Measuring Explicit and Implicit Knowledge: a Psychometric Study in SLA

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ABSTRACT

Lack of valid means of measuring explicit and implicit knowledge in acquisition of second language is a concern issue in investigations of explicit and implicit learning. This paper endeavors to validate the use of four tests (i.e., Untimed Judgment Grammatical Test, UJGT; Test of Metalinguistic Knowledge, TMK; Elicited Oral Imitation Test, EOIT; and Time pressured Judgment Grammatical Test, TJGT) from a set of instruments introduced by Ellis (2005) to measure explicit and implicit knowledge of ESL learners. The result of Principal Component Analysis shows the UJGT and TMK loaded on the first factor (i.e., explicit knowledge) and the EOIT and TJGT loaded on the second factor (i.e., implicit knowledge) when a two factor solution was imposed. The study also shows that second language students respond in a different way to ungrammatical and grammatical sentences in the UJGT. Hence, Pearson Product Moment Coefficient tests have been conducted amid the ungrammatical and grammatical sentences in the UJGT and other instruments. The outcome suggests that in the case of UJGT ungrammatical sentences would provide a superior measurement of explicit knowledge.

Keywords: *ESL, SL, implicit knowledge, explicit knowledge, test measurement*

INTRODUCTION

THE terms implicit and explicit knowledge have been applied to language knowledge originally by Bialystok (1978). Bialystok suggests that ultimate language fluency and acquisition largely depends on the amount of implicit language knowledge or *knowledge of a language* one has. Explicit language knowledge or *knowledge about a language* represents the conscious facts that can be articulated about the language. Her definition indicates similarities between the concepts of Krashen's (1981) "learned system", Anderson's (1993) "declarative knowledge" and Langacker's (1991) "external grammar" with explicit language knowledge. These are all characterized by awareness of the language knowledge that comes through analyzing the language. Similarly, "acquired system", "procedural knowledge", and "internal grammar" are comparable to implicit language knowledge, and can be characterized as fluent and accurate language use which comes about without thinking or analyzing that knowledge.

Dispute over the interaction between implicit and explicit knowledge or whether explicit knowledge transforms to implicit knowledge in cognitive psychology is recognized as the *issue of interface* with three specific views on instructing grammar: the *non-interface* view whose advocates believe that explicit knowledge cannot transform into implicit knowledge of grammar; the *strong interface* view whose advocates believe that explicit knowledge can transform into implicit knowledge of grammar; and the *weak interface* view whose advocates believe that explicit knowledge can transform into implicit knowledge of grammar in certain circumstances and under certain restrictions (Dalili, 2011; Spada, 2015).

Some scholars such as Krashen (1982) debated in favor of the non-interface view, while others, such as DeKeyser (1998) reinforced the strong interface view. The criticisms directed at both views led to the emergence of the integrative view which is recognized as the weak interface view (Ellis, 1994). According to this theoretical perspective, it seems that "explicit knowledge by assisting learners to notice linguistic forms of input and make a comparison between what they have noticed and their own current interlanguage (i.e., by noticing the gap) contributes indirectly to the development of implicit knowledge" (Ellis, 2008).

Second language acquisition (SLA) researchers' interest in interface studies and debates whether explicit knowledge of grammatical forms have a facilitating role or convert to implicit knowledge highlighted the necessity of measuring implicit and explicit knowledge separately.

Yet, pure measurements of either implicit or explicit knowledge currently do not exist (Akakura, 2009). "Recent experimental developments in measuring language knowledge, however, have enabled closer approximations in discriminating between implicit and explicit knowledge" (Ellis, 2005, cited in Rohollahzadeh Ebadi, Mohd Saad, & Abedalaziz,, 2014b, p. 26).

Building on the study of Han and Ellis (1998), Ellis (2005) sought to develop a battery of instruments that would make available moderately distinct measurements of explicit and implicit knowledge and incorporate a measure of target structures in natural, unplanned language use. Ellis first hypothesized behavioral measures differentiating the two knowledge types. Three criteria hypothesized to translate into how the tests could be created so as to probabilistically obtain indications of the degree of the two knowledge types were: the amount of *time available*, with time pressure (implicit) vs. no pressure (explicit), the *focus of attention*, with primary focus on meaning (implicit) vs. primary focus on form (explicit) and the *utility of metalanguage*, not required (implicit) vs. encouraged (explicit). Additional conditions were hypothesized to provide supporting evidence that the test was in fact measuring what it purported to measure. These were: the *degree of awareness,* responses by feel (implicit) vs. responses by rule (explicit); *systematicity,* consistent responses (implicit) vs. variable responses (explicit); and the degree of *certainty in response*, high (implicit) vs. low (explicit). *Learnability,* related to the notion of a maturational factor in SLA that is age dependent (Long, 2007; Singleton & Ryan, 2004), was also cited as an observed tendency, with early learning favored (implicit) vs. later form-focused instruction favored (explicit). These criteria are summarized in Table 1.

Table 1 Criteria for Measuring Explicit and Implicit Knowledge

Criterion	Explicit knowledge	Implicit knowledge	Current understanding
Primary focus of attention	Form	Meaning	Empirical support (Ellis et al., 2009)
Time available	Unrestricted	Restricted	Empirical support (Ellis, 2005; Han & Ellis, 1998).
Metalinguistic knowledge	Encouraged	Not required	Theoretical support (Elder & Manwaring, 2004)
Degree of awareness	Response according to rule	Response according to feel	Unreliable as dependent on self-report
Systematicity of response	Variable	Consistent	Empirical evidence for variable explicit knowledge (Han & Ellis, 1998).
Degree of certainty in response	Low	High	Empirically unsupported (Ellis, 2005; Roehr, 2006)
Learnability	Late explicit instruction favored	Early learning favored	Theoretical support (Long, 2007; Singleton & Ryan, 2004)

Note. (Adapted from Ellis, 2005, p. 152)

Several researchers (Ellis, 2005; Bowles, 2011; Ellis & Loewen, 2007) then explored the extent to which it is conceivable to differentiate implicit from explicit knowledge on the basis of behavioral measures

hypothesized to distinguish between the two knowledge types. In a study among 91 second language (L2) participants and 20 first language participants, knowledge of 17 English constructions deemed difficult by L2 users was examined using a set of five tests consisting of "an elicited oral imitation test, oral narrative test, timed grammaticality judgment test, untimed grammaticality judgment test, and a metalinguistic knowledge test" (Ellis, 2005, p. 156). Test scores were analyzed to determine whether there are two underlying dimensions (explicit and implicit) in knowledge of second language. A confirmatory factor analysis revealed that there were indeed two separate factors these tests loaded onto. The two oral tests (imitation/ narrative) and "the timed grammaticality judgment test" which required the unplanned language use under speeded conditions loaded on one factor. "The untimed grammaticality judgment test and metalinguistic tests" which were expected to be representative of analyzing explicit knowledge loaded on another (Ellis, 2005, p. 161).

The significance of this result is that it confirmed it is conceivable to measure explicit and implicit knowledge separately by manipulating the conditions to elicit one type of language knowledge over the other. Ellis and Loewen (2007) and Bowles (2011) in separate studies confirmed and supported Ellis's results.

Using multiple measures of explicit as well as implicit knowledge was deemed necessary to avoid making erroneous inferences (VanPatten & Sanz, 1995), especially since no pure measures of explicit and implicit L2 knowledge are possible.

The goal of this study was to validate the Elicited Oral Imitation Test *(EOIT)*, Time pressured Judgment Grammatical Test *(TJGT),* Untimed Judgment Grammatical Test *(UJGT)*, and Test of Metalinguistic Knowledge *(TMK)* from a set of tests represented in Ellis (2005) to make available relatively separate measures of explicit and implicit L2 knowledge following Ellis's guidelines in Malaysia.

Thus, this research attempts to find out whether the EOIT and TJGT are valid tests for measuring implicit knowledge of ESL learners in Malaysia and also whether the UJGT and TMK are valid tests for measuring explicit knowledge of ESL learners in Malaysia. Hence the specific question motivating the study is:

- Do scores of the EOIT, TJGT, UJGT and TMK load on two factors, and provide construct validity for the tests to measure explicit and implicit L2 knowledge of English learners in the context of Malaysia, in the way that they did in R. Ellis (2005)?

METHOD

Research context

This study was done in a selected academic center in Kuala Lumpur in March 2013. While there is no consensus among scholars about the appropriate size of a sample in Principal Component Analysis (PCA), which is performed in this study, there is a suggestion to have at least 100 +- 10 cases for PCA (Hatch & Lazaraton, 1991). Thus, we administered the instruments to a group of 94 postgraduate ESL students having the same language proficiency level.

A background questionnaire revealed that most of the L2 users (87%) were from East Asian origin with the mean age of 29 years who were staying more than six months in Malaysia.

Content of the Tests

The tests in this study were designed and adapted from a set of instruments (Ellis et al., 2009) to provide appropriate measurement of learners' L2 knowledge of six grammatical structures. The specific structures were selected primarily based on the judgments of ten scholars in the field of Linguistics and SLA from "a list of universally problematic structures to learners" (Ellis et al., 2009, pp. 43-44), using a five-point Likert Scale. The rating scale of the questionnaire determined the number of problematic structures to be used as specific structures of the study. Finally, *Regular past tense, Modal verbs (can, have to), Unreal conditionals, Present perfect tense and Comparative adjectives* were selected (Rohollahzadeh Ebadi, Abedalaziz, Mohd Saad, & Chin, 2014).

Description of the Tests

(a) Elicited Oral Imitation Test (EOIT). The EOIT consists of 24 belief sentences. Half of the sentences (i.e., 12 statements) are grammatically correct and the other statements are grammatically incorrect. In this test four statements, two grammatical and two ungrammatical, are allocated to each specific structure. Using

audio tape, each sentence one by one was presented orally: To focus students' attention on the meaning, they were required first to indicate whether the sentence is True or False, or whether they are not sure about it. Then, students were required to restate the correct form of the sentence verbally. Learners' answers to the statements were recorded by audiotape to analyze and find out whether a specific structure had been applied. Each reproduced sentence was assigned a mark either one (if the target structure was correctly reproduced) or zero (if it was avoided or incorrectly imitated).

(b) *Time pressured Judgment Grammatical Test (TJGT).* The TJGT consists of 36 sentences, 18 grammatical and 18 ungrammatical sentences. Six sentences (i.e., three grammatical and three ungrammatical sentences) have been allocated for each target structure of the study. The test was delivered on the computer screen within a specific time limit, using PowerPoint slides for each student in computer labs. Students were required to judge whether each sentence is ungrammatical or grammatical by marking the correct response in their answer sheets. "The time limit for each sentence was specified on the basis of average response time by native speakers. Considering slower processing speed of ESL learners, 30% of [the] time taken for each sentence was added" (Rohollahzadeh Ebadi, Mohd Saad, & Abedalaziz, 2014a, p. 14). Each item of the test was scored either correct or incorrect, with unanswered items marked as incorrect.

(c) *Untimed Judgment Grammatical Test (UJGT).* The UJGT included the same types of sentences as the TJGT but in different order. It was also delivered in written form but on paper. Students were asked to point out whether each statement is True or False, just as they had done in the TJGT, except that they were instructed to answer at their own pace because the test had no set time limit.

(d) *Test of Metalinguistic Knowledge (TMK).* This test is based on the test in Alderson, Clapham, and Steel (1997) as reported in Ellis et al. (2009). This is an untimed test in two sections. The first section included 12 ungrammatical sentences based on the target structures of the study. Each sentence contains a grammatical error which is underlined. Students are asked to select the rule, out of 4 provided choices, that best explains each error. In the second section students are presented with another 12 sentences. In front of each sentence is a bracket within which a grammatical feature is mentioned. Students are asked to find the item requested and underline it in the presented sentence. And finally a total percentage accuracy score is calculated.

The EOIT and the TJGT are designed to measure implicit L2 knowledge of our target structures. "These tests are designed to elicit the learners 'feel' for what was grammatical, they will require learners to process language without encouraging the use of metalinguistic knowledge" (Ellis et al., 2009, p. 46). UJGT and TMK are designed to measure explicit L2 knowledge, "favor the use of 'rule' and are unpressured, it will focus attention on form and encourage the application of metalinguistic knowledge" (See Table 3) (Ellis et al., 2009, p. 46).

Table 3 Features of the Instruments of the Study

Measure	EOIT	TJGT	UJGT	TMK
Awareness degree	by feel	by feel	by rule	by rule
Availability of time	pressured	pressured	not pressured	not pressured
Concentration	on meaning	on form	on form	on form
Utility of Knowledge of Metalanguage	no	no	yes	yes

Source. Adapted from Ellis et al., 2009, p. 47

Data Analysis and Results

Establishing reliability. Instrument reliability was calculated using Cronbach's alpha coefficient of internal consistency (SPSS Version 21). The instruments for measuring implicit L2 knowledge consisted of EOIT and TJGT. These tests were conducted under time pressure and their focus of attention was on meaning. The instruments for measuring explicit L2 knowledge consisted of UJGT and TMK. In these tests the focus of attention was on form and the measures of explicit L2 knowledge were self-paced; participants were given no restrictions on the amount of time to reflect on their knowledge. The tests were conducted in a language laboratory at the education center for all participants in this order: EOIT, TJGT, UJGT and TMK. This order of presentation ensured that the explicit knowledge tests would not prime learners. The four tests took around

two hours to complete by participants. The number of target items tested in each test is described in Table 4.

Table 4 Number of Target Items Tested in the Study

Test	Grammatical Items	Ungrammatical Items	Total
EOIT	12	12	24
TJGT	18	18	36
UJGT	18	18	36
TMK	12	12	24

As summarized in Table 5, the reliability values of the four instruments are above .80; therefore suggesting very good internal consistency (Pallant, 2010).

Table 5 Reliability (Cronbach's alpha) Value of Instruments

Test	N of participants	N of items	Cronbach's alpha
EOIT	94	24	.87
TGJT	94	36	.91
UGJT	94	36	.82
MKT	94	24	.86

Moreover, Item-Total Statistics table of analysis shows correlation value of more than 0.3, indicating appropriate correlation of each item with the total score (Pallant, 2010).

Establishing validity. Evidence for test validity was first investigated by judgment of ten scholars in the field of linguistics.

Second, in order to check for evidence that the tests may tap the types of knowledge as hypothesized, construct validity of the instruments was assessed.

In order to investigate whether the EOIT, TJGT, UJGT and TMK predominantly assessed the types of knowledge as hypothesized, a PCA was conducted. "Principal Component Analysis is directed toward enabling one to use fewer variables to provide the same information that one would obtain from a larger set of variables" (Leech, Barrett, & Morgan, 2005, p. 76).

Prior to PCA, the researcher visually inspected the bivariate correlation matrix as a preliminary step to assess inter-item correlation. The investigation indicates moderate range (.3) and above for most of the values. Then, the researcher calculated the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy. This was attained by "a ratio of the sum of the squared correlations to the sum of the squared correlations plus squared partial correlations" (Pallant, 2010, p. 181). The result shows The KMO value was acceptable at .794 indicating factor analysis was appropriate for the scale. Moreover, as presented in Table 6 Bartlett's Test of Sphericity was significant [χ^2 (11.28) = 2884.824]; hence the null hypothesis that the correlation matrix was an identity matrix was not met.

Table 6 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.794
Bartlett's Test of Sphericity	Approx. Chi-Square	2884.824
	Df	1128
	Sig.	.000

"By rejecting the null hypothesis the correlation matrix was deemed acceptable for factor analytic techniques" (Pallant, 2010, p. 181). The results shows high communalities extending from .488 to .831, and factors with eigenvalues of greater than 1.0, accounting for 69.25% of variance. Inspecting the scree plot (see Figure 1), and judging from previous theory, two factors which capture much more of the variance (44.74%) were retained.

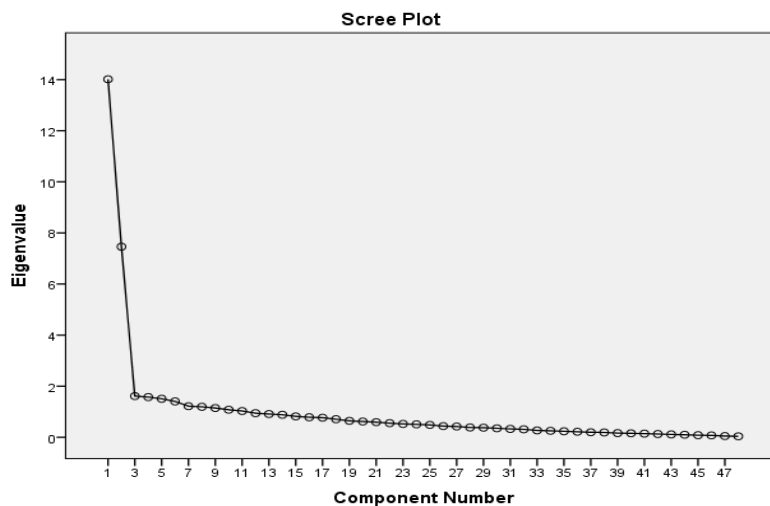Figure 1 shows the Scree plot of the sores in PCA.

Figure 1. The Scree plot in PCA.

Additionally, the Component Matrix table indicates that most of the items load quite strongly (above .4) on the first two components.

Ideally, an additional Confirmatory Factor Analysis which assumes all associations between factors as unanalyzed may also be conducted, as has been pointed out by Isemonger (2007). However, as the Principal Components Factor Analysis yielded two factors, a Confirmatory Factor Analysis was not conducted.

Third, in order to examine the psychometric properties of the ungrammatical and grammatical statements in UJGT, as proposed by Ellis and his colleagues (2009), Pearson Product Moment Coefficient analysis was conducted. The result is shown in Table 3.7.

Table 3.7 Correlation Matrix of Grammatical and Ungrammatical Structures in UJGT with Other Three Tests

	TJGT	UJGT grammatical structures	UJGT ungrammatical structures	TMK
EOIT				-.144
TJGT			-.029	-.084
UJGT grammatical structures	.894*	.859*	.008	.005
		.876*	.067	
UJGT ungrammatical structures				.791*

* Correlation is significant at the .05 level.

As shown by the results in Table 3.7 the scores of the grammatical sentences of UJGT correlate significantly (at .05 level) with scores of the other tests, but more strongly with scores of the EOIT (r = .859) and TJGT (r = .876) than with scores of the TMK (r = .005). In contrast, the ungrammatical sentences' scores

correlate very strongly with scores of the TMK (*r* = .79) and less strongly with scores of the EOIT (*r* = -.029) and TJGT (*r* = .008).

CONCLUSION

This study was primarily concerned with providing evidence for the construct validity of four tests from a set of tests designed in Ellis (2005) to make available moderately separate measures of explicit and implicit knowledge. The research question addressed the issue of validity generally and asked whether scores on the four tests would load on two separate factors, one representing implicit knowledge and the other representing explicit knowledge.

The result of PCA shows that the EOIT and TJGT loaded on one factor (implicit knowledge) and the UJGT and TMK loaded on the second factor (explicit knowledge) when a two factor solution was imposed. Hence the study supports the theory (Ellis, 2005) that implicit and explicit knowledge each represent separate constructs.

Moreover, the result of Pearson Product Moment Coefficients between the scores of the ungrammatical and grammatical statements in UJGT and scores of the other tests shows that the grammatical sentences' scores correlate more strongly with the EOIT and TJGT than with TMK. In contrast, the ungrammatical sentences' scores correlate very strongly with scores of the TMK and less strongly with scores of the EOIT and TJGT. This suggests that in the case of UJGT the scores of the ungrammatical sentences would provide a better measure of explicit L2 knowledge than the scores of the grammatical sentences or total scores.

Therefore, this study provides support for the construct validity of the EOIT, TJGT, UJGT and TMK from the battery of tests in Ellis (2005), with another population of learners. It gets the field of ESL study one step closer to having reliable and valid instruments for measuring implicit and explicit linguistic knowledge of learners. Such instruments allow researchers to "investigate issues of central theoretical importance in the study of L2 acquisition" (Ellis, 2005, as cited in Bowles, 2011, p. 262).

Some researchers (e.g., Bowles, 2011; Ellis & Loewen, 2007) suggested that separate measurement of explicit and implicit L2 knowledge could provide better understanding of SLA studies. Ellis (2009) said "the main limitation of the research to date lies in the method of testing" (p. 315). These could provide appropriate measurements to come across the controversial issue of interface and noninterface positions of L2 researchers. The study could help to clarify some of the ambiguities and substantiate some of the findings which exist in the SLA researches.

All the same, armed with that knowledge, researchers and teachers will be better equipped to design instruction in English classes. They also could determine in what ways various components, such as explicit information, negative evidence, and structured input affect the interlanguage system.

This study was limited in terms of its target structures, participants and so on. Thus, further researches would shed more light in this field of study.

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