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Testing the Procedural Developmental Sequence (ProDS)

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This study attempted to demonstrate the validity of the Procedural Developmental Sequence (ProDS) of Stage $1x,...1x^2,...1x^3,...kx^n$ in terms of the Speech Processing Mechanisms (SPM) and the SPM functions proposed by Yong-Myeong Kim and Oryang Kwon (2006). To see whether the theoretical procedural stages of the ProDS reflects L2 learners' actual developmental stages, this study calculated the Implicational Scaling of the performance ProDS produced in real time by the L2 learners. The result of the Scaling showed that the actual ProDS significantly corresponds to the theoretical ProDS. In addition, to see if there is a relationship between each stage of the ProDS and the L2 learners' grammatical proficiency, this study conducted the Spearman Correlation and the Kruskal-Wallis Test. The analyses of the two tests demonstrated that the ProDS has its validity. In sum, the SPM and the SPM functions are a kind of cognitive or procedural mechanism which can analyze, describe, and sequentialize the IL development of procedural knowledge. Thus, the SPM, its functions, and the ProDS can provide not only a viable explanation for the developmental problems to second language acquisition (SLA), but also a theoretical framework for *acquisition-oriented language teaching and testing*.

[**interlanguage/procedural knowledge/Speech Processing Mechanism/procedural developmental sequence**/중간언어/절차적 지식/발화 처리 기재/절차적 발달 단계]

I. INTRODUCTION

Since Anderson (1976) broached procedural knowledge in his Adaptive Control of Thought Model, a number of studies have been carried out based on this or similar concept (Levelt, 1989; Paradis, 1994; Pienemann, 1998; Robinson, 1996). However, up to now, few studies have made a systematic definition, or even an operational one for procedural knowledge. From a psycholinguistic perspective, if we could agree on an operational definition of procedural knowledge as executive or performing knowledge of how to process and produce language in real time, then it will be necessary to find out a cognitive or procedural mechanism that can govern the IL development of procedural knowledge.

Clahsen (1984), based on Bever's strategies (1970) and Slobin's principles (1973), suggested Speech Processing Strategies (SPS), stated in such a way that the SPS is cognitive constraints on movement transformations. According to the SPS, he and his colleagues constructed the *developmental sequence*, which is the core of the Multidimensional Model (Meisel, Clahsen & Pienemann, 1981; Pienemann & Johnston, 1987)[1]. However, the SPS is formulized as such a serial connection combination that it seems to have difficulty in explaining the IL developmental processes of embedded clauses, and hence in determining an IL developmental sequence of embedded clauses (Full discussion will be presented in the next section.).

As an alternative, Yong-Myeong Kim and Oryang Kwon (2006) proposed the Speech Processing Mechanisms (SPM) and the SPM functions based on the reviews of the SPS (Clahsen, 1984). From a psycholinguistic perspective, it can be argued that the SPM and its functions are a kind of cognitive or procedural mechanism which can analyze, describe, and sequentialize procedural knowledge. More specifically, the SPM, capturing the degrees of constituent movements and word order changes, can quantify the relative procedural complexity of the utterances produced in real time by IL learners (Full discussion will be elaborated on in the next section.). In addition, the SPM functions can sequentialize the degrees of this complexity quantified by the SPM, and hence determine an IL developmental sequence of procedural knowledge called the Procedural Developmental Sequence (ProDS) of Stage $1x$, ...$1x^2$,... $1x^3$,... kx^n (here, n is the number of embedded clauses). In sum, the SPM and the ProDS can explain the IL developmental processes of embedded clauses as well as those of simple sentences.

The question then is whether or not the theoretically built procedural stages of the ProDS reflect the actual developmental stages of L2 learners and correlate their language proficiency. Thus, to see if there is an error on the ProDS, the ProDS will be tested by a real-time experimental method called the *Flash-window Method* (Yong-Myeong Kim & Oryang Kwon, 2005). In addition, to see if there is a relationship between the procedural stages of the ProDS and the scores on a standardized test (i.e., the Grammar test of the TEPS), the Spearman Correlation and the Kruskal-Wallis Test will also be conducted.

[1] The Multidimensional Model, as its name suggests, constitutes two dimensions. One is the developmental axis that is governed by the universal speech processing (i.e., the SPS) is held to be invariant. The other is variational axis, along which learners are essentially located according to their degree of linguistic norm-orientation, as evidenced by percentages of production of redundant items or structures within the developmental processing capacities of the learner.

Finally, the results of the experiments will be reported, and the implications will be discussed.

II. THEORETICAL BACKGROUND

1. Procedural Developmental Sequence

Based on the Multidimensional Model (Meisel, Clahsen & Pienemann, 1981), Pienemann and Johnston (1987) proposed the Developmental Sequence of English as a Second Language (ESL) as seen in Table 1.

Table 1
The Developmental Sequence of ESL

Stages	SPS			Critical structures	Examples
	[COS]	[IFS]	[SCS]		
X	+	·	·	Canonical SVO	[I kissed Mary] yesterday.
X + 1	+	+	+	Do-fronting	In the park, [I kissed Mary] __.
X + 2	-	+	+	Y/N-question	Did [you kiss(-ed) Mary]?
X + 3	-	-	+	Wh-question	Who did [you kiss(=ed)_]yesterday?
X + 4	-	-	-	Embedded clause	[I don't know [who met Mary]].

Note: COS: Canonical Order Strategy, IFS: Initialization-Finalization Strategy, SCS: Subordinate Clause Strategy

As seen in Table 1, the sequence consists of five implicational stages of X, X+1, X+2, X+3, and X+4 in terms of the hierarchical combinations of three components of the Speech Processing Strategies (SPS) proposed by Clahsen (1984), which act as cognitive constraints on IL development. According to Pienemann and Johnston (1987), L2 learners can pass through from one stage to the subsequent stage on the sequence only if they can operate the SPS imposed hierarchically on each stage. In this respect, the SPS can function as a procedural mechanism for determining an IL developmental sequence of what Anderson (1976) calls procedural knowledge. However, the sequence is too ‘sparse’ to explain the IL developmental processes of embedded clauses in stages higher than Stage X+4. Consider the following embedded clauses.

(1) a. I know that John loved Mary at that time.

b. I wonder who loved Mary at that time.
c. I know the girl *whom John loved at that time*.
d. Do you know *who(m) John loved at that time*?
e. *Who(m)* do you think *John loved at that time*?

Since all the examples in (1) contain embedded clauses, represented as [-COS], [-IFS], and [-SCS] in terms of the SPS, they are hence the structures belonging to Stage X+4 on the sequence as in Table 1. This assumes that their processing complexity will be the same. Yet, even though all the examples of (1) have embedded clauses, there will be differences in the degrees of procedural complexity depending on whether the embedded clause in question is an object of a matrix verb, a relative, an indirect question, and this is compatible with our linguistic intuition. Thus, these differences should also be represented on the developmental sequence of procedural knowledge.

As a possible solution to the SPS, Yong-Myeong Kim and Oryang Kwon (2006, p. 117) proposed the SPM derived from the SPS (Clahsen, 1984) and a set of *developmental-stage-functions* called the SPM functions as seen in (2) (see Yong-Myeong Kim & Oryang Kwon, 2006, pp. 116-128).

(2) Speech Processing Mechanism (SPM) functions
a. SPM $f(\alpha, \beta)$=[αIFM]/[βCOM],
b. SPM $f(\alpha, \beta, \gamma)$=[γSCM([αIFM]/[βCOM])*]
(The value of variable α, β, or γ is + or -.)
("*" indicates that ([αIFM]/[βCOM]) is recursive.)

The SPM is a kind of procedural mechanism that can quantify the degrees of constituent movements and word order changes for realizing grammatical changes (e.g., modality) and sentential forces (e.g., interrogatives). It consists of three components ([IFM], [COM], [SCM]).

First, Initialization Finalization Mechanism (IFM) is a mechanism operating on constituent movements to realize grammatical changes and sentential forces such as declarative, topical, and interrogative. Hence, the variable α of [αIFM] will have a positive value (+) if a certain constituent moves from an internal position to an external position, and *vice versa*, and the variable α will have a negative value (-) if one moves from an internal position to another internal position within a sentence (i.e., double movements) as seen in (3a-3b) below. Canonical Order Mechanism (COM) is a mechanism operating on word order changes within a sentence. Hence, the variable β of [βCOM] will have a positive value (+) if no change takes place in the canonical order, and the variable β will have a negative value (-) if any change takes place in the order as the results of the operations of the IFM mechanism as in (3c-3d). Finally, Sentence Combination Mechanism (SCM) is a mechanism operating on an embedded clause when more than two sentences are combined to form a complex sentence. Hence, as a result of combining two sentences, the variable *γ* of [*γ*SCM] will have a positive value (+) if a certain constituent moves only within the embedded clause, and the variable *γ* will have a negative value (-) if one moves to the outside of the embedded clause, i.e., moves to the matrix, as in (3e-3f).

(3) a. Can [you _ do it]? ([+IFM])
b. What are [you _ doing _] now? ([-IFM])
c. Yesterday, [John kissed Mary] __. ([+COM])
d. What are [you __ doing __] now? ([-COM])
e. [Do you know [who(m) Mary loved __ at that time]]? ([+SCM])
f. [Who(m) do you think [_ Mary loved _ at that time]]? ([-SCM])

The SPM functions, which formularize three components of the SPM as an implicational recursive connection combination, can sequentialize a procedural developmental stage. (2a), as a serial connection combination of [*α*IFM] and [*β*COM] among the three components of SPM, is the SPM function of non-embedded clauses, which can quantify the procedural complexity of simple or matrix clauses. Hence, according to the values of variable *α* and *β* of the SPM function, the developmental sequence of simple or matrix clauses can be ordered into stages from 1*x* to 4*x* as in Table 2 (Yong-Myeong Kim & Oryang Kwon, 2006, p. 119).

Table 2
Developmental Sequence for Non-embedded Sentences

SPM *f* (α,β) =	[*α*IFM]/[*β*COM]	Stages
If *α* = ·, *β* = +,	·/+	1*x*
If *α* = +, *β* = +,	+/+	2*x*
If *α* = +, *β* = -,	+/-	3*x*
If *α* = -, *β* = -,	-/-	4*x*

Note: ‘ . ’ indicates non-application of the component in question.

Also, (2b), as an implicational recursive connection combination of the components derived from inserting the serial combination of (3a), i.e., the [*α*IFM]/[*β*COM], into the implicational components of the [*γ*SCM (/)*], is the SPM function of embedded clauses, which can quantify the procedural complexity of embedded clauses. Hence, depending on the values of variable *α*, *β*, and *γ* of the SPM function, the developmental sequence of embedded clauses can be ordered into stages from $1x^2$ to $5x^2$ as in Table 3 (Yong-Myeong Kim & Oryang Kwon, 2006, p. 119).

Table 3

Developmental Sequence for Embedded Sentences

SPM f (α, β, γ) =	[*γ*SCM([*α*IFM]/[*β*COM])]	Stages
If α = ·, *β* = +, *γ*= ·	·(·/+)	$1x^2$
If α = +, *β* = +, *γ*= +	+ (+/+)	$2x^2$
If α = +, *β* = -, *γ*= +	+ (+/-)	$3x^2$
If α = -, *β* = -, *γ*= +	+ (-/-)	$4x^2$
If *α* = -, *β* = -, *γ*= -	- (-/-)	$5x^2$

Note: '·' indicates non-application of the component in question.

In addition, since a complex sentence consists of a matrix and embedded clauses, the developmental stage of a complex can be formalized by combining that of the matrix clause determined by the simple SPM function (3a) and those of the embedded clauses by the embedded SPM function (3b). Thus, the developmental stages of a complex sentence can be represented in the form of kx^n+kx^{n-1}...kx (here, *n* is the number of embedded clauses).

2. Procedural Developmental Stages

However, another problem has not yet been settled on what leads IL development from one stage to the next higher stage on the ProDS. As a possible answer to this problem, Yong-Myeong Kim and Oryang Kwon (2006) suggested procedural developmental gaps as developmental force by adopting the concepts of *gaps* and *driving force* (Færch & Kasper, 1986; White, 1987). IL structures (i.e., the output learners produce) will be called the *triggering force*, and target language (TL) structures (i.e., the L2 input learners receive in the linguistic environment) will be called the *triggering cue*. And the gaps between the triggering force and the triggering cue will be called the *procedural developmental gaps*. Thus, they postulated that IL learners will proceed from one procedural system to the next in a stepwise fashion on the ProDS, by inducing a clue to bridge the procedural developmental gaps through the interactions between the triggering force and the triggering cue. In the next section, each stage of the ProDS will be fully specified according to the SPM functions, drawing on the procedural developmental gaps discussed above.

1) Procedural Developmental Stage *Kx*

Procedural Developmental Stage *kx*, hinging on the non-embedded SPM function $f(\alpha, \beta)$=[αIFM]/[βCOM], is subdivided into 1*x*, 2*x*, 3*x*, and 4*x*, depending on the hierarchical combinations of the values of the variable α and β.

(1) Procedural Developmental Stage 1*x*

Procedural Stage 1*x*, as an initial state of IL development, involves the operation of SPM [·IFM]/[+COM], on which any movement or word order change is blocked in a sentence. Thus, at this stage, IL learners can produce only canonical SVO structures, without grasping any grammatical relations among constituents in a sentence, simply by mapping their conceptual or mental structures directly onto the verb's argument structure, or by imitating structures in the linguistic input.

(2) Procedural Developmental Stage 2*x*

Procedural Developmental Stage 2*x* is involved in operating on the SPM [+IFM]/[+COM], according to which it is permitted to move an external element of the canonical SVO to other external (i.e., final or initial) positions ([+IFM]), but this movement does not cause any change of canonical word order ([+COM]). Fronting-structures such as *adv/do/wh-* fronting in English are the critical structures of this stage. Consider the following fronting sentences in (4).

(4) a. *Yesterday* [I met him].
b. **Do* [you *met* her]?
c. **Where* [*you are going*]?

As IL learners perceive that the examples of (4) consist of the canonical SVO and its external element, which are considered to be a semantic periphery, they can infer that the external element of the canonical (i.e., a semantic periphery) can be moved from the final position to the initial position ([+IFM]) as seen in (4a) and (4c), or the new element *Do*, also considered as a kind of adjunct, can be added to the initial position ([+IFM]), by imitating *true* Y/N-questions, as in (4b). But this movement does not cause the change of the canonical order ([+COM]). Consequently, as processing the SPM [+IFM]/[+COM], they can produce the critical structures of Stage 2x such as *adv/do/wh*-frontings.

(3) Procedural Developmental Stage 3x

In Procedural Stage 3x, the development is related to the operation on the SPM [+IFM]/[-COM], according to which it is possible to move the internal elements of canonical SVO to the final or initial position of the sentence ([+IFM]), or to insert new elements into the internal position of canonical SVO ([+IFM]), which, in turn, causes the changes of the canonical order ([-COM]). Aux-*en/-ing* (such as *be-ing*, *have/be+pp*), Comp-*to* (e.g., *I want to go*), and Y/N-inversion are the critical structures of this stage.

Consider the development of Y/N-questions, which can be regarded as playing a bridging role to proceed from Stage 3*x* to 4*x*. At this point, IL learners may be in a dilemma in which they have to communicate by utilizing Y/N-questions, but they are not able to produce them because of not having yet acquired the prerequisite procedural system such as *inversion*. Thus, in order to meet such communicative needs, they have to rely on *pseudo* Y/N-questions (*Do*-fronting) like (5a) simply by adding *Do* to the sentence initial position. However, as the frequency of exposure to linguistic input increases, they will have access to grammatical sentences like (5b) as positive evidence to (5a).

(5) a.*Do $[_{vp}$ you $[_{v'}$ met her]]?
b. Did [you meet_ her]?

Now, by recognizing the procedural gaps through the interactions between the triggering force (5a) and the triggering cue (5b), the learners are able to move the internal constituents (i.e., inflectional elements) of the structures to the initial position ([+IFM]) as in (5b), thus causing the canonical order to change ([-COM]). Finally, they can process Y/N-questions productively thorough operating the SPM [+IFM]/[-COM].

(4) Procedural Developmental Stage 4x

Procedural Stage 4x is governed by the operation of the SPM [-IFM]/ [-COM], on which it is possible to move the internal constituents of canonical SVO to another internal position ([-IFM]), thereby causing the word order to change ([-COM]). *Wh*-inversion and *neg*-inversion are the critical structures of this stage.

While IL learners can produce Y/N-questions like (6a) through the SPM [+IFM]/[-COM] established at the previous stage, they may not process *true wh*-questions because of not having yet acquired the prerequisite procedural system at this point. Thus, to satisfy the communicative needs in such dilemmas as mentioned earlier, IL learners are forced to resort to *interim wh*-questions (i.e., *wh*-fronting) like (6b). However, they will get access to grammatical sentences like (6c) as a counterexample to (6b).

(6) a. Did you do it yesterday?
b.*What you did yesterday?
c. What *did* you do*(-ed)* __ yesterday?

By recognizing procedural gaps through the comparisons of IL structure (6b) and TL structure (6c), first the learners are able to move the internal constituent (*what*) of the canonical order to the initial position ([+IFM]) by relying on the *wh*-fronting mechanism (6b) available to them at this point. Next, they can induce that the internal elements (*did*=*ed*) should be moved to the internal position of the sentence ([-IFM]) by using the Y/N-inversion built up at the proceeding stage as in (6a), and these double movements invite the change of the canonical order to take place ([-COM]). Consequently, by establishing the SPM [-IFM]/[-COM], they can process *wh*-questions productively.

2) Procedural Developmental Stage Kx^2

Procedural Developmental Stage $k\mathrm{x}^2$, hinging on the embedded SPM function $f(\alpha, \beta, \gamma)$=[γSCM([αIFM]/[βCOM])]], is decomposed into $1x^2$, $2x^2$, $3x^2$, $4x^2$, and $5x^2$ in terms of the hierarchical combinations of the values of the variable α, β, and γ of the function.

(1) Procedural Developmental Stage $1x^2$

In Procedural Stage $1x^2$, the development is related to the operation on the SPM [·SCM([·IFM]/[+COM])], according to which no movement and word order change are permitted within an embedded clause. Thus, IL learners can produce the most prototypical embedded clauses simply by combining one canonical SVO to another without any movement or word order change within an embedded clause, using *that* as a connector as in *I hope* ***that*** *John will marry Ann*. By establishing the SPM [·SCM([·IFM]/[+COM])], in addition to the *that*-clause, the learners are able to produce other embedded clauses such as *for*-construction as in *I hope for John to marry Ann*, 2-Sub-Comp as in *I want John to marry Ann*, and Causative as in *I make John marry Ann*.

(2) Procedural Stage $2x^2$

In Stage $2x^2$, while IL learners can produce structures like (7a) and (7b) by utilizing the core procedural systems available to them, they may not produce structures like (7c) as they lack the relevant procedural mechanism. However, they will be able to access these structures through the input.

(7) a. I wondered.
b. Who had loved you at that time?
c. I wondered ***who*** *had loved you* at that time.

Recognizing the procedural gaps through the interactions between the triggering force and the triggering cue, the learners can induce that the *wh*-fronting structure (7b) can be combined with the canonical sentence (7a) by using *who* as a connector as seen in (7c).

(3) Procedural Stage 3x^2

In Procedural Stage 3x^2, though IL learners can produce structures like (8a) and (8b), they may not produce structures like (8c) as they lack the associated procedural mechanism. However, they will be able to access these structures through the input.

Now, perceiving the processing gaps through interacting the force with the cue, the learners can infer that since *the man* of (8a) and *him* of (8b) are in an anaphoric relation, *him* can be substituted by a relative pronoun *whom*, which is fronted (topicalized) to the sentence initial position, and that by adopting *whom* as a connector, the matrix (8a) and the embedded (8b) can be combined to one complex (relatives) as in (8c).

(8) a. I know **the man**$_i$
b. She will meet **him**$_i$ at the party.
c. I know **the man**$_i$ **whom**$_i$ she will meet t_i at the party.

(4) Procedural Stage 4x^2

In Procedural Stage 4x^2, IL learners can produce structures like (9a) and (9b) by operating on the core procedural systems available at this point, whereas they may produce ungrammatical sentences like (9c) without canceling *wh*-inversion. As Pienemann (1998) pointed out, these phenomena are almost universal in IL development. However, the learners will be exposed to grammatical sentences like (9d) as positive evidence to (9c).

(9) a. Whom does John like in the class?
b. Do you **know** who likes John in the class?
c.*Do you **know** whom **does** John like in the class?
d. Do you **know** whom John like**s** in the class?

Perceiving the processing gaps through the comparisons of the triggering force and the cue, the learners come to realize that combing the root *wh*-question (9a) with the matrix question *Do you know* results in the ungrammatical sentence as in (9c). Thus, they can infer that when a root question becomes an embedded clause, SAI (Subject/Aux Inversion) has to be *canceled* or *reinverted*, that is, *does* should be moved back to the original position, and this movement brings about word order changes as in (9d).

Substitute these movements and word order changes for the function $f(\alpha, \beta, \gamma)=[\gamma SCM([\alpha IFM]/[\beta COM])]$. Since what Pienemann (1998) calls *cancel inversion* takes place (since there are double movements), the value of the variable α is '-'. Since these movements, in turn, invite word order changes, the value of the variable β is '-'. And since the final landing site of the movements is within the embedded clause, the value of the variable γ is '+'. Consequently, the SPM function is reduced to [+SCM([-IFM]/[-COM])], and hence the embedded clause of (9d) is a critical structure belonging to Stage $4x^2$. In addition, the matrix *do you know* belongs to Stage $3x$ since the auxiliary *do* is moved to the initial position, and this movement causes canonical word order to change. Thus, the procedural stage of the complex sentence (9d) is $4x^2+3x$.

(5) Procedural Stage $5x^2$

In Procedural Stage $5x^2$, IL learners can produce indirect questions like (10b) by utilizing the core procedural systems of Stage $4x^2$, but they might make ungrammatical structures like (10c) simply by applying the same mechanisms as operated on (10b) directly into the construction of the sentence (10c). But they will have access to grammatical sentences like (10d) as positive evidence to (10c).

(10) a. Whom does John like in the class?
b. Do you **know** whom John likes in the class?
c.*Do you **think** whom John likes in the class?
d. **Whom** do you **think** John likes in the class?

Now, they can infer, recognizing the procedural gaps, that in the case of the matrix clause *Do you know* as in (10b) where the matrix verb is a *non-opinion verb* which simply asks a 'Yes or No answer' of the interlocutors, there is no need to move *whom* from the initial position of the embedded clause to the initial position of the matrix clause. Whereas in the case of the matrix clause *Do you think* as in (10d) where the matrix verb is an *opinion verb* which asks 'specific opinions', not Y/N answers, the *wh*-phrase *whom* should be moved out of the embedded clause into the initial position of the matrix clause.

Apply these movements and word order changes into the function $f(\alpha,\beta,\gamma)$= [γSCM([αIFM]/[βCOM])]]. The values of the variable α and β are the same as those of (10b), whereas the variable γ is '-', since the final landing site of the embedded constituent *whom* is not inside but outside of the embedded clause (i.e., in the matrix). Consequently, the SPM function is represented in [-SCM([-IFM]/[-COM])], and the embedded clause of (10d) is a critical structure belonging to Stage $5x^2$. As discussed above, the matrix *do you think* belongs to Stage $3x$. Thus, the procedural stage of the complex (10d) is $5x^2+3x$.

3) Procedural Developmental Stage Kx^3

The developmental stages of *double* complex sentences which consist of more than two embedded clauses, represents Procedural Stage kx^3, can also be sequentialized by recursively applying the same SPM function as have been applied to Procedural Stage kx^2. Apart from the full discussion of Procedural Stage kx^3, the movements of constituents (especially, *wh*-words) will be mentioned briefly. Examine the degrees of the movements of constituents and the changes of word order in (11).

(11) [***Who*** [do you believe [_ Mary thinks[_ John loves _ at the college]]]?

As seen in (11), *who*, which corresponds to the object of the verb *love* in the lowest embedded clause, moves first to the initial position of the lowest embedded clause (...[*who* John loves_...]]]), and then to the initial position of the higher embedded (...[*who* Mary thinks...]]]), and finally to the initial position of the matrix clause ([*Who*[do you guess...]]]). Therefore, the procedural stage of the double complex sentence (11) can be expressed as $5x^3+5x^2+3x$. The sentence (11) is the case where the number of embedded clauses are two, but in cases where the number of embedded clauses are three, four, or even *n*, the developmental stages can also be sequentialized by the recursive applications of the SPM functions.

To sum up, the SPM, which captures the degrees of movements and changes of word order for realizing grammatical changes and illocutionary forces, can quantify the relative procedural complexity of the construction and the processing of utterances IL learners produce. In addition, not only can the SPM functions determine an IL developmental sequence of procedural knowledge called the ProDS, but also predict critical structures and error patterns at each stage on the ProDS as illustrated in Table 4.

A closer examination of Table 4 reveals that inherent in the ProDS is an implicational scale in which the higher stage on the ProDS can subsume the SPM and the critical structures of the lower stages, but not *vice versa*. This means that the SPM of each lower stage is a prerequisite for the functioning of the higher stage. What this implicational relation implies is that each Procedural Stage on the ProDS cannot be *skipped* or *beaten*, and hence, in a sense, the ProDS constitutes the predetermined shedding processes of the SPM combinations. Therefore, IL learners cannot proceed from one stage to the subsequent stage until they can *process* the SPM imposed on a given stage on the ProDS, just as a caterpillar goes through the ordained shedding process step by step and finally becomes a butterfly.

Yet, a remaining question to be settled is whether there is any “error” on the theoretical ProDS. This came down to the following research hypotheses: (1) The performance ProDS produced by L2 learners through an empirical test (i.e., a real time Sentence Construction Tests) will correspond to the theoretical ProDS. (2) The test performance on a standardized proficiency test (i.e., the Grammar test of the TEPS) will positively correlate with the ratings on the ProDS. These hypotheses will be investigated, and the results will be reported in following section.

Table 4
Procedural Developmental Sequence on SPM

Stages		Procedural developmental sequence		
		SPM $f(\alpha,\beta)$ = [αIFM]/[βCOM]	SPM $f(\alpha,\beta,\gamma)$ = [γSCM([αIFM]/[βCOM])]	Critical structures
Simple	1*x*	[·/+]	·	SVO
Sentence	2*x*	[+/+]	·	*Adv*/*Wh*/*Do*-fronting
	3*x*	[+/-]	·	Aux-*en*/-*ing*, Y/N-Inv.
	4*x*	[-/-]	·	*Wh*-questions
Complex sentence	$1x^2$	[±/±]	[·([·/+])]	2-Sub-Comp, *that*-clause
	$2x^2$	[±/±]	[+([+/+])]	Indirect-question(sub.) Relatives(sub.)
	$3x^2$	[±/±]	[+([+/-])]	Relatives (obj., obl.)
	$4x^2$	[±/±]	[+([-/-])]	Indirect-question (obj.)
	$5x^2$	[±/±]	[-([-/-])]	Long distance-questions
Double complex	⋮	⋮	⋮	⋮
Sentence	kx^n	±/ ±	(±/±)+(±/±)+…	⋮

(Adapted from Yong-Myeong Kim & Oryang Kwon, 2006, p. 117)

III. TESTING THE PROCEDURAL DEVELOPMENTAL SEQUENCE

1. Research Method[2]

2 This study is additional research to Yong-Myeong Kim and Oryang Kwon (2007). To confirm the research findings of the study, this study conducted the Spearman Correlation and the Kruskal-Wallis Test of the rating on the ProDS and proficiency on grammar test of the TEPS. The research method of this study was not different from that of Yong-Myeong Kim and Oryang Kwon except for conducting the Correlation and the Kruskal-Wallis Test. This part was recapitulated here for convenience's sake of readers.

1) Participants

The participants of this research were 165 college students (21 males and 144 females), whose ages ranged from 18 to 35 (average age, 23.7), from freshmen to seniors, and whose majors were linguistics (82%: Korean, English, Japanese, etc.), the humanities, and the social sciences (18%: philosophy, economics, etc.).

2) Instruments

The stimulus sentences were developed according to the procedure adopted by Yong-Myeong Kim and Oryang Kwon (2007). From each Procedural stage on the ProDS (see Table 4), critical structures were first chosen. Based on these structures, five critical sentences were composed, which best reflect the syntactic mechanisms of each stage of the ProDS.

[Preparation Phase]: Preparing Instruction

Please read the following sentence carefully.

(A cursor will blink for 3 seconds, and then the following sentence will appear.)

John kissed Mary last night.

(This window will disappear in 2 seconds.)

[Performance Phase]: Performing Instruction

Change "*last night*" into "*when*" in the following sentence,
and make a *wh*-question in your mind.

(This window will disappear in 5 seconds, and then the following sentence will appear.)

John kissed Mary <u>*last night*</u>?
↑
When

(This window will disappear in 3 seconds.)

[Completion Phase]: Completing Instruction

Type the question you thought of on the blank.

ǁ ____________________________________**?**

(This window will disappear in 15 seconds.)

[Relaxation Window]: Along with a buzzer signaling the end of writing, music is played for 10 seconds, and then another buzzer signals the start of the next item.

Figure 1. Sentence conversion test (Yong-Myeong Kim & Oryang Kwon, 2007, pp. 269-270).

In order to minimize the effects of the length of the sentences and words on the experiment, each critical sentence was made up of “7±2” thought groups according to Miller’s *magic number* (1956), using basic words and familiar proper nouns. These five critical sentences consisted of stimuli called the *critical sentence set* of forty-five items (see Appendix).

The critical sentences were converted into two types of Sentence Construction Tests (SCT): the Sentence Conversion and the Sentence Combination Test. These tests were played in *real time* onto the *Flash-window Method* (Yong-Myeong Kim, 2007; Yong-Myeong Kim & Oryang Kwon, 2007).

As shown in Figure 1 and 2, the method consisted of four phases (i.e., the Preparation, the Performance, the Completion, and the Relaxation Phase). In the Preparation Phase, the participants were asked to read a given sentence or two or more sentences on the screen within a given time (160wpm). At the Performance Phase, in the case of the Sentence Conversion Tests as in Figure 1, they were required to convert the sentence into another pattern (e.g., *wh*-questions) in their minds within a given amount of time (120wpm).

[Preparation Phase]: Preparing Instruction **Please read the following two sentences carefully.** (A cursor will blink for 3 seconds, and then the following sentence will appear.) **Do you know ...?** **Who kissed Mary last night?** (This window will disappear in 2 seconds.)
[Performance Phase]: Performing Instruction **Combine the next two sentences to make an indirect-question in your mind.** (This window will disappear in 5 seconds, and then the following sentence will appear.) **Do you know? + Who kissed Mary last night?** (This window will disappear in 4 seconds.)
[Completion Phase]: Completing Instruction **Type the question you thought of on the blank.** ǀǀ **____________________________?** (This window will disappear in 15 seconds.)
[Relaxation Window]: Along with a buzzer signaling the end of writing, music is played for 10 seconds, and then another buzzer signals the start of the next item.

Figure 2. Sentence combination test (Yong-Myeong Kim & Oryang Kwon, 2007, pp. 269-270).

In the Sentence Combination Tests, as in Figure 2, they were required to combine two or more sentences to form one complex sentence (e.g., indirect questions) in their minds within a given amount of time. In the Completion Phase, they were asked to write down the converted or combined sentence they had just processed in their mind (60wpm). Finally, in the Relaxation Phase, music was played for about 10 seconds to help them to erase the previous item from their memories, to relieve their tension, and to prepare them for the next item.

Also, in order to demonstrate the relationships of the Procedural Developmental Stages of the ProDS and scores on a standardized test, this study adopted GR test of the TEPS. The GR test was slightly tailored for this research. Out of the 50 items on the test, the last 10 items were excluded because the types and the length of the items and the degree of difficulty were quite different from the other part of the test.

3) Data Collection Procedures

Participants were given some explanations of two types of the SCT, and then presented a set of practice items with a beam projector to familiarize them with the tests. After the practice items had been run, they were presented the randomized sentence set. The test took about 60 minutes. After the test was completed, the participants were asked to fill out a biodata questionnaire and an '*excuse blank'*: I couldn't do my best in the test because of "________________" (such as having a cold, mental distraction, or reluctance). The excuse blank was intended to give an opportunity to make any excuse for a participant who did not have a bias for the best and hence to exclude his or her data from the corpus. In the GR test section, participants were told not to select an answer from the choices by "wild guessing". The GR test lasted 15 minutes.

4) Data Analysis Procedures

Of all the data elicited from the participants through the SCT, the following were excluded in order to minimize the effects of faulty data on the result of the analysis: (a) irrelevant or unintelligible (illegible) cases, (b) cases unanswered more than three items in a row, (c) cases filled in an excuse blank. The other data were analyzed by the following procedures. For the sake of the analysis, to each response of each participant to each test item, a plus (+), a minus (-) or an equal (=) was given according to the degree of matching of a participants' response against the answer. A '+' was given to a response when it was matched to the answer. A '-' was given when it was either not matched to the answer or incomplete. If a response was not completely matched to the answer, and *interim* or *transitional* critical structures were *reconstructed* from it by the IL analysis, a '=' was given to the corresponding Procedural Stage which the reconstructed structures belong to on the ProDS. Also, only trivial or insignificant lexical errors with no relations to the Procedural mechanisms were overlooked.

Criterion for *Pass* of each stage on the ProDS was set as follows: If more than four responses of the five items of each stage match the answers, a positive (+) was marked on the implicational scale, which means that the learner was considered passing the stage in question (called the *pass stage*)[3]. If less than four match the answers, a negative (-) was marked on the scale, which means that the learner was considered not passing the stage (called the *non-pass stage*). In the GR test, one point was assigned to each item if it was a right answer, and then the number of right answers was tallied up.

2. Results and Discussion

1) The Correspondence of the Performance ProDS to the Theoretical ProDS

In order to see whether the theoretical Procedural Developmental Stages reflect the actual developmental stages of the L2 learner, implicational scaling of the performance ProDS was conducted. Of the responses elicited from the total 165 participants through the SCT, 11 cases in the unanalyzable categories were excluded from the analysis. The others (154 cases) were analyzed by the Implicational Scaling Test.

Table 5 displays the implicational scaling of those 154 cases. On the top of the table, the Procedural Stages of the ProDS are listed from right to left in order of the hierarchy. In the table, the vertical bold line in an inverted-stair shape represents the marginal line of an *idealized implicational scaling*.

Table 5

The Implicational Scaling Scalogram

Subj.	Procedural Developmental Stages										Stages	TEPS
	x^3	$5x^2$	$4x^2$	$3x^2$	$2x^2$	$1x^2/5x$	4x	3x	2x	1x	Performed	GR
54	+	+	+	+	+	+	+	+	+	+	10	34
74	+	+	+	+	+	+	+	+	+	+	10	33
88	-	+	+	+	+	+	+	+	+	+	9	33
34	-	+	+	+	+	+	+	+	+	+	9	31
18	-	+	+	+	+	+	+	+	+	+	9	28
36	-	+	+	+	+	+	+	+	+	+	9	28
38	-	+	+	+	+	+	+	+	+	+	9	30
68	-	+	+	+	+	+	+	+	+	+	9	26

[3] This research simply followed the convention that requires five instances and an 80% cut off points, though there is no well-documented rationale for either of this convention (Hatch & Lazaraton, 1991, p. 215).

31	-	+	+	+	+	+	+	+	+	+	9	25
49	-	+	+	+	+	+	+	+	+	+	9	21
y37	-	+	+	+	+	+	+	+	+	+	9	x
y49	-	+	+	+	+	+	+	+	+	+	9	31
y62	-	+	+	+	+	+	+	+	+	+	9	27
y64	-	+	+	+	+	+	+	+	+	+	9	30
y54	-	(+)	+	(-)	+	+	+	+	+	+	8	31
78	-	-	+	+	+	+	+	+	+	+	8	32
10	-	-	+	+	+	+	+	+	+	+	8	22
55	-	(+)	+	(-)	+	+	+	+	+	+	8	30
57	-	-	+	+	+	+	+	+	+	+	8	31
79	-	-	+	+	+	+	+	+	+	+	8	29
1	-	-	+	+	+	+	+	+	+	+	8	24
56	-	-	+	+	+	+	+	+	+	+	8	25
102	-	-	+	+	+	+	+	+	+	+	8	25
77	-	-	+	+	+	+	+	+	+	+	8	28
40	-	-	+	+	+	+	+	+	+	+	8	28
60	-	-	+	+	+	+	+	+	+	+	8	28
y01	-	-	+	+	+	+	+	+	+	+	8	25
y22	-	-	+	+	+	+	+	+	+	+	8	30
y65	-	-	+	+	+	+	+	+	+	+	8	26
112	-	-	+	+	+	+	+	+	+	+	8	26
106	-	-	+	+	+	+	+	+	+	+	8	26
y66	-	-	+	+	+	+	+	+	+	+	8	28
110	-	-	+	+	+	+	+	+	+	+	8	22
45	-	-	+	+	+	+	+	+	+	+	8	23
58	-	-	(+)	(-)	+	+	+	+	+	+	7	25
y24	-	-	(+)	(-)	+	+	+	+	+	+	7	27
32	-	-	(+)	(-)	+	+	+	+	+	+	7	30
2	-	-	(+)	(-)	+	+	+	+	+	+	7	24
y32	-	-	(+)	(-)	+	+	+	+	+	+	7	24
90	-	-	-	+	+	+	+	+	+	+	7	28
65	-	-	-	+	+	+	+	+	+	+	7	27
71	-	-	(+)	(-)	+	+	+	+	+	+	7	27
y13	-	-	(+)	+	+	(-)	+	+	+	+	7	23
39	-	-	-	+	+	+	+	+	+	+	7	23
y47	-	-	(+)	+	(-)	+	+	+	+	+	7	27
100	-	-	-	+	+	+	+	+	+	+	7	22
101	-	-	-	+	+	+	+	+	+	+	7	22
108	-	-	-	+	+	+	+	+	+	+	7	22
105	-	-	-	+	+	+	+	+	+	+	7	24
13	-	-	(+)	(-)	+	+	+	+	+	+	7	25
y04	-	-	-	+	+	+	+	+	+	+	7	22
y36	-	-	-	+	+	+	+	+	+	+	7	23
y40	-	-	-	+	+	+	+	+	+	+	7	23
y57	-	-	-	+	+	+	+	+	+	+	7	21

y55	-	-	-	(+)	(-)	+	+	+	+	+	6	22
50	-	-	-	(+)	+	(-)	+	+	+	+	6	17
y53	-	-	-	(+)	+	(-)	+	+	+	+	6	20
16	-	-	-	-	+	+	+	+	+	+	6	22
72	-	-	-	-	+	+	+	+	+	+	6	25
84	-	-	(+)	-	(-)	+	+	+	+	+	6	21
86	-	-	(+)	-	(-)	+	+	+	+	+	6	21
87	-	-	(+)	-	(-)	+	+	+	+	+	6	24
27	-	-	-	-	+	+	+	+	+	+	6	21
23	-	-	-	-	+	+	+	+	+	+	6	24
92	-	-	-	-	+	+	+	+	+	+	6	24
119	-	-	-	-	+	+	+	+	+	+	6	24
104	-	-	-	-	+	+	+	+	+	+	6	23
61	-	-	-	-	+	+	+	+	+	+	6	20
y05	-	-	-	-	+	+	+	+	+	+	6	22
8	-	-	-	-	+	+	+	+	+	+	6	21
y07	-	-	-	-	+	+	+	+	+	+	6	16
62	-	-	-	-	+	+	+	+	+	+	6	16
y21	-	-	-	-	+	+	+	+	+	+	6	25
y26	-	-	-	-	+	+	+	+	+	+	6	21
y44	-	-	-	-	+	+	+	+	+	+	6	30
y45	-	-	-	-	+	+	+	+	+	+	6	23
y58	-	-	-	-	+	+	+	+	+	+	6	19
29	-	-	-	-	-	+	+	+	+	+	5	24
6	-	-	-	-	(+)	(-)	+	+	+	+	5	19
y08	-	-	-	-	(+)	(-)	+	+	+	+	5	22
y14	-	-	-	-	(+)	(-)	+	+	+	+	5	21
y27	-	-	-	-	(+)	(-)	+	+	+	+	5	23
83	-	-	-	(+)	-	(-)	+	+	+	+	5	18
15	-	-	-	-	-	+	+	+	+	+	5	19
117	-	-	-	-	-	+	+	+	+	+	5	22
28	-	-	-	-	-	+	+	+	+	+	5	20
30	-	-	-	-	-	+	+	+	+	+	5	25
97	-	-	-	-	-	+	+	+	+	+	5	25
124	-	-	-	-	-	+	+	+	+	+	5	25
75	-	-	-	-	-	+	+	+	+	+	5	18
59	-	-	-	-	-	+	+	+	+	+	5	19
y10	-	-	-	-	-	+	+	+	+	+	5	19
y11	-	-	-	-	-	+	+	+	+	+	5	21
y28	-	-	-	-	-	+	+	+	+	+	5	15
66	-	-	-	-	-	+	+	+	+	+	5	17
y48	-	-	-	-	-	+	+	+	+	+	5	19
85	-	-	-	-	-	+	+	+	+	+	5	20
20	-	-	-	-	-	+	+	+	+	+	5	18
y63	-	-	-	-	-	+	+	+	+	+	5	18
y67	-	-	-	-	-	+	+	+	+	+	5	19

17	-	-	-	-	-	+	+	+	+	+	5	16
21	-	-	-	-	(+)	(-)	+	+	+	+	5	14
y46	-	-	-	-	-	(+)	(-)	+	+	+	4	17
43	-	-	-	-	-	(+)	(-)	+	+	+	4	23
11	-	-	-	-	-	-	+	+	+	+	4	18
52	-	-	-	-	-	-	+	+	+	+	4	20
70	-	-	-	-	-	-	+	+	+	+	4	23
12	-	-	-	-	-	-	+	+	+	+	4	16
111	-	-	-	-	-	-	+	+	+	+	4	19
4	-	-	-	-	-	-	+	+	+	+	4	18
24	-	-	-	-	-	-	+	+	+	+	4	18
y02	-	-	-	-	-	-	+	+	+	+	4	15
41	-	-	-	-	-	-	+	+	+	+	4	14
107	-	-	-	-	-	-	+	+	+	+	4	13
y06	-	-	-	-	-	-	+	+	+	+	4	12
y12	-	-	-	-	-	-	+	+	+	+	4	16
y16	-	-	-	-	-	-	+	+	+	+	4	20
y34	-	-	-	-	-	-	+	+	+	+	4	16
y38	-	-	-	-	-	-	+	+	+	+	4	20
y39	-	-	-	-	-	-	+	+	+	+	4	16
y43	-	-	-	-	-	-	+	+	+	+	4	19
y59	-	-	-	-	-	-	+	+	+	+	4	16
19	-	-	-	-	-	-	-	+	+	+	3	20
35	-	-	-	-	-	-	-	+	+	+	3	21
51	-	-	-	-	-	-	-	+	+	+	3	20
3	-	-	-	-	-	-	-	+	+	+	3	15
80	-	-	-	-	-	-	-	+	+	+	3	15
46	-	-	-	-	-	-	-	+	+	+	3	15
76	-	-	-	-	-	-	-	+	+	+	3	18
y09	-	-	-	-	-	-	-	+	+	+	3	15
y25	-	-	-	-	-	-	-	+	+	+	3	14
103	-	-	-	-	-	-	-	+	+	+	3	14
y29	-	-	-	-	-	-	-	+	+	+	3	15
y31	-	-	-	-	-	-	-	+	+	+	3	17
y33	-	-	-	-	-	-	-	+	+	+	3	13
y41	-	-	-	-	-	-	-	+	+	+	3	19
69	-	-	-	-	-	-	-	+	+	+	3	13
y56	-	-	-	-	-	-	-	+	+	+	3	13
y60	-	-	-	-	-	-	-	+	+	+	3	18
y50	-	-	-	-	-	-	-	+	+	+	3	12
y51	-	-	-	-	-	-	-	+	+	+	3	14
47	-	-	-	-	-	-	-	-	+	+	2	17
y03	-	-	-	-	-	-	-	-	+	+	2	18
y17	-	-	-	-	-	-	-	-	+	+	2	x
y18	-	-	-	-	-	-	-	-	+	+	2	11
y23	-	-	-	-	-	-	-	-	+	+	2	12

y30	-	-	-	-	-	-	-	-	+	+	2	13
y52	-	-	-	-	-	-	-	-	+	+	2	10
y61	-	-	-	-	-	-	-	-	+	+	2	10
89	-	-	-	-	-	-	-	-	+	+	2	15
91	-	-	-	-	-	-	-	-	-	+	1	12
y19	-	-	-	-	-	-	-	-	-	+	1	8
y20	-	-	-	-	-	-	-	-	-	+	1	8
y42	-	-	-	-	-	-	-	-	-	+	1	7
Tot	152 2	138 16	108 46	105 49	77 77	59 95	34 120	13 141	4 150	0 154		

Note: +: Pass Stage, -: Non-pass Stage, (+)/(-): Non-parallel Stage, x: Non-attendance at the TEPS.

The degrees of the correspondence of the performance ProDS produced in real time by the L2 learners through SCT to the theoretical ProDS were calculated by the *Guttman Procedures* (Hatch & Lazaraton, 1991). The result shows that the coefficient of scalability is .83, far greater than the minimum requirement of .60 for an acceptable scale. The high scalability means that the performance ProDS significantly corresponds to the theoretical ProDS built by this study. In addition to this evidence, this study found some additional proofs, for example, the correspondences of the errors predicted by the ProDS to the actual ones produced by the participants, and the existence of transitional or On-or-Off stage on the performance ProDS.

2) The Relationship of the ProDS and Language Proficiency

In order to see if there is a relationship between each stage of the ProDS and the scores on the GR test of the TEPS (see the last two columns in Table 6), the Spearman Correlation Test was conducted. As illustrated in Table 6, the Procedural Stages of the ProDS were highly correlated with the scores on the GR test (ρ=.865, p<.01), which implies that the validity of the ProDS is demonstrated by a concurrent validity test.

Table 6

Correlations between ProDS and GR

	ProDS	GR
ProDS	1	
GR	.865*	1

Note: *p<.01

A more in-depth analysis, the Kruskal-Wallis Test was run to examine whether there is a rank difference of language proficiency among stages of the ProDS. As shown in Table 7, the value for Kruskal-Wallis χ^2 stood at 144.49 for GR. In addition, as in Table 8, the Procedural Stages of the ProDS fell into line with the order of mean ranks of the GR test, which proves a statistical difference among the stages of the ProDS. All these results suggest that the ProDS has a potential for developing an *IL-sensitive* or an *acquisition-oriented scale* in language teaching and testing.

Table 7
Kruskal-Wallis Test Statistics (a, b)

	GR
Chi-Square	144.49
Df	9
Asymp. Sig	.000

Note: a. Kruskal-Wallis Test, b. Grouping Variable: ProDS

Table 8
Kruskal-Wallis Test: Ranks

Stages of the ProDS	N (193)	Mean Rank: GR
1x	7	5.71
2x	9	21.11
3x	22	40.09
4x	25	57.68
$1x^2$	33	82.15
$2x^2$	29	109.05
$3x^2$	24	132.48
$4x^2$	25	156.12
$5x^2$	16	164.72
kx^3	3	191.83

IV. CONCLUSION AND IMPLICATIONS

In an attempt to explore what mechanism operates on the development of procedural knowledge and how we can determine a procedural IL developmental sequence, Yong-Myeong Kim and Oryang Kwon (2006) proposed the Speech Processing Mechanisms (SPM) and the SPM functions. The SPM can quantify the relative procedural complexity of processing the utterances L2 learners produce. The SPM functions can sequentialize the degrees of this complexity quantified by the SPM, and hence constitute an IL developmental sequence called the ProDS. Thus, going beyond the limitations of

Pienemann and Johnston's Developmental Sequence (1987), the ProDS can explain the IL developmental processes of embedded clauses as well as those of simple sentences. In addition, it can also predict the critical structures and the error patterns manifested at each stage of the ProDS. To see whether the theoretically built Procedural Developmental Stages of the ProDS reflects L2 learners' actual developmental stages and correlates their language proficiency, the Implicational Scaling, the Spearman Correlation, and the Kruskal-Wallis Test were conducted. The results of the Implicational Scaling showed that the performance ProDS produced in real time by the L2 learners significantly corresponds to the theoretical ProDS. In addition, the analyses of the Spearman Correlation and the Kruskal-Wallis Test demonstrated that the ProDS has its validity.

In conclusion, going beyond the limitations of Pienemann and Johnston's Sequence, the ProDS can explain the IL developmental processes of embedded clauses and those of single ones. From the logic of the implicational relations inherent in the ProDS, it follows that the ProDS is a kind of acquisitional map on the IL procedural development along which L2 learners follow from the initial stage through the next higher stages, in a stepwise fashion, until up to the final stage, processing the procedural mechanisms imposed on a given stage on the ProDS. Thus, just as when we are on our trip to a strange place, relying on the map of that area, we can find out our journey route from where we are now to where we are going to go next, so, by analyzing L2 learners' IL data, we can find out not only where they are now on the acquisitional map, that is, what structures or rules they are able to process in terms of the ProDS, but also we can predict where they are going to go next on the map, that is, what structures or rules they are able to learn next in terms of the ProDS. From a pedagogical perspective, ProDS can offer a theoretical framework for *acquisition-oriented* teaching and testing. As Yong-Myeong Kim (2008) puts it, the ProDS can provide a possible alternative to the principal question raised from recent research into Form-focused Instruction (Jaehack Chang, 2007; Doughty & Williams, 1998; Robinson, 1996): When and how can we provide what rules for IL learners? Specifically, an answer to *when to teach them* will be the stage subsequent to the IL learners' current stage. An answer to *what rules to teach them* will be the critical structures or rules of the subsequent stage. And an answer to *how to teach them* can be obtained by utilizing the concept of procedural developmental gaps and the Flash-window Method. Thus, the ProDS can give them a “timely remedy and tailored teaching”.

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APPENDIX

A Critical Sentence Set

1. Procedural Developmental Stage 1*x*

2. Procedural Developmental Stage 2*x*

1) Do you wash the dishes every day?
2) Who opened the windows on this cold day?
3) What happened at the party last night?
4) Who appeared on the concert last night?
5) Do you play tennis with your friends every weekend?

3. Procedural Developmental Stage 3*x*

1) Did you watch that news on TV last night?
2) Can you go camping with us this weekend?
3) Have you read an English novel recently?
4) Do you want to go there this weekend?
5) Would you like to have a snack after studying?

4. Procedural Developmental Stage 4*x*

1) When did you see her on the campus?
2) Where would you like to have a drink after the show?
3) What have you been writing since last week?
4) Who do you want to meet at the concert this Friday?

5) What did you give to Mary at the party last night?

5. Procedural Developmental Stage kx^2

5.1. Procedural Developmental Stage $1x^2$
1) Did you ask her to go for a drive last night?
2) What does he want you to do this summer vacation?
3) Who does she expect to hold a party next time?
4) Who does he want her to meet this Sunday?
5) I think that John is going with his sweetheart to the concert today.

5.2. Procedural Developmental Stage $2x^2$
1) Did you ask your daughter who liked her in her class?
2) The man who studies mechanics at college will investigate the car accident.
3) Do you know who taught English to this class last year?
4) Have you ever met the lady who was talking with John in the park last night?
5) Do you know who helped him to fix the broken TV?

5.3. Procedural Developmental Stage $3x^2$
1) John has proposed to the girl whom you longed to meet at college.
2) The girl whom you taught in college is going to marry my son next month.
3) The man whom Mary spoke to in the theater studies history at the college.
4) Have you ever met the man whom my father expects me to marry?
5) John employed a woman whom he thought to be honest at the job interview.

5.4. Procedural Developmental Stage $4x^2$
1) Does she know whom John came with to the party last night?
2) Do you want to know why Jane decided to divorce her husband last year?
3) Would you like to know who(m) my mother wants me to meet this Sunday?
4) Do you want to know who(m)Tom ordered to fire her after the audit?
5) Did you ask Mary what she handed John during history class?

5.5. Procedural Developmental Stage $5x^2$
1) Why do you think John parted from his sweetheart last week?
2) Where do you think they went to have drinks after the show?
3) Who does she think John handed the note to during the English test?
4) Who do you think Mary expects him to invite to the reception?
5) Who do you suppose John wants to introduce her to the mayor?

6. Procedural Developmental Stage kx^3

1) Do you want to know who John thinks Mary gave the nice gift to at the party?

2) Who do you guess Mary thinks John loves at the college?

3) Do you know who Mary thinks John asked Alice to invite to the reception?

4) Who do you believe John thinks Mary wants to introduce Alice to the president?

5) Who do you think John believes Mary told Alice to fire after the audit?

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