = 2{,}243$, $p < .05$, and a clear interaction, $F_1(1, 70) = 6.74$, $MSE = 1{,}609$, $p < .05$; $F_2(1, 94) = 6.44$, $MSE = 2{,}243$, $p < .05$. There was, therefore, both a significantly greater effect for preview of Noun 1 in the PP phrases and a significantly greater effect of preview of Noun 2 in the CNP. While the former remains a puzzle that we take up in the General Discussion, the latter fits in with the overall pattern.

Discussion

Experiment 5 showed that it is not necessary, at least in left-branching languages, to thoroughly process the word that is the head of the subject phrase before utterance onset. This supports the conclusion that scope of lexical access is defined by a particular level of phrase, one that is smaller than the whole verb argument phrase, even though such a phrase is subordinate.

General Discussion

Summary of Results

Our aim in the experiments reported here was to test whether scope of lexical access is affected by phrasal grouping. The head-final characteristic of Japanese was of particular importance as it allowed us to see whether lexical access to the head of an initial phrase that played a role in the verb argument structure (in this case, a subject phrase) was necessary prior to utterance onset. The results show that while preview to the first noun in a two-phrase subject phrase always substantially reduces onset latency, the effect of preview to the second noun varies systematically with the relation between the two phrases. In Experiments 1 and 3, it was shown that when the subject phrase consists of a CNP, there is an effect of preview of the second picture to be named, whether in Japanese or English. In Experiment 2, it was shown that with a coordinating structure that has a looser semantic binding and a different syntactic structure than that used in Experiments 1 and 3 (one that may be likened to a listing structure), there is no effect for preview of the second word. This experiment rules out visual coordination in the stimulus display as the cause of any difference in processing scope. In Experiments 4 and 5, it was shown that, for both Japanese and English, in sentences in which the subject phrase consists of a noun phrase modified by a PP, there is no effect of preview of the second picture to be named, thus confirming that lexical access for the head of the initial verb argument phrase is not necessary before utterance onset. Experiments 1 and 3 also show that when there is an effect for preview of a second word, it is significantly smaller than that to the first word.

Analysis

The results support the overall hypothesis that scope of pre-utterance planning is defined by a particular level of phrase. We originally suggested this is a phrase that serves a minimal function either in the thematic or conceptual encoding of the utterance, though we could not rule out a syntactic explanation (Allum & Wheeldon, 2007). We return to this issue later. The key point made in this article is that such a phrase has an effect on the scope of lexical access. Most important, since such a phrase is not necessarily the head phrase of the first argument phrase, we can claim that syntactic ordering processes precede lexical access processes, with the former guiding the latter. This in turn suggests that syntactic information, in particular word-ordering information, must derive, at least in part, from sources other than lexical. The

most likely candidates are conceptual-level processes or an intermediate thematic representation. As discussed earlier, Chang et al.'s (2006) model allows the thematic and syntactic to interact to order accessing of lexical items in the correct order. Our results thus support a model with this kind of mechanism. We elaborate on this later. First, however, we briefly consider two alternative explanations of the locus of the preview effect and look at some issues that require further investigation.

Syntactic Locus of Effect

Smith and Wheeldon (1999) argued that in their experiments, benefits from picture preview are unlikely to have arisen from allowing earlier planning of syntactic processes. They pointed out that in their experiments, preview did not provide information regarding the syntax of the sentence initial phrase. The syntactic structure depended on postpreview movements of the pictures. Thus, syntactic planning related to the whole subject phrase could not have benefited from preview as subjects could not have known in advance whether that would be a single noun phrase, a coordinated noun phrase, or a noun modified by a relative clause. Smith and Wheeldon (2001) also showed that a single noun phrase at the beginning of a sentence (e.g., "The eye moves up and the fish moves down") does not prime a coordinated noun phrase (e.g., "The spoon and the car move up"). Priming would be expected if syntactic structure is created noun by noun (e.g., Ferreira, 2000) since both utterances start with a noun phrase. Their result suggests that syntactic structure for the whole subject phrase (a coordinated noun phrase) is planned as a unit that can be primed by a similar phrase in the previous utterance. Thus, priming of syntactic information associated with lemmas does not seem to be the likely locus of preview effects.

Phonological Locus of Effect

It is unlikely that preview effects can be accounted for solely in terms of phonological benefit. There is evidence that the scope of phonological encoding is limited to a single phonological word (Wheeldon and Lahiri, 1997, 2002). Meyer (1996) found no effect for a phonological interfering stimulus to the second word in a coordinated noun phrase. Costa, Navarette, and Alario (2006) also showed that in a coordinated noun phrase, there is no effect on utterance onset latency when there is a phonological relation of the second word to the first while there is an effect for a semantic relation. Thus, processing to the phonological level of the second word is unlikely to have been part of pre-utterance planning. This, of course, does not mean that preview provides no phonological activation or that such activation cannot be used. It simply means that a considerable part of the effect likely occurs at other levels.

Further Issues

Degrees of processing. In this section, we consider the issue of preview to the second noun having a lesser effect than that to the first. Such a difference has been taken to indicate that there is a lesser degree of processing of the second lemma prior to speech onset. Smith and Wheeldon (1999) made a comparison of effects of preview to the second noun in sentences beginning with a coordinated noun phrase such as "The dog and the kite move up" and those beginning with a noun modified by a relative clause such as "The dog which is next to the kite moves up." The second noun in each sentence type was previewed for 1,000 ms. This was followed by a 1,000-ms gap and then the appearance of the two stimuli pictures and immediate onset of the movement designed to stimulate the respective sentences (Experiment 5). Preview of the second noun in either subject phrase type facilitated utterance. However, the effect was bigger for the noun in the coordinated noun phrase than for that in the relative clause. This allowed Smith and Wheeldon to conclude that processing of the noun in the coordinated noun phrase was more thorough than that in the relative clause. One interpretation of the degree of processing is that speakers only plan at higher levels for material further downstream, and thus only part of the information that is made available by preview is useful for pre-utterance planning. In both Experiment 3 and Experiment 4, it was found that the effect of preview on the second noun in a CNP was less than that to the first. While this could, as Smith and Wheeldon (1999) suggested, imply that even within the same functional phrase, there is a difference in degree of processing of the first and second open-class words, it may simply mean that preview information cannot be as effectively used further downstream because it interferes with processing of the initial word. As mentioned earlier, Meyer (1996) and Costa, Navarette, and Alario (2006) both found that that semantic processing of the second word in a CNP occurs prior to utterance onset. It seems likely, then, that preview effects for the second word are at least partly a result of semantic-level processing of the second lemma. It may be, then, that when preview is to the first word, the phonological information from preview can be used. When preview is to the second, it is less useful as this falls outside the scope of initial phonological planning. Such a conclusion would tie in with conclusions from the two experiments described earlier, showing that effects of phonological interference are limited to the first word.

Thus, the phonological information that could be made available through preview may only assist with the first word because speakers only plan ahead for the first phonological word as mentioned earlier. Alternatively, it may be that very high activation of a word that is second before the one that comes first has been activated causes some conflict in the process of accessing and ordering the first word. Further investigation is needed to pinpoint the cause of this difference.

Differences in reduction of latency to first word from preview. There was a 44-ms advantage to preview of Noun 1 in the Japanese PP compared with the Japanese CNP. Onset to the PP was also much faster. These results would tie in with the view that for the PP, speakers only plan for the first phrase, a one-word prepositional phrase, which takes less time that for a two-word phrase. It might also be the case that with the CNP phrases, speakers cannot start as quickly as the preview does not provide them with everything they need to start the utterance: They still need to process the unpreviewed second word to some level before utterance begins. Thus, less advantage can be taken of the initial word preview. While this remains a possible explanation for Japanese CNP and PP, it does not allow an explanation of why there was less of an advantage for Noun 1 preview in MOMO compared with preview in CNP. It also does not provide a satisfactory explanation of why there was a 120-ms advantage for Noun 1 preview in English CNP

compared with such a preview in English PP. Further investigation of this aspect of the results remains to be done.

Theoretical Implications

The series of five experiments reported here give strong support for the idea proposed in Allum and Wheeldon (2007) that a preferred scope of planning is a certain level of phrase and that this affects the scope of lexical access. The key point about this finding is that, whatever the exact nature of that phrase, given the results from Japanese, our results clearly indicate that syntactic ordering processes must occur prior to lexical access.

In terms of the exact nature of the phrase involved, our original idea that this is a minimal functional unit may require some modification. The contrast between results for Experiments 1 and 2 shows that it is not unity of function alone that defines scope. One way to interpret the difference between a list structure and a CNP structure is by saying that in the first, each item works independently in relation to the verb, whereas in the latter, the two items work as a unit. In this sense, it could be that the former consists of two functional phrases even though the function is the same, whereas in the latter the CNP forms one functional unit. This would allow us to maintain the claim that the minimal functional unit is the relevant unit to define scope of lexical access. However, it is also possible that closeness of conceptual or syntactic grouping is the relevant factor. This remains to be investigated further.

Nevertheless, our findings have important implications for models of language production. First, our findings indicate that in the Japanese experiments, there is lexical access for words in the first phrase within the verb argument phrase, a subordinate phrase, but not for those in the second, the verb argument head phrase. This requires that a linear order that is purely grammatically defined affects the activation of elements within the conceptual or thematic representation of the message to prompt ordered activation of the lemmas required at the beginning of the utterance. The prepositional phrase has the function in the conceptual message of modifying or defining the theme. However, as argued earlier, the order of modifier phrase and head phrase is grammatical rather than conceptual; it differs according to the grammatical conventions of each language rather than to any conceptual formulation of the message. Thus, as mentioned in the introduction, purely conceptual weighting could not account for the initial lexical item in these sentences being more activated than that for the head and therefore initially selected for processing. The data reported here suggest that lexical access is mediated by purely syntactic information.

Models that allow the conceptual and grammatical to interact independently or prior to access to lemmas could provide mechanisms whereby the lexical item that is the head of the phrase is less activated than that for a modifying element. As mentioned earlier, in Chang et al.'s (2006) model, conceptual elements within the meaning path interact with grammatical processes within the sequencing path prior to lexical access. It is the interaction between the two that results in selection of the next lexical item. Our data strongly support this aspect of the model and in fact, we would claim, require some such process. No other explanation seems possible.

Nevertheless, there is no provision within this model for the effect of any particular unit on lexical access, other than the overall assumption that a clause is processed as one unit in the meaning path and that the elements in this path interact with the sequencing path weightings to produce word-by-word lexical access. Given the evidence cited in the introduction (and in more detail in Allum & Wheeldon, 2007) that the initial phrase, rather than initial word, is more thoroughly processed than the rest of the utterance, there is clearly a need for a model that shows how scopes of processing at different levels are decided and implemented in addition to having a mechanism that allows prelexical syntactic processes to occur.

Our data strongly support the idea that syntactic factors, specifically word order, affect the order of lemma activation and mediate between conceptual and lexical access processes. The data also suggest that the scope of such lexical access is subject to syntactic or conceptual factors. Our findings rule out the idea that access to one of the verb arguments, the head of such a phrase, is necessary before initiating utterance and also show that processing is not simply word by word. While the comparison of the *mo . . . mo* (MOMO) and *to . . . wa* (TOWA) patterns rules out our initial suggestion that function alone influences scope of lexical access, it does suggest that further research should focus on contrasting the effect of conceptual and syntactic factors on scope of lexical access.

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