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Individual Differences, L2 Development, and Language Program Administration: From Theory to Application

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Chapter 2

Aptitude as Grammatical Sensitivity: Recent Research on Processing Instruction

Bill VanPatten, Michigan State University

Aptitude as an individual difference in adult SLA has long been a concern of those involved in instructed SLA. Dating back to the 1950s, aptitude has been researched from a variety of perspectives (e.g., Carroll, 1981; DeKeyser, 2000; Harley & Hart, 1997; Horwitz, 1987; Reves, 1982; Robinson, 2002; Skehan, 1982; Wesche, 1981). The general consensus is that there is such a thing as aptitude and that it correlates with outcomes of instructed SLA (Dörnyei, 2005; Skehan, 2012).

The purpose of the present chapter is to summarize a recent cross-linguistic study on grammatical sensitivity (a sub-component of the Modern Language Aptitude Test) as it applies to processing instruction. The chapter is divided as follows. In the first section, I will describe the construct of grammatical sensitivity and how it has been measured to date. Next, I will review previous research on aptitude in L2 research, focusing on results related to grammatical sensitivity. In the third section, I will summarize a large, four-language study that explored the role of grammatical sensitivity in processing instruction. I will conclude with a discussion of the findings and what they suggest for (1) how we conceptualize language in instructed L2 research, as well as the consequences of this conceptualization (e.g., what acquisition involves, what type of intervention is suggested), and (2) the implications of these conceptualizations for the construct of grammatical sensitivity.

Grammatical Sensitivity

Grammatical sensitivity is a sub-component of language aptitude as measured by the Modern Language Aptitude Test (MLAT). The MLAT consists of five sections. One section measures memory by testing participants on their ability to memorize numbers in an unfamiliar language. A second section measures sound-symbol ability by testing participants' ability to write out English words in a phonetic script. A third section tests the ability to correlate sounds and symbols by having participants read English words that are spelled in unconventional ways and then select from a list of possible synonyms. A fourth section tests what can be called "rote memory" and requires that participants memorize as quickly as possible 24 new words in Mayan, on which they are subsequently tested.

The fifth section is the focus of the present chapter. Called "Words-in-Sentences" on the MLAT, this section tests grammatical sensitivity by having participants read a sentence with a word underlined. Participants then see a second sentence with multiple words underlined and must indicate which of the underlined words "plays the same role" as the underlined word in the first sentence. The underlined words represent various functions and three examples are provided here from the samples at the CB-MLAT website (http://www.2lti.com/htm/test_cb_mlat.htm#12). The Words-in-Sentences section contains 45 such items.

Example 1. MARY is happy.

From the look on your face, I can tell that you must have had a
A B C D

bad day.
E

Example 2. We wanted to go out, BUT we were too tired.

Because of our extensive training, we were confident when we
A B C

were out sailing, yet we were always aware of the potential
D E

dangers of being on the lake.

Example 3. The officer gave me a TICKET!

When she went away to college, the young man's daughter wrote
A B

him the most beautiful letter that he had ever received.
C D E

As can be seen from these three examples, the Words-in-Sentences section samples a variety of grammatical functions of words: subject, direct object, conjunction, complementizer, and demonstrative, to name a few. It is the only part of the MLAT that measures anything related to sensitivity to relationships among words. That is, while not a test of underlying grammatical knowledge per se (e.g., what a grammaticality judgment test might examine), the test purportedly measures the ability of a participant to determine the function of a particular word within a sentence. Because all words in a sentence have a grammatical function (i.e., they fit into some "slot" within a sentence) presumably knowledge of these functions underlies some general grammatical sensitivity.

Previous Research on Grammatical Sensitivity

Grammatical sensitivity is, without a doubt, the most studied aspect of aptitude within the MLAT. While many studies have used the MLAT in its entirety, a number of studies have singled out grammatical sensitivity as a factor to correlate with second language (L2) learners' knowledge of grammar in the language they are acquiring. I will review three major studies here as exemplary research. All three

studies used the Words-in-Sentences section of the MLAT as a measure of grammatical sensitivity.

Robinson (1995) examined the role of grammatical sensitivity under various conditions while learners were exposed to the same target sentences one at a time in each condition. In total, he examined four conditions: (1) an implicit condition in which participants were exposed to sentences and then asked afterwards whether two words were next to each other or not; (2) an incidental condition in which participants were exposed to sentences and then answered yes-no questions about the content of those sentences; (3) a rule-search condition in which participants were explicitly told to look for a rule in the sentences they were exposed to without being told what the rule was; and (4) the explicit group in which participants were told what the rule was and then were told to "apply" these rules as they saw each sentence, followed by questions about the nature of the sentence itself (e.g., "Did the subject come before the verb?"). The pre-/post tests were grammaticality judgment tests on the target rules. Robinson found strong positive correlations between grammatical sensitivity scores and accuracy scores on the tests regardless of the condition of exposure, and concluded that even in the non-explicit conditions, learners with strong grammatical sensitivity were probably consciously seeking patterns in the input sentences to which they were exposed.

In another laboratory-type study, de Graff (1997) reports a role for grammatical sensitivity. He conducted two studies, one on a language adapted from Esperanto (eXperanto) and one on Spanish. I will focus here on his experiment in Spanish. His treatment involved an eclectic set of input- and output-oriented activities, and his assessment tasks included sentence judgment, sentence completion, and sentence correction. His results revealed a limited role for grammatical sensitivity, with significant correlations only for scores on the sentence completion test and only for those who received explanation (explicit information) prior to treatment. He concluded that an effect for aptitude (overall) did not differ depending on whether learners received explicit information or not prior to treatment.

DeKeyser (2000) examined ultimate attainment in a group of English L2 speakers in the Pittsburgh area using a grammaticality judgment task first used by Johnson and Newport (1989). He ran correlations between the scores on the grammaticality judgment test and scores on Words-in-Sentences and found that the grammatical sensitivity scores of the late-arrival learners (those who came to the United States as adults) correlated positively with scores on the grammaticality judgment task. However, the scores of those who arrived as children did not correlate. He also reported that those adult L2 learners with above-average grammatical sensitivity scores were the only participants in that group to achieve native-like scores on the grammaticality judgment task. He concluded that aptitude—specifically, grammatical sensitivity—is an important factor in adult SLA. (For general reviews of L2 aptitude research as well as grammatical sensitivity as a component, the reader is referred to Dörnyei, 2005; Sawyer & Ranta, 2001; and Skehan, 2012).

The Issue

Although it is clear that the Words-in-Sentences section of the MLAT tests some kind of knowledge of word function, it is not clear how this knowledge relates to acquisition. The problem with both the grammatical sensitivity section of the MLAT and most L2 research on aptitude is that they are grounded in the notion that learners "internalize rules." For example, in Robinson's (1995) study, one of the design factors was rules-to-be-learned, with such rules divided into "easy and hard" (see, e.g., pp. 313–314). In addition, his experimental conditions included whether or not learners were instructed to "search for rules," and the post-experimental measure included a paper-and-pencil grammaticality judgment task intended to test the learners' knowledge of the targeted rules. Similarly, de Graff (1997) focused on rule learning (or what he called "structures"), and also divided rules into two categories: simple and complex. (He had a secondary distinction—morphological and syntactic—that is not relevant to the present discussion.) His tests of performance included three sections, all focused on rule knowledge: a grammaticality judgment test, a sentence judgment with subsequent correction of the parts of a sentence the learners deemed incorrect, and a sentence completion test. The DeKeyser (2000) study, while not focused on rule learning as in typical instructed SLA studies on aptitude, did use a grammaticality judgment test to determine learners' knowledge of morphosyntactic structures. Implied in his study is that learners internalize rules, and this implication is especially evident when one examines DeKeyser's post-experimental discussion about what the participants did well on and what they did not (e.g., pronoun gender, *do*-support in *wh*-questions, basic word order).

The idea that learners internalize rules is probably the dominant perspective in instructed SLA research. In 2005, in his definitions of explicit and implicit learning in adult SLA, Hulstijn uses the following revealing phrase: "Explicit learning is input processing with the conscious intention to find out whether the input information contains regularities and, if so, to work out *the concepts and rules* with which these regularities can be captured" (p. 131, emphasis added).

The question in the present chapter is this: what if acquisition is not conceptualized as the internalization of rules but instead as (1) the processing of morpho-phonological units in an input stream, combined with (2) feature selection and constraints from something like Universal Grammar (UG)?[1] Under this scenario, rules are not internalized; that is, there are no rules in the input to process. In fact, rules of the type that are typically researched in instructed SLA do not even exist. What develops in the mind of the learner (or any knower-speaker of any language) is a lexicon along with a computational system (a syntax) that allows sentences to be both understood and produced. (I am purposefully omitting the other formal parts of language for ease of presentation; e.g., phonology, semantics, discourse). This "mental representation" of language—at least the formal

[1]I am, of course, ignoring for the purpose of the present discussion social and interactional factors that may affect quantity and quality of input.

components—contains abstract implicit knowledge or properties of language from which rule-like behavior is derived (e.g., Harley & Noyer, 1999; Jackendoff, 2002; Radford, 2001; Rothman, 2010; VanPatten, 2011; VanPatten & Rothman, forthcoming; White, 2003). From a generative perspective (see Chomsky, 2007, for a historical review), these abstract properties include universal linguistic operations (e.g., Move, Merge, and Agree), constraints on well-formedness (e.g., Structure Dependency, Locality Conditions), and features and their associated functional categories needed for feature-checking operations (e.g., nominal and verbal phi-features, EPP-features, CP, TP/I). Acquisition proceeds by learners processing morpho-phonological units (i.e. words and their variations due to morphological inflection) and tagging them with features and categories provided by the inventory in UG. In this way, learners' internal grammars evolve over time as a consequence of the internal mechanisms selecting particular features from UG, which are stored with the words that are internalized from the input (see, e.g., Truscott & Sharwood Smith, 2004). Thus, learners do not internalize rules from the input; instead, grammar "grows" over time (see also, Schwartz, 1993).[2]

Let's take a relatively straightforward example: auxiliary *do* in *yes-no* questions in English. Typical *yes/no* questions are formed using *do*, while other options, such as subject-verb inversion, are prohibited as in (1) and (2) below. The reverse is true in a language like Spanish that has subject-verb inversion and lacks so-called auxiliary *do-support* as in (3).

(1) Does John live near the university?
(2) *Lives John near the university?
(3) *¿Vive Juan cerca de la universidad?*

While we can describe the use of *do* in questions with a statement like "insert *do* for *yes-no* questions and invert with the subject," in a mental grammar of English *do* is the result of a series of interactions between abstract features of the grammar. Comp, which is the head of the Complementizer Phrase (CP), contains some feature (we will call it "Q") that is able to enter into what is called an "AGREE relationship" with the features enumerated in auxiliary verbs in English that probe movement. This feature-based Agree relationship forces movement of *do* (which also contains the feature Q) out of the Inflectional Phrase (Infl), where it is generated to carry Tense features, and up to C, yielding the surface word order of typical *yes/no* questions. These kinds of syntactic operations occur when relevant lexical units have functional features that must be checked in the course of a syntactic derivation. What we describe as varying syntactic word orders are thus surface reflexes of functional feature checking that result in observable lexical insertion or movement of a constituent into a phrase to fulfill the AGREE relationship. Thus, our textbook type rule of "insert

[2]There have been calls for those of us working from generative perspectives to look at alternative theoretical approaches that are generative at heart, but not couched within the framework outlined here—which is essentially a Minimalist approach (see, e.g., the review in Lardiere, 2012). Nonetheless, I believe that whatever approach one takes to the nature of language culled from current linguistic theory, that approach would not espouse rules in the traditional sense.

do and invert subject and auxiliary verb" is not what actually exists in people's internal underlying grammars; it is a specific short hand way to describe a particular consequence of more abstract principles and underlying features of the grammar.

So, what exactly is learned from the input when it comes to *yes/no* questions? The answer is the auxiliary *do*, in all of its allomorphic realizations: *do, does*, and *did*. The learner must tag this lexical unit in the input, and during sentence computation (comprehension), the processor must assign it some kind of status. If the processing is successful, it will get tagged with the feature labeled [Q] in current Minimalist Theory (along with other relevant features). What gets internalized from the input then, is *do* with at least these features:

do: <+Q>, <−past>
does: <+Q>, <−past>, <3rd person>, <sing>
did: <+Q>, <+past>

Once the auxiliary is tagged in this way, it can participate in the constraints and/or parametric variations on the grammar that yield *yes/no* questions (e.g., verb movement or not). Of course, nothing guarantees that *do* gets tagged correctly at the outset, but that is irrelevant to the discussion here. The point is that learners do not learn a rule about *yes/no* question formation from the input; they process *do* and from this, *yes/no* question formation evolves in the grammar as the inventory of features in English is developed. (For more detailed discussion on the issue of "rules" in acquisition, see VanPatten & Rothman, forthcoming.)[3]

The point to be underscored here is that most research on instructed SLA has not conceptualized acquisition in this way. Nor has that research conceptualized underlying mental representation for language as I have done here. However, processing instruction does. The premise of processing instruction is not rule-internalization, but instead the correct processing of morpho-phonological units in the input. Processing instruction is informed by a particular model of input processing by VanPatten (e.g., VanPatten, 1996, 2004, 2007, 2009, 2012). We will focus on one aspect of the model that is the most relevant to the present research. In this model, learners begin processing an L2 using the First-noun Principle (FNP): learners tend to interpret the first (pro)noun they encounter in an utterance as the subject/agent. This processing principle has negative consequences for object-first sentences, English-like passives in which the

[3]Although I take a generative perspective on language in this paper along with what this perspective means for acquisition, I point out that emergentists would take a similar perspective on acquisition; that is, that acquisition involves the processing of input data and that "knowledge" builds up in the mind over time. In addition, emergentists do not subscribe to language as rules in the classic sense used in this paper; however, they also do not subscribe to a generative grammar with an innate component called Universal Grammar. In short, while generativists and emergentists disagree on the nature of language, and they also tend to use different data sets (because generativists are concerned with mental representation and emergentists are more focused on actual use), they agree in many ways about the role of processing in acquisition and the non-role of classic rules (see, e.g., Ellis & Larsen Freeman, 2006).

subject is not the agent, and case marking (learners may ignore it), among other grammatical structures. In the case of SLA, the FNP may lead to erroneous sentence interpretation. For example, in *gustar* [to like] constructions in Spanish, word order has been grammaticalized as indirect object-verb-subject as in *A Juan le gusta María* (lit: To $John_{DAT}$ is pleasing $Mary_{NOM}$). With such structures, learners tend to misinterpret Juan as the subject, "John likes Mary". In the same vein, learners misinterpret simple object-verb-subject sentences in which the object is a clitic direct object, such as *Lo ve María* (lit: Him_{ACC} sees $Mary_{NOM}$). In this case, learners misinterpret the clitic pronoun as a subject and equate lo with "he," that is, "He sees Mary." The result of a reliance on this processing principle in Spanish is problems in the acquisition (i.e. development) of the Spanish pronoun system as well as non-canonical structures such as *gustar*. In languages like German and Russian, this processing principle affects the acquisition of case marking, for example, and in a language like French this principle affects such things as left-dislocation of objects and the causative with *faire*. (I will present more information about these problems later when I describe a particular study on Spanish, German, Russian, and French.)

Processing instruction is an intervention or focus on form (not a method or an approach) designed to mitigate the outcomes of natural processing tendencies. In processing instruction, the problem of the FNP is tackled by providing activities that manipulate input such that learners are forced to abandon a reliance on the FNP. This manipulated input is referred to as structured input. Referential structured input activities within processing instruction usually begin a string of activities and are structured so as to have right or wrong answers. In the case of Spanish and clitic object pronouns, for example, learners hear a mixture of SVO, OVS, OV sentences in which both the subject and object are capable of performing the action (e.g., boy looking for a girl or a girl looking for a boy). They are asked to select between two pictures in order to indicate they have correctly processed and comprehended the sentence. Such activities are designed to force the learners' internal processors to abandon a strict reliance on the FNP. Affective structured input activities follow referential activities and are those that do not have right or wrong answers, but instead allow learners to offer opinions, indicate something about themselves, and so on. For example, students might see a list of OV sentences that may or may not indicate how they feel about a female relative (e.g., *la respeto* [I respect her], *la admire* [I admire her], *la detesto* [I hate her], *la adoro* [I adore her], *la comprendo bien* [I understand her well]) and are asked to indicate which ones apply to them. The purpose, again, of processing activities is to push learners away from the FNP and to correctly process both OVS and SOV sentences. In this way, the focus of processing instruction is not on rule internalization but the correct encoding of morpho-phonological units and their underlying features. That is, in the case of Spanish and clitic object pronouns, learners are not internalizing a rule for how sentences with object pronouns are formed; instead, they are learning to correctly interpret clitic object pronouns in the input. (For detailed information on processing instruction and structured input activities, see Farley, 2005; Lee & VanPatten, 2003; Wong, 2004, 2005.)

The question for instructed SLA, then, is whether something like grammatical sensitivity—which has been shown to correlate with rule learning in previous research when measured by the MLAT—would correlate or be a significant factor in the outcomes of processing instruction. Because processing instruction is not focused on rule learning, it is not clear that something like grammatical sensitivity would correlate with the outcomes of this particular treatment. However, Robinson (2002) makes this claim: "[processing instruction] may be a technique for inducing focus on form that is differentially affected by the fourth aptitude complex [...]—particularly the *grammatical sensitivity component* of what I have termed metalinguistic rule rehearsal" (p. 131). In the next section, I will summarize recent research that addresses this issue.

Summary of a Recent Study on Grammatical Sensitivity in Processing Instruction

In VanPatten, Borst, Collopy, Qualin, and Price (2013), we examined the effects of processing instruction across four languages in four different experiments. We looked at the processing/interpretation problems created by the intersection of the FNP and four distinct structures:

Spanish: clitic object pronouns and word order

German: accusative case on articles and word order

Russian: nominal accusative case and word order

French: causative *faire*

In the case of Spanish, German, and Russian, we looked at the effects of processing instruction on the above structures with both canonical and non-canonical word order. For Spanish, canonical word order was subject-object-verb and non-canonical was object-verb-subject. For German and Russian, canonical order was subject-verb-object and non-canonical order was object-verb-subject. Examples appear below.

Spanish:

(1) OVS: *Lo* *oye* *el gato*
him$_{ACC}$ hears the cat$_{NOM\text{-}MASC}$
"The cat hears him"

(2) SOV: *El gato* *lo* *oye*
the cat$_{FEM}$ him$_{ACC}$ hears
"The cat hears him"

German:

(3) OVS: *Den* *Hund* *hört* *die* *Katze*
the$_{ACC\text{-}MASC}$ dog hears the $_{NOM\text{-}FEM}$ cat
"The cat hears the dog"

(4) SVO: *Die* *Katze* *hört* *den* *Hund*
the $_{\text{NOM-FEM}}$ cat hears the$_{\text{ACC-MASC}}$ dog
"The cat hears the dog"

Russian:

(5) OVS: *Cooaky* *chauium* *kouika*
dog $_{\text{ACC-FEM}}$ hears cat $_{\text{NOM-FEM}}$
"The cat hears the dog"

(6) SVO: *Kouika* *chauium* *Coõaky*
cat $_{\text{NOM-FEM}}$ hears dog $_{\text{ACC-FEM}}$
"The cat hears the dog"

Pretests demonstrated that indeed our subject populations in each language were taking the first noun or pronoun as the subject/agent and were misinterpreting OVS strings as SVO strings (i.e., Spanish mean score = 2.3 out of 7.0; German mean = 1.15; Russian = 1.92).[4]

Because French does not scramble word order the way the other three languages do, we tested the FNP as it intersects with causative and non-causative *faire*. Examples appear below:

French:

(7) *Le garçon* *fait chanter* *une chanson* *à la fille*
the boy$_{\text{NOM-MASC}}$ makes to sing a song $_{\text{ACC-FEM}}$ to the girl $_{\text{DAT-FEM}}$
"The boy makes the girl sing a song"

(8) *Le garçon* *fait* *un tableau* *pour la fille*
the boy$_{\text{NOM-MASC}}$ makes a painting $_{\text{ACC-MASC}}$ for the girl $_{\text{OBL-FEM}}$
"The boy makes a painting for the girl"

Pretests demonstrated that our subject population took the first noun in the causative structure (7) to be the subject of the entire sentence, when in reality the subject of the second verb *chanter* is *la fille*. That is, the girl does the singing, not the boy. Thus, our subjects were interpreting the sentence to mean something like "The boy sings a song to the girl" (M = 0.52 out of 7.0).[5]

[4] The actual number of pretest items was ten, but only seven items were OVS sentences. In addition, one reviewer queried the level of proficiency for the participants and to what extent they had the same proficiency. In studies such as this, in which all participants are culled from a limited contact situation (i.e., end of third-semester beginning of fourth-semester of college language study), proficiency is not a significant factor; only prior knowledge of the target structure or ability to process it correctly is. Hence, the use of a pretest is to ensure that all participants were well below the level of being able to process OVS sentences correctly. In this case, that was a score of 3 or less out of a total of 7.

[5] See note 4.

For the treatment, all language groups listened to 50 sentences through earphones. These 50-sentence sets were constructed so that three items in a row had either non-canonical word order (for Spanish, Russian, and German) or causative *faire* (for French) and the fourth sentence had either canonical word order or non-causative *faire*. This ordering was necessary for our scoring procedure (described below). In the case of Spanish, German, and Russian, the task was to listen to a sentence and then indicate which of two pictures represented what they heard. In the case of examples (1) through (6) above, the picture would have been (a) of a cat hearing a dog sneaking up on it or (b) of a dog hearing a cat sneaking up on it. All the sentences involved the same vocabulary for all three languages and involved looking at the same pictures. Pictures were presented on a computer screen via SuperLab 4.0 and participants indicated their choice by pressing either an "a" or a "b" button on a response pad. After each item, participants received feedback without explanation (i.e., "Correct! Proceed to the next item." or "Sorry. Incorrect. Proceed to the next item.").

For French, given the nature of the sentences, each sentence was accompanied by a question instead of pictures. In (7), for example, the participants heard the sentence and then pressed a button to get this question: "Who sings a song? a. *le garçon* b. *la fille*." Once they made their selection by pressing the response pad, these participants received the same type of feedback as those in the other language groups. As opposed to typical processing instruction treatments, the treatment in this study was limited to referential items. Because of the laboratory nature of the study, affective items were not used.

All participants in all groups worked at their own pace through the 50 sentences. The principal measure we took was trials-to-criterion. Trials-to-criterion refers to how long it takes an individual to begin processing correctly. For example, Jane Doe might begin processing OVS structures in Spanish by item number 12, while John Smith might begin processing the same structures by item 20. (SuperLab records all responses as well as other data.) Processing correctly was operationally defined as it was in previous research (e.g., Fernández, 2008; Henry, Culman, & VanPatten, 2009): (1) the correct processing of three OVS (or causative *faire*) plus one non-OVS (or one non-causative *faire*), all in a row; (2) the initial criterion must be followed by a percentage of correct interpretations above 60% for the rest of the treatment.

There were two factors we examined. One was the role of explicit information. All language groups were divided into two groups: +explicit information (+EI) and –explicit information (−EI). The +explicit information group received a short, jargon-free explanation of both the structure and the processing problem prior to working with the 50-item set of sentences. The –explicit information groups received no such information and simply began working through the items. We also administered two sections of the MLAT: (1) the Words-in-Sentences section (as our measure of grammatical sensitivity) and (2) the section in which participants read English words that are spelled in unconventional ways and then select from a list of possible synonyms. This latter part of the MLAT served as a distractor task.

Figure 2-1 Research design used in VanPatten et al. (2013)

Languages	FNP intersected with…	Factor 1 and n sizes	Factor 2	Treatment (50 items in all cases)	Procedural steps
Spanish	Clitic objects	+EI: 23 −EI: 19	Scores on MLAT Words in Sentences	OVS and SOV sentences	1. Informed consent 2. Pretest (10 items) 3. Words in sentences test 4. "Spelling" test 5. 50-item treatment
German	Article case marking	+EI: 24 −EI: 22	Scores on MLAT Words in Sentences	OVS and SVO sentences	
Russian	Nominal case marking	+EI: 23 −EI: 21	Scores on MLAT Words in Sentences	OVS and SVO sentences	
French	Causative *faire*	+EI: 23 −EI: 25	Scores on MLAT Words in Sentences	Causative *faire* and non-causative *faire*	

EI = explicit information prior to treatment.

The ordering of events was as follows: 1. introduction and informed consent; 2. pre test (10 items, seven of which were targets); 3. Words-in-Sentences section of the MLAT; 4. distractor section of the MLAT; 5. treatment with the 50-item sentence set. All participants completed the experiment in one hour. The research design is summarized in Figure 2-1.

For the purposes of the present chapter, I will not detail the results of the factor explicit information in the experiment, except to say that it showed up as an effect for the measure trials-to-criterion only in German ($F[1, 44] = 15.574, p < 0.0001, \eta^2_{\text{partial}} = 0.26$) and French ($F[1, 47] = 27.816, p < 0.0001, \eta^2_{\text{partial}} = 0.38$). In short, in German and French, participants began processing sooner if they received explicit information prior to treatment; this did not happen in the Spanish ($F[1, 41] = 0.083$, $p = 0.78$, $\eta^2_{\text{partial}} = 0.002$) and Russian ($F[1, 43] = 2.270, p = 0.14, \eta^2_{\text{partial}} = 0.05$) groups. Descriptive statistics are provided in Table 2-1.

For the factor grammatical sensitivity, there were no significant correlations between scores on the MLAT Words-in-Sentences and trials-to-criterion except in one instance: for the German +explicit information group ($r = -.437, p = .03$).[6] No other language groups showed any significant correlations. These results are summarized in Table 2-2.

[6]For trials-to-criterion, correlations should be negative; that is, the higher the score on Words-in-Sentences, the lower should be the trials-to-criterion score (indicating the learner is processing sooner than later).

Table 2-1 Descriptive Statistics for Results of Trials-to-criterion (from VanPatten et al., 2013)

Group		M	SD
Spanish	+EI (n = 23)	19.78	5.19
	−EI (n = 19)	18.68	3.15
German	+EI (n = 24)	5.25	10.65
	−EI (n = 22)	23.96	20.40
Russian	+EI (n = 23)	10.48	13.63
	−EI (n = 21)	18.10	19.62
French	+EI (n = 23)	7.30	10.94
	−EI (n = 25)	29.68	17.42

EI = explicit information.

Table 2-2 Correlation of GS with Trials-to-criterion (from VanPatten et al., 2013)

	+EI	−EI
1. Spanish: FNP with OVS sequences and clitic object pronouns	No: r = −.271 p = .21	No: r = −.320 p = .18
2. German: FNP with OVS sequences and case marking on articles	Yes: r = −.437 p = .03	No: r = .224 p = .32
3. Russian: FNP with OVS sequences and case marking on nouns	No: r = −.241 p = .27	No: r = −.148 p = .52
4. French: FNP with causative faire	No: r = −.185 p = .40	No: r = −.114 p = .59

EI = explicit information; GS = grammatical sensitivity; FNP = First-noun Principle; OVS = object-verb-subject sequences.

In short, our study failed to show any significant role for grammatical sensitivity for any language, for the processing of any sentence type, either in terms of trials-to-criterion or a post test. The lone exception, as noted, was the German +EI group. We cannot tell at this point if this lone significant correlation is generalizable or is spurious. Given the results of the other groups, it would appear that this particular result is spurious.

Correlations do not have to be looked at solely in terms of significance (i.e., whether a *p* value is less than .05), although they normally are. The range of *r* values in Table 2-1 for trials-to-criterion is −.437 to .224. As Table 2-1 shows, there is one correlation in the −.4 range, one in the lower −.3 range, two in the −.2 range, three in the −.1 range, and one in the positive .2 range. These are not particularly strong sets of correlations under most accounts, and as stated in note 4, correlations for trials-to-criterion should all be negative if there is a relationship to grammatical sensitivity.

Discussion and Conclusion

The results of VanPatten et al. are intriguing from the perspective of aptitude as an individual difference—in the present case, grammatical sensitivity as a subcomponent of aptitude. Whereas previous research has documented significant correlations between grammatical sensitivity and various treatments and instructional formats, VanPatten et al. did not obtain such results except in one isolated case. It is important to keep in mind that the VanPatten et al. study contained four experiments, one in each of the four languages of Spanish, German, Russian, and French. The sample population was the same, and the research design across the four experiments was kept as constant as it could be and the experimental conditions were the same. Thus, there was a built-in replication effect for the four experiments. With one experiment, we might consider the results to be spurious. But because there were a total of four experiments, our conclusion is that we are actually seeing a non-effect for grammatical sensitivity in our research on processing instruction.

Why the difference in results between our research and previous research? I will argue that the difference must be due to (1) the underlying conceptualization of language, (2) the underlying conceptualization of acquisition, (3) the nature of the treatment/intervention, and (4) the nature of the measures used. Regarding language, as stated earlier in this chapter, most instructed SLA research seems to conceptualize language as "rules in the head." Thus, learners have a "rule for the passive" or a "rule for the use of the subjunctive" or a "rule for plural formation"—in general "a rule for X." But in current generative theory, such rules do not exist: they are shorthand ways to talk about concepts that are too complex and abstract to describe in simple rules. To be sure, in generative theory we can talk about rules, but in doing so we are cognizant of the fact that such rules are surface manifestations of the intersection of various aspects of the grammar working together to create a sentence. As stated earlier in this chapter, what exists in the peoples' minds is a lexicon, with each entry containing not only meaning but also grammatical information related to syntax (e.g., features, categories). What also exists in the minds of people is a syntactic component that computes or generates sentence structure. Lexical items are selected for "insertion" into the syntax and when this happens, various operations occur to yield what is spoken or written.

If we conceive of mental representation as described above, then language acquisition will have to be conceptualized differently. Acquisition becomes the processing of lexical (morpho-phonological) units in the input, which in turn are processed by internal mechanisms tasked with making language. Syntax emerges over time as the appropriate features and relevant constraints in the L2 are selected and activated. During sentence comprehension, then, the learner's parsing mechanism (which makes sense of the input stream) tags morpho-phonological units with meaning, while at the same time tagging them with categories (e.g., noun, verb, adjective). Internally, these items are analyzed for features based on any additional information provided by the sentence (e.g., *do* is tagged with the feature [Q] because it seems to appear in a question; the Spanish

clitic object pronoun is tagged with [A] because it seems to be an anaphor). As learners hear more and more sentences and build up a more robust lexicon, additional information is computed and used by the internal mechanisms to continue creating a mental representation (e.g., *do* always appears before a subject and a lexical verb always appears after the subject, so this language does not have verb movement; *do* must be in Comp and thus must be the head of Comp, so this language must have the feature +Q in Comp which probes and attracts *do* from another position in the sentence). Acquisition, then, proceeds not through rule internalization, but by the successful processing and parsing of elements in a sentence combined with internal mechanisms that operate on lexical items processed in the input.

This conceptualization suggests that an appropriate treatment or intervention might be one that promotes or forces correct processing of morphophonological units in the input. That is, if we understand that acquisition proceeds *initially* from the way that learners process input sentences, then interventions that are based on how learners actually process sentences are better candidates for aiding acquisition than those that do not. Having as its underlying premise various principles that guide learner input processing is precisely what distinguishes processing instruction from all other focus-on-form interventions.

Finally, the object of an intervention may be measured in different ways depending on what the treatment is. In the case of processing instruction, the measure always involves interpretation (correct vs. incorrect) of sentences. This measure may be something like a post test or it may be something like trials-to-criterion. These kinds of measurements are much different from grammaticality judgment tasks, sentence completion, translation, and other measures used in most instructed SLA research. Because such research is focused on rule learning, one has to test whether learners know a rule, especially when some of the treatment conditions involve having the learners explicitly looking for rules. But when the research is focused on whether or not learners are correctly processing sentences, the measure has to be about sentence interpretation.

These four aspects of research—conceptualization of language, conceptualization of acquisition, conceptualization of treatment, and nature of the measurement—directly impact how a researcher designs and executes a study, as well as how that researcher interprets the results. In the present case, my interpretation of the VanPatten et al. research is that it strongly suggests that grammatical sensitivity is not an important factor in processing instruction, and by extension, how input processing develops over time in learners (with or without intervention). The reason for this is that the test of Words-in-Sentences as a measure of grammatical sensitivity is predicated upon the notion of rule learning. This particular test was formulated in the 1950s (e.g., Carroll & Sapon, 1959, based on Carroll's prior research) and was strongly influenced by structural linguistics (i.e., a language can be described by a list of rules) and the dominant learning paradigm of the time, behaviorism (i.e., learning is the internalization of habits, and habits in this case were language rules). Thus, a test of language aptitude developed in the 1950s would naturally have traits that reflect the prevailing beliefs of the time. Although theoretically we have

moved away from both structural linguistics and behaviorism, it is not clear to me that we have gotten away from the notion of rules in applied linguistics circles (something I will return to when I discuss more recently developed tests of aptitude below). However, the moment we change both the perspective on language and what acquisition is, and then develop treatments and assessments to reflect this change, such correlations do not automatically fall out. Indeed, in the case of the VanPatten et al. study, such correlations are not there. As far as individual differences are concerned, what this means is that what is considered an individual difference may be a reflex of a particular framework with underlying assumptions about language and acquisition. Teaching rule learning in some way and then checking to see if sensitivity to rules is at work will most likely yield a correlation. Intervention as processing, however, would not yield the same correlation.

To be sure, this argument does not mean there are no individual differences in input processing or in processing instruction. The standard deviations and range of scores on trials-to-criterion in the VanPatten et al. study suggest there are. To take one example, in the Russian +explicit information group, the mean score for trials-to-criterion was 10.48, with a standard deviation of 13.63; for the –explicit information group, the mean was 18.10 with a standard deviation of 19.62. What is more, in the Russian +explicit information group, one person did not reach criterion; in the –explicit information group, four people did not reach criterion. Given these kinds of results, clearly there are individual differences in performance in a treatment such as processing instruction. However, given also that grammatical sensitivity did not emerge as a significant correlate in the VanPatten et al. study, the only conclusion that can be drawn from such results is that grammatical sensitivity was not the individual difference responsible for the variation in scores, or, to be generous, did not contribute significantly to the variation in performance observed among individuals. The more appropriate conclusion, then, is that individual differences such as those observed in this study must be attributed to some other factor or trait. Because research on individual differences in processing instruction has just begun, it is not clear what this trait might be. Working memory suggests itself as one possibility. Because part of the processing of sentences involves holding one piece of information in working memory while processing another part of the sentence, individual differences in this ability would seemingly show up in something like processing instruction. We are currently turning our attention to this matter by replicating parts of the VanPatten et al. study, but using scores on a working memory test as the measure of individual difference as opposed to grammatical sensitivity (VanPatten & Santamaria, in progress). As of this writing, we have tested 44 participants. We are not finding that working memory as measured by traditional working memory tests is a significant factor in processing instruction. However, Sanz, Lin, Lado, Bowden, and Stafford (submitted) have found that in a processing instruction-like treatment with Latin, working memory seems to play a role in the absence of explicit information prior to treatment. It does not appear to play a role when explicit information is provided prior to treatment. Clearly, research on working memory and processing instruction is warranted, then.

Before concluding, I would be remiss without mentioning more recent claims about aptitude. Skehan (2012) provides an overview of recent developments in aptitude research, including newer tests such as the LLAMA and the Canal-F. Perhaps using these newer measures we will uncover the source of individual differences in processing instruction, but again, much will depend on the underlying assumptions about language and acquisition used to formulate these tests. I am not sure, however, that these newer tests have abandoned the concept of rule learning. The LLAMA aptitude test (Meara, 2005), for example, contains a section called "Grammatical Inferencing." Originally, this section asked participants to read sentences in an unknown language along with a translation in the L1. The task of the participants is to "work out the grammatical rules that operated in the unknown language" (Meara, 2005, p. 15). Subsequently, this section was altered to be more of a grammaticality judgment task, and as the manual for the test claims, "If your main purpose is to identify really good analytical linguists, then this test is a good place to start" (Meara, 2005, p. 15). It is clear, then, that at least in this test, the conceptualization of language and language acquisition is still routed in traditional applied linguistics notions of rules and rule learning. The same can be said of the Canal-F test. Grigorenko, Sternberg, and Ehrman (2000) describe section 5 (called "Learning Language Rules") in the following way: (1) participants are given some vocabulary, some grammar, and some examples of how the Ursulu language works; (2) based on the information provided, participants are expected to "have learned the most evident rules of Ursulu language" (p. 396). In addition, these authors also discuss language "acquisition" processes as underlying traits, one of which is the following: selective transfer. They state, "It is particularly helpful to learners in understanding how, based on their previous knowledge, they can carry over to a different context the rules they have learned in a previous situation" (p. 392). While not explicitly stated by either the LLAMA or Canal-F descriptions, it seems that rule learning is also *conscious* rule learning. Perhaps for this reason, Skehan (2012) claims that grammatical sensitivity (however it is measured) continues to generate consistent correlations in aptitude research (p. 391). As stated earlier, if you believe acquisition is about rule learning and then you test people's abilities to analyze rules, you are likely to get correlations in instructed SLA.

Because the AAUSC volumes attempt to relate theory and research to practice, as well as teaching assistant education via language program direction, it is tempting to make such connections. However, because the work on individual differences in processing instruction is just beginning, such connections must be tentative, even though I believe my analysis of the nature of aptitude is correct. The first connection I would like to make is that aptitude, as it is currently formulated, has little to do with acquisition but a good deal to do with explicit rule learning. Instructors should understand the difference between underlying mental representation and the learning of textbook rules. It is probably not out of line to claim that most instructors believe that what is presented in textbooks is what learners internalize. But given the research and arguments in this paper (as well as research and arguments from the theoretical side of things), such a belief should be challenged during teaching assistant education and training.

If acquisition is a result of processing (along with other internal processes and mechanisms), then what does rule learning have to do with how language gets in learners' heads? This is not trivial as instruction can only be advanced if teachers understand the nature of the object of acquisition (i.e., language) as well as the nature of acquisition itself. As far as individual differences are concerned, it is not clear which differences impact acquisition. As shown here, there is individual difference in performance when it comes to trials-to-criterion. It is also shown that this is (most likely) not due to some kind of aptitude. Because processing instruction lends itself well to online environments, this is good news; any learner, regardless of underlying aptitude for "rule" learning, can benefit from processing instruction because its effects are not dependent on some kind of special ability. However, some learners do seem to take longer to reach criterion compared to others. This does not suggest that these learners need some specialized treatment. It may be they just need more structured input activities (i.e., exposure to more "items"). Again, such suggestions and connections are tentative while we await continued research on individual differences in processing instruction.

To conclude, then, I list the following points:

- how researchers conceptualize language influences how they conceptualize acquisition;
- these conceptualizations lead researchers to consider certain individual differences as opposed to others;
- processing instruction departs significantly from most treatments used in instructed SLA research regarding these conceptualizations;
- as such, processing instruction outcomes do not correlate with typical individual differences researched in instructed SLA in terms of grammatical sensitivity or ability to learn rules.

To be sure, these are strong claims; but only strong claims lend themselves to rigorous discussion as well as empirical investigation.

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