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Validation and Investigation of Sentence Parsing Strategies: a Study of EFL Learner's Psych and Language Processing

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ABSTRACT

Having a proper insight into understanding the human cognition in sentence processing strategies, this study explored the nature of Minimal Attachment and Late Closure strategies in relation to language proficiency levels. Facing the problem that why some EFL learners tend to parse differently (i.e., use Minimal Attachment and Late Closure Strategies), on one hand and the need to develop a reliable and valid instrument to do the respective investigation on the other hand, was the motive behind this study. By administering a Preliminary English Test (PET), three groups of Iranian adult EFL learners, both male and female were conventionally classified into three levels of proficiency. Three separate researcher-made sentence comprehension tests (each for one proficiency level) were then adopted as the main data collecting instruments through applying 'Think- Aloud Protocol' in which all steps of instrument validation were taken. Findings revealed the use or better to say construct validity of various strategies. Meanwhile, the analyses revealed that the parsing strategies are, to some extent if not that much, associated with language proficiency levels, indicating that language proficiency level has some degree of effect on the participants' use of parsing strategies as a whole, although findings on Minimal Attachment and Late Closure strategy use as two separate ones differed. While, there was not much effect of language proficiency level on Minimal Attachment strategy, the findings indicated a moderately large effect size on Late Closure strategy use and the three groups showed almost higher means on Late Closure strategy rather than the other one. Therefore, certain parsing strategies are associated with language proficiency level proving the fact that language proficiency level is an effective parameter as far as human cognition in language processing in general and sentence processing in particular are concerned. Moreover, not only is there relationship among language proficiency levels and the strategy use but the nature of relationship varies depending on language proficiency level and strategy type.

Key words: Language proficiency- Late Closure strategy- Minimal Attachment strategy- Parsing- Validity

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1. INTRODUCTION

Language perception is primarily known with oral modality in which listeners are just going to categorize the sounds into classes during this temporal aspect of language. In fact, as Carroll (2008) puts, it is an extraordinarily complex task because lots of other factors as interference of environmental context with the speech signal or the variability of the speech signal itself (prosodic factors) as well as lack of invariance, i.e., no one-to-one correspondence between acoustic stimulus and perceptual experience, raise a major problem. In the same vein, written modality, another manifestation of language processing, enjoys its own characteristics as it is spatial.

Moreover, according to Information Processing (IP) theory, comprehension is one of stages of IP and a feature of language processing. A number of terms such as perception, understanding, recognition, and interpretation are used in corporation with comprehension. Garman (1990) defines the usage of each term including, "*perception*, usually reserved for the initial processing of input; *understanding*, the end product; *recognition*, which implies a stored memory element; and *interpretation*, which suggests a creative process going beyond the strict properties of the signal" (p. 305). Meanwhile, Gibson and Pearlmutter (1998) hold that language comprehension system operates in three levels: first, processing syntactic and morphological properties of a sentence called *syntactic processing*; second, context independent meaning processing of the sentence, i.e., *semantic processing*; and third, connecting language to the real world through focusing on contextual and world knowledge named *discourse processing*. On the other hand, Garnham (1985) cited in Scovel (2001), takes a different opinion and proposes sub-processes of language comprehension as word recognition, parsing, semantic interpretation, model construction, and pragmatic interpretation.

1.1 Sentence Processing: Parsing

Among the sub-processes of language comprehension, sentence processing mainly identified by the term 'Parsing' which has received prime attention in the literature. Parsing is defined as "a first step in the process of understanding a sentence is to assign elements of its surface structure to linguistic categories, a procedure known as parsing" (Carroll, 2008, p.132). Just and Carpenter (1980) believe that parsing is a conscious way for solving a problem or making a decision about the linguistic categories of the chain of words presented in a sentence while reading it. Sentence processing operation mostly comes under the umbrella term of parsing which has been a topic of investigation for decades and has attracted the attention of psycholinguists in general, and teachers and linguists in particular. For instance, Tabor and Tanenhaus (1999) set parsing as a two-step procedure of, first, identifying the syntactic categories of the words and, second, computing the grammatical functions of the noun phrases in the sentence.

1.2 Nature of Parsing

Sentence comprehension, based on Traxler (2012), deals with the discovery that how comprehenders determine how words in different sentences relate to one another during the process of interpreting. According to Brown and Miller (1991), in order to consider how we might describe the structure of a sentence such as *The dog frightened the child*, we will make three initial assumptions. First, although we are reading a single sentence, it is not the only sentence in language. Indeed, we normally use our knowledge of other potential sentences to guide our analysis. Second, we are concerned with the five words represented in the sentence, i.e. we go through the syntactic categories of the words and see whether they are, for example, noun, verb, adjective, or adverb. Even, we go further and recognize *frightened* as the "past tense" form of the verb *frighten* and then, it is readily analyzable into the smaller constituents *frighten* and *–ed*. Brown and Miller (1991) take the third assumption concerned with the sentence itself. They mean "We will use the natural string to refer to any sequence of constituents; so we can refer to *the dog, frightened, the child,* ... This string do not form other types of constituents" (p. 12).

1.3 Approaches to Parsing/ Sentence Comprehension

There are considerable controversies about when and how readers use different sources of information during parsing. Can all relevant information be used immediately or no, some can be used and some cannot? Do we use our syntactic, semantic, and pragmatic knowledge at once and simultaneously to comprehend sentences? Or no, we process syntactic information first? All these inquiries have led sentence processing theories to be divided into modular vs. interactive accounts, or serial vs. parallel accounts by Frazier and Fodor (1978), Just and Carpenter (1980), and Carroll (2008). Meanwhile, hierarchically speaking, these sound theoretical approaches or theories have been the foundations of parsing models used which, in turn, have led to the suggestion of a number of parsing strategies.

1.3.1 Modular vs. Interactive Model

According to Carroll (2008), "The parsing strategies identified by Frazier are consisted with the modular approach to language comprehension in which comprehension as a whole is the result of many different modules each devoted to a particular aspect of comprehension" (p.135). In this regard, a sentence is broken into different elements and categories, i.e., syntactically, semantically, lexically, and even phonologically. Van Gompel and Pickering (2007) say, "Modular models assume that the mind consists of models that perform very specific process….

In contrast to modular model, some psycholinguists (e.g., Tyler & Marslen-Wilson, 1977; Crain & Steedman, 1985; Taraban & McClelland, 1988) assume that all comprehension processes are activated in parallel, not one after another.

Van Gompel and Pickering (2007) adopt the idea that "The processor immediately draws upon all possible sources of information during sentence processing, including semantics, discourse context, and information about the frequency of syntactic structures" (p. 292). According to Carroll (2008), in constraint-based model, a subcategory of the interactive model, "we simultaneously use all available information in our initial parsing of a sentence- syntactic, lexical, discourse, as well as nonlinguistic and contextual information" (p.136).

1.4 Neoroimaging Approach

The neoroimaging studies may specifically provide new approaches in psychology of sentence comprehension. A number of studies (e.g., Dapretto & Bookheimer, 1999; Newman et al., 2003; Kuperberg et al., 2000) have attempted to dissociate between sentence-level syntactic and semantic processes in neoro-anatomical terms, and have compared sentences with syntactic subject-verb agreement violations against sentences including an extra verb. According to Borkissel- Schlesewky and Friederici (2007), the result of these studies show that "while in semantic processes there is more activation in anterior frontal gyrus, in syntactic processes there is higher activity in inferior frontal gyrus" (p. 409). As Borkissel- Schlesewky and Friederici (2007) put, "several authors have used these data to argue for a crucial role of inferior frontal gyrus in syntactic processing" (p. 417). In this perspective, Caplan et al. (2000) cited in Borkissel- Schlesewky and Friederici (2007), state that "the increased activation of inferior frontal gyrus in the processing of complex sentences should be attributed to higher working memory demands" (p. 215). On the other hand, Carroll (2008) attributed the higher working memory demands to misanalysis and reanalysis in ambiguous sentences. Thus, activation of working memory comes into play when processing demands increase during comprehension of complex sentences.

1.4.1 Bottom-Up vs. Top-Down

Palmer (1981) assumes "The top-down algorithm is theoretically based on the idea of using a generative grammar to produce all possible sentences in a language until one is found which fits the input sentence. This would in most cases take too much time, but there are ways to restrict the method to the most fruitful possibilities" (p. 208). While, according to him, "The bottom-up algorithm... tries to combine elements in the input sentence in different ways until a tree covering the whole sentence is found." (p. 204). That is, comprehension starts with single words and then they are grouped together to make larger units again and again until the whole sentence is grouped together.

1.4.2 Depth-First vs. Breadth-First

As De Roeck (1983) puts, a *depth-first* approach similar to the top down approach moves between root and leaves or leaves and root similar to the bottom-up approach. Conversely, a *breadth-first* approach explores all branches at each level before going up/down a level.

1.4.3 Immediacy Principle vs. Wait-and-See Approach

Taking from the words of Carroll (2008), we immediately start to fit the words of the sentence into the syntactic structure of the sentence and so access its meaning from our permanent memory without any hesitation (immediacy principle). However, sometimes the reader postpones interpreting a word or phrase until makes sure about the intention of the writer (wait-and-see approach). The latter approach truly shows "garden-path" sentence effects. For example, the sentence *The horse raced past the barn fell* (Bever, 1970) is ambiguous because while reading, readers assume that *raced* is an active past-tense verb, thus up to the verb *fell*, they find the sentence complete. However, as encountering *fell*, they realize that this is impossible and reinterpret *raced* as a past participle construction. Besides, this approach overloads the working memory until the sentence is finished and the interpretation is done.

1.5 Sentence Comprehension Strategies

Comprehension of various sentence types has induced various speculations on the ways reader resort to. For example, some believe that processing ambiguous sentences need more reflection to be understood. To this end, Kimball (1973) proposed "Right Association" and "Closure". Attempting to refine Kimball's basic concept and proposing their own strategies, Frazier and Fodor (1978) proposed the strategies of "Minimal Attachment" and "Local Association". Later, Church (1980) proposed the "A-over-A Early Closure Principle"; and Ford, Bresnan and Kaplan (1982) introduced the notions of "Lexical Preference" and "Final Arguments". However, making inferences from most of their hypotheses and discussions, it turns out that they all had the same perspectives. For example, "Right Association" roughly states that post modifiers prefer to be attached to the nearest previous possible head which exactly explains what Frazier (1987) called "Late Closure". Another consideration which stipulates that attaching new items to fewest syntactic nodes is favored is implied by Frazier and Fodor's Minimal Attachment (1979), and also by Ford, Bresnan and Kaplan's Lexical Preference (1982).

All these coinages and terminologies may be an indication of a sort of skepticisms or chaos in true understanding of the way sentences are comprehended. This state of the affair justifies further explorations on and investigation of the true nature or validity of the parsing strategies especially those of the two commonly supported parsing strategies including Minimal Attachment and Late Closure strategies.

1.5.1 Minimal Attachment Strategy

Frazier (1979), by Minimal Attachment strategy, believes that while reading, when possible, the reader tends to attach the incoming material into the phrase marker being constructed using the fewest nodes consisted with the well-formedness rules of the language. Taken from Carroll's explanation (2008), "we prefer attaching new items into the phrase marker

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being constructed using the fewest syntactic nodes consistent with the rules of language" (p. 134). Traxler (2012) believes that "when more than one structure is licensed and consistent with the input, build the structure with the fewest nodes" (p. 149).

By providing an example, Cooper and Jeanne-Cooper (1980) state that "in the sentence *The old men and women left early* an ambiguity rises because the left-branching adjective *old* can modify just *men* or both *men* and *women* " (p. 26). Based on Minimal Attachment strategy, sentence comprehenders tend to interpret that *old* is immediately dominated by an NP that dominates an additional NP containing both *men* and *women* as follows:

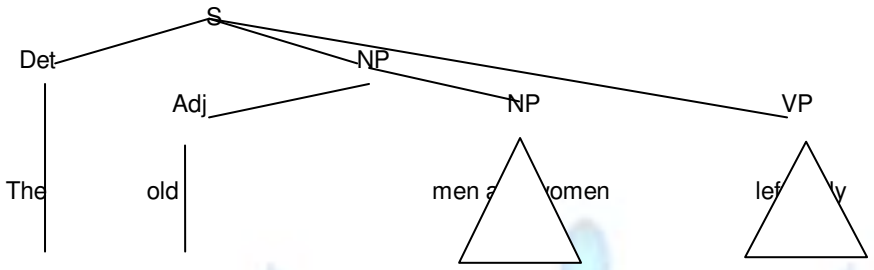

Figure 1. Tree diagram for *The old men and women left early*. (Based on "Syntax and speech" by Cooper and Jeanne-Cooper, Massachusetts: Harvard University Press, 1980, p. 27)

However, as Cooper and Jeanne-Cooper (1980) state, structural ambiguities resulting in Minimal Attachment interpretation do not exist only in left-branching which involves a dominance relationship between a constituent and either of the two possible additional constituents. Conversely, "there exists a variety of other structural ambiguities involving right-branching such as *My uncle Abraham presented his talk naturally*" (p. 29).

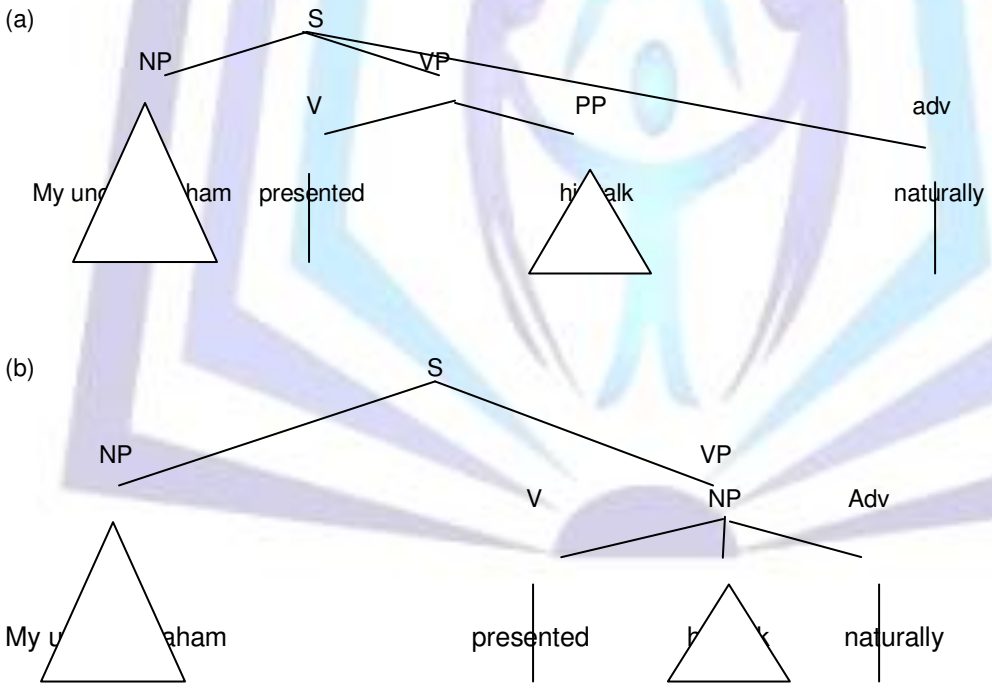

Figure 2. Tree diagrams for *(a) Naturally, my uncle Abraham presented his talk. (b) My uncle Abraham presented his talk in a natural way.* (Based on "Syntax and speech" by Cooper and Jeanne-Cooper, Massachusetts: Harvard University Press, 1980, p. 30)

1.5.2 Late Closure Strategy

According to Frazier (1987), in Late Closure strategy the reader attaches the incoming material into the clause or phrase currently being parsed. Traxler (2012) states that "Do not postulate unnecessary structures. To see how Late Closure heuristic operates, he mentions the sentence *While Susan was dressing the baby… .* In that, he maintains two possible interpretations: [While Susan was dressing the baby]… getting to the NP *the baby*, readers may choose to attach it as part

of the preceding clause; or, [While Susan was dressing] [the baby]…getting to the NP *the baby*, parserss may start building a new clause. According to him, "Late closure heuristic dictates that the first organization will be pursued, because doing so allows the parser to continue working on the same clause" (p. 150).

However, strategy as the term speaks implies a factorial decision which means one deals with a problems or task in light of existing factors which determine the way the problem should be tackled. So, besides the psychological reality or validity of the parsing strategies, it is assumed that sentence parsing strategies like any other mental activities, should be affected by various parameters as well.

1.6 Sentence Comprehension and Effective Factors

Among many of factors which may determine parsing strategy selection, we may refer to semantic effects, frequency effects, discourse effects, and working memory capacity in sentence comprehension (Kintsch & Keenan, 1973; Daneman & Carpenter, 1980; Van Dijk & Kintsch, 1983; Altmann & Steedman, 1988; Fletcher, 1994; Mitchell, 1994; Gibson & Pearlmutter's, 1998; Gaskell, 2007; Staub & Rayner, 2007; Van Gompel & Pickering, 2007; Carroll, 2008 and Traxler, 2012). Besides, language proficiency is probably among the most effective and commonly investigated variables in language research as it is mostly supposed to determine all language related issues especially the way it is processed. So, facing the problem why certain EFL learners with different proficiency levels tend to parse differently and use different strategies, this study was designed to explore the possible relationship between the two target parsing strategies and EFL learner's language proficiency level alongside the validity study of the strategies. To this end, three research questions were raised as follows:

1.7 Research Questions

Question 1: Do parsing strategies (i.e., Minimal Attachment strategy and Late Closure strategy) have psychological reality (i.e., construct validity)?

Question 2: To what extent is the extent of use of parsing strategies the function of EFL learner's language proficiency level?

Question 3: To what extent is the type of parsing strategies (Late Closure vs. Minimal Attachment) related to EFL learner's language proficiency level?

2. METHOD

2.1 Participants

The very first participants in this study included three randomly selected groups of 43 elementary, 45 intermediate, and 49 advanced Iranian adult EFL learners, both male and female, aged ranged from 18-35. These groups were then classified into elementary, intermediate, and advanced levels, 29, 29, and 28 students, respectively. This classification was done by the Preliminary English Test (PET) as a general English proficiency test.

2.2 Instrumentation

(1) **Preliminary English Test:** To run this study, a version of the PET was adopted to select three homogenous groups in order to expose them to three different sets of sentence comprehension tests matching their levels to study Minimal Attachment and Late Closure strategies in relation to the language proficiency levels.

(2) **Researcher-made Sentence Comprehension Tests:** Three sets of tests, as the main data collecting instruments, each including 30 separate sentences (i.e., 30 sentences for elementary students, 30 sentences for intermediate students, and 30 sentences for advanced students) were developed through manipulating them based on 17 native authored English text books in different levels to make sure of grammaticality criteria. The researcher-made strategy assessment tests were then piloted to make sure of the item qualities and also to run reliability and validity estimations prior to their actual administration according to Shahid Beheshti University – Psychology Campus criteria.

(3) **Think-Aloud Protocol:** Think-Aloud Protocol was also developed to triangulate the data and make sure of further and in-depth exploration of mental processing.

2.3 Procedure

Sampling: This process was done from a total of 43 elementary, 45 intermediate, and 49 advanced students, both male and female aged 18-35, from different intact classes. Then, they received PET thereby they were categorized into three groups of 29 elementary, 29 intermediate, and 28 advanced participants based on their positions on normal distribution curve. In line with the validation efforts, the writing and speaking sections of the PET were rated by two raters. Then, the inter-rater reliability indices were calculated.

Data collection: To do so, the three separate sentence comprehension tests which were developed into three respective questionnaires each including 30 sentences (15 to study Late Closure strategy and the other 15, to study Minimal Attachment strategy) were made as follows:

1. The researcher developed a likert scale for each sentence (strongly agree, agree, no idea, disagree, strongly disagree).

2. The sentences were given to three teachers, expert in psychology and English language to validate them in terms of content representation of the target strategies.
3. 90 sentences were finally verified (45 addressing Minimal Attachment strategy and the other 45 addressing Late Closure strategy).
4. The sentences were divided into three groups of elementary, intermediate and advanced; 30 sentences in each based on the structural complexity: simple sentence (for elementary EFL learners), complex (for intermediate EFL learners), and compound-complex (for advanced EFL learners), as well as, word difficulty considerations.
5. The researcher piloted the three sets of sentences with 30 participants (10 in each level)
6. The reliability (Cronbach alpha) was measured.

The construct validity of the tests was also measured through factor analysis.

Ultimately, the members of each group were exposed to their respective test/questionnaire and were encouraged to while selecting the desired choice, to immediately explain verbally their interpretations in either English or Persian during and after reading each sentence. Two raters recorded the interpretations in a bid to increase the reliability of the data. The inter-rater reliability indices were then estimated and showed a significant agreement between the two raters who rated the participants' use of Late Closure strategy (r (86) = .79) and Minimal Attachment strategy (r (86) = .74)

3. DATA ANALYSIS AND RESULTS

3.1 Investigation of the Research Questions

3.1.1 Research Question One

In order to investigate whether parsing strategies (i.e., Minimal Attachment strategy and Late Closure strategy) have psychological reality (i.e., construct validity), the valuation process of the construct of parsing which included content and construct validations along with reliability estimation was run. The results as reported in tables 1-7 all together support the validity and acceptable reliability levels.

3.1.1.1 Validation Process

Inter-Rater Reliability

The results of the Pearson correlations indicated that;

A: There was a significant agreement between the two raters who rated the participants' use of Minimal Attachment strategy (r (86) = .74, P < .05).

Table 1. ***Inter-Rater Reliability***

Strategy			Rater 1
Minimal Attachment	Rater 1	Pearson Correlation	.749**
		Sig. (2-tailed)	.000
		N	86
Late Closure	Rater 1	Pearson Correlation	.790**
		Sig. (2-tailed)	.000
		N	86

B: There was a significant agreement between the two raters who rated the participants' use of Late Closure strategy (r (86) = .79, P < .05).

Construct Validity

In addition to the content validity as was assured through consulting a panel of experts, the tests were developed to explore the participants mentality in terms of the reality of the strategies used to implement parsing, rigorous statistical steps were taken to do so, and factor analysis through varimax rotation was carried out as to each strategy type, either.

A: Minimal Attachment Strategy

A factor analysis through the varimax rotation was carried out to probe the underlying constructs of the components of the 15 sections of the Minimal Attachment strategy. The number of factors to be extracted should be determined before running the analysis.

To be more objective, the parallel analysis was run instead of a scree plot. The parallel analysis determines the optimum number of factors using a statistical technique. Based on the results displayed in Table 2, it can be concluded that the first two factors are accepted because the actual eigenvalues extracted by the SPSS are higher than the values computed through the parallel analysis.

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Table 2. ***Parallel Analysis; Determining Optimum Number of Factors for Minimal Attachment Strategy***

Eigenvalue			
Factors	Actual Values	Parallel Analysis Values	Decision
1	2.424	1.790	***Accepted***
2	1.774	1.594	***Accepted***
3	1.579	1.454	Rejected
4	1.512	1.330	Rejected
5	1.241	1.226	Rejected
6	1.210	1.127	Rejected
7	0.988	1.036	Rejected
8	0.860	0.951	Rejected
9	0.783	0.870	Rejected
10	0.619	0.793	Rejected
11	0.556	0.716	Rejected
12	0.470	0.643	Rejected
13	0.435	0.569	Rejected
14	0.300	0.494	Rejected
15	0.249	0.407	Rejected

Moreover, as Table 3 shows, varimax rotation was run whereby two factors account for 27.98 percent of the total variance.

Table 3. ***Total Variance Explained; Minimal Attachment Strategy***

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.424	16.158	16.158	2.424	16.158	16.158	2.372	15.813	15.813
2	1.774	11.824	27.982	1.774	11.824	27.982	1.825	12.168	27.982
3	1.579	10.527	38.508						
4	1.512	10.083	48.591						
5	1.241	8.275	56.866						
6	1.210	8.064	64.930						
7	.988	6.589	71.519						
8	.860	5.734	77.253						
9	.783	5.220	82.472						
10	.619	4.129	86.602						
11	.556	3.704	90.306						
12	.470	3.133	93.439						
13	.435	2.902	96.341						
14	.300	2.001	98.342						
15	.249	1.658	100.000						

Accordingly, Table 4 displays the factor loadings of the 15 sections of the Minimal Attachment strategy under the two extracted factors.

Table 4. ***Rotated Components Matrix; Minimal Attachment Strategy***

	Component	
	1	2
MAS10	.632	
MAS14	.565	
MAS8	.551	
MAS6	.549	
MAS13	.536	
MAS11	.423	
MAS12	.406	
MAS1	.399	
MAS3	.365	
MAS7	.324	.701
MAS5		.576
MAS4		.528
MAS2		.516
MAS9		.382
MAS15		.243

B: Late Closure Strategy

Similarly, a factor analysis through the varimax rotation was carried out to probe the underlying constructs of the components of the 15 sections of the Late Closure strategy. Based on the results displayed in Table 5, it can be concluded that the first four factors are accepted because the actual eigenvalues extracted by the SPSS are higher than the values computed through the parallel analysis.

Table 5. ***Parallel Analysis; Determining Optimum Number of Factors for Late Closure Strategy***

	Eigenvalue		
Factors	Actual Values	Parallel Analysis Values	Decision
1	2.584	1.790	***Accepted***
2	1.990	1.594	***Accepted***
3	1.590	1.454	***Accepted***
4	1.369	1.330	***Accepted***
5	1.212	1.226	Rejected
6	1.070	1.127	Rejected
7	.887	1.036	Rejected
8	.804	0.951	Rejected
9	.730	0.870	Rejected
10	.592	0.793	Rejected
11	.554	0.716	Rejected
12	.513	0.643	Rejected
13	.469	0.569	Rejected
14	.338	0.494	Rejected
15	.296	0.407	Rejected

Contrary to the Minimal Attachmet case, the four extracted factors, as shown in Table 6, account for 50.22 percent of the total variance.

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Table 6. ***Total Variance Explained; Late Closure Strategy***

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.584	17.229	17.229	2.584	17.229	17.229	2.409	16.059	16.059
2	1.990	13.270	30.499	1.990	13.270	30.499	1.882	12.546	28.605
3	1.590	10.603	41.102	1.590	10.603	41.102	1.649	10.994	39.598
4	1.369	9.127	50.229	1.369	9.127	50.229	1.595	10.631	50.229
5	1.212	8.082	58.311						
6	1.070	7.131	65.442						
7	.887	5.911	71.353						
8	.804	5.357	76.710						
9	.730	4.867	81.578						
10	.592	3.950	85.528						
11	.554	3.697	89.224						
12	.513	3.418	92.642						
13	.469	3.130	95.772						
14	.338	2.252	98.024						
15	.296	1.976	100.000						

Based on the data, then, Table 7 displays the factor loadings of the 15 sections of the Late Closure strategy under the four extracted factors.

Table 7. ***Rotated Components Matrix; Late Closure Strategy***

	Component			
	1	2	3	4
LCS5	.739			
LCS4	.637			
LCS12	.615			
LCS13	.571			
LCS1	.479			
LCS8		.744		
LCS7		.632		
LCS14		.519		
LCS3		.482		
LCS11			.652	
LCS15			.650	
LCS10			.519	
LCS6			.519	
LCS9				.782
LCS2				.715

3.1.2 Research Questions Two and Three

Given the integration of the second and third research questions concerning the relationship between parsing strategy use and type, certain statistical analyses of both quantitative and qualitative data were run. Quantitatively speaking, normality assumptions were checked as to the PET scores. However, the core of the analyses was concerned with qualitative data which were analyzed thorough frequency analysis and calculation of the percentages as displayed in Tables 8-14.

3. 2 Investigation of Sentence Parsing Strategies

To investigate the second and third research questions, the participants' parsing strategy use by applying the think-aloud protocol through qualitative analysis was explored. The PET as a general English language proficiency test was administered to three groups of students. The students whose score fell between plus and minus one standard deviation were selected from each group to form three groups of elementary (N = 29), intermediate (N = 29) and advanced (N = 28). Table 8 displays the mean, SD and sample size for each of the three groups.

Table 8. ***Descriptive Statistics; PET***

	N	Mean	Std. Deviation
Elementary	**43**	**36.41**	**11.14**
Intermediate	**45**	**53.88**	**14.45**
Advanced	**49**	**68.06**	**13.21**

The qualitative driven nature of the methodology of this study yielded the outputs presented below:

3. 2.1 Minimal Attachment Strategy Use

To investigate the effect of EFL learners' language proficiency levels on Minimal Attachment strategy use, the number of times (i.e., frequency), each group of learners had totally used the respective strategy through the process of Think-Aloud. Accordingly, Table 9 indicates that the total number of Minimal Attachment strategy use in the elementary, intermediate and advanced learners were 219, 222, and 212, respectively. It is concluded that the Iranian EFL learners' language proficiency level does not have much effect on Minimal Attachment strategy use.

Table 9. ***Language Proficiency Levels and Minimal Attachment Strategy Use***

Sentence	Elementary		Intermediate		Advanced	
	Freq.	%	Freq.	%	Freq.	%
1	10	34	20	69	16	57
2	19	66	10	34	21	75
3	12	41	22	76	13	46
4	6	21	12	41	20	71
5	20	69	11	38	20	71
6	9	31	17	59	10	36
7	12	41	17	59	9	32
8	21	72	11	38	13	46
9	9	69	13	45	14	50
10	15	52	15	52	17	61
11	19	66	12	41	14	50
12	13	45	14	48	11	39
13	22	76	12	41	6	21
14	17	59	10	34	16	57
15	15	52	16	55	12	43
Total	219		222		212	

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Thus, the data show that use of parsing strategy i.e., Minimal Attachment strategy is not that much a function of language proficiency level.

3. 2. 2 Late Closure Strategy Use

As far as Late Closure strategy as the second parsing strategy is concerned in this study, the number of times (i.e., frequency) each group of learners had totally used the respective strategy through the process of think-aloud was calculated, either. In this regard, Table 10 indicates that the elementary, intermediate, and advanced learners have, respectively, used 263, 273, and 229 times Late Closure strategy. In conclusion, similar to the Minimal Attachment strategy use, no strong relationship between the Iranian EFL learners' language proficiency levels and Late Closure strategy use is seen.

Table 10. ***Language Proficiency Levels and Late Closure Strategy Use***

Sentence	Elementary		Intermediate		Advanced	
	Freq.	%	Freq.	%	Freq.	%
1	20	69	15	52	8	29
2	18	62	21	72	14	50
3	18	62	16	55	11	39
4	18	62	17	59	18	64
5	22	76	19	66	16	57
6	20	69	16	55	15	54
7	14	48	21	72	17	61
8	16	55	15	52	14	50
9	14	48	29	100	11	39
10	12	41	18	62	24	86
11	18	62	19	66	9	32
12	11	38	18	62	13	46
13	24	83	17	59	16	57
14	18	62	14	48	19	69
15	20	69	18	62	13	50
Total	263		273		229	

EFL Learners' Language Proficiency Level and Parsing Strategy Type

To investigate whether there are any relationships between parsing strategy types and each language proficiency level, the number of times (i.e., frequency) the Minimal Attachment and Late Closure strategies have been used were compared for each group separately in order to probe the third research question. The results are displayed as follows:

A: Regarding the elementary EFL learners' language proficiency level, Table 11 indicates that the number of times they have used Late Closure strategy (N=263) was more than their Minimal Attachment strategy use (N=219). It can be concluded that there was a difference between the elementary learners' use on the Late Closure and Minimal Attachment strategies, in that; elementary learners showed a significantly higher number of use on Late Closure strategies. Thus, some extent of predictive power of language proficiency level type of parsing strategy is seen.

B: As far as the intermediate EFL learners' language proficiency level is concerned, Table 12 represents that the number of times they have used Late Closure strategy (N=273) was more than their Minimal Attachment strategy use (N=222). The results show that the intermediate learners used higher number of Late Closure strategies. In short, there is some extent of difference between the intermediate learners' use of Late Closure and Minimal Attachment strategies.

C: Finally, concerning the advanced EFL learners' language proficiency level, Table 13 represents, the advanced learners used 229 times Late Closure strategy and 212 times Minimal Attachment strategy, which indicated that the language proficiency , to some degree, determines parsing strategy type. Although the frequency of Late Closure strategy use is still greater than that of Minimal Attachment strategy use, the difference is not much salient.

Table 11. ***Minimal Attachment vs. Late Closure Strategy in the Elementary Level***

Strategy	Number of Times
Minimal Attachment	219
Late Closure	263

Table 12. ***Minimal Attachment vs. Late Closure Strategy in the Intermediate Level***

Strategy	Number of Times
Minimal Attachment	222
Late Closure	273

Table 13. ***Minimal Attachment vs. Late Closure Strategy in the Advanced Level***

Strategy	Number of Times
Minimal Attachment	212
Late Closure	229

4. DISCUSSION AND CONCLUSION

This study sought three purposes in the form of specific research question. The first one aimed at, theoretically, supporting the nature and psychological reality of two most common parsing strategies through statistical data. For this purpose, as reported in Tables 1-7, factor analysis was run to statistically prove the reality of the target construct. The data and the number of the extracted factors on one hand, and the test score consistency realized in the form of reliability indices on the other hand, support the validity of the construct of sentence processing done through parsing strategies.

The second and third aims were an investigation into the relationship between language proficiency level and parsing strategies in terms of both use and type. Given the interactive nature of these two aims, they were addressed together. According to the results obtained, although the elementary learners used higher Minimal Attachment and Late Closure strategies while reading sentences, the total number of strategy use is less than the one is used by intermediate learners. On the other hand, it is not distinctively higher than what is used by the advanced group. Therefore, it can be certainly concluded that the elementary levels do not exercise using the parsing strategies a lot due to their less EFL proficiency level i.e. processing mistakes is common among all readers. As Traxler (2012) puts, "In sentence processing, when people have a choice of different structures, they sometimes make the wrong choice. If they always made the correct choice, then there should be no problem processing any part of sentence" (p. 145).

Results show that the majority of parsing strategy use was within learners of the intermediate language proficiency level. Traxler (2012) states that, "according to garden-path theory, the parser … obeys the simplicity principle by developing processing heuristics, basic rules that can be applied quickly and constantly" (p. 149). For example, in sentence *The burglar blew up the safe with the rusty lock*, without addressing any specific readers (i.e., poor or good readers) he explains that by reading the sentence, "the thematic processing will generate on error massage as it does not make any sense to use a *rusty lock* to *blow up a safe*" (p. 150). However, the advanced EFL learners were the ones with less parsing strategy use while comprehending sentences. However, the number of times they implemented Minimal Attachment and Late Closure strategies was not distinctively less than the numbers used by the other two groups of elementary and intermediate. Carroll (2008) addresses memory for sentences and calls memory load a natural phenomenon. He explains that "in natural discourse, one sentence follows rapidly on the hills of another, then another, and it is unlikely that we can retain all of them accurately" (p. 150). By observing the advanced levels' high parsing strategy use, it might be concluded that the Carroll's above remark can come true even in a single sentence. In other words, ambiguous sentences overwhelm the memory and it is extremely difficult, if not possible, to get the meaning in an immediacy principle without implementing garden-path theory or at least wait-and-see principle. Hence, it may turn out that the advanced EFL learners' with the highest language proficiency level are not free from getting rid of memory load and so not free from using parsing strategies to comprehend sentences.

The results of the sentence comprehension tests revealed that the proficiency level had an effect on the participants' use of Minimal Attachment and Late Closure strategies. Therefore, it can be concluded that sentence processing or parsing as a cognitive strategy and process is associated, to some extent, with language proficiency level. The number of times participants in each level used Minimal Attachment strategy proved less remarkable effects in between. Thus, it can be safely concluded that language proficiency level acts differently concerning each strategy when the association is addressed separately; level-strategy type.

Finally, a comparison was made on the use of Minimal Attachment and Late Closure strategies for each group separately. It can be concluded that: (1) There was much difference between elementary learners' means on Late Closure and Minimal Attachment strategies. That is to say, the elementary learners showed a a bit higher frequency on the Late Closure strategy. (2) There was some degree of difference between the intermediate learners' frequency of use of the Late Closure and Minimal Attachment strategies. As the results show, the intermediate learners showed a bit higher frequency of use on Late Closure strategy. And (3) There was not much difference between the advanced learners' means on the Late Closure and Minimal Attachment strategies. As a general conclusion, the statistical analyses support some degree of association among language proficiency levels and parsing strategy use, though the nature of association varies depending on the level and strategy type.

Theoretically the findings explore the nature of the parsing strategies in relation to language proficiency level. In the other word, it involves discovering how comprehenders with different language proficiency levels use syntactic cues available during the process of interpreting a sentence. Second, the results of this study will be in favor of those who are looking for the validation of parsing strategies to do their potential researches. So, the findings cast a light on the literature, though there still remain rooms for further studies to suggest a strong and solid theory. Pedagogically speaking, the main beneficiaries of this study are EFL teachers, in that, they can get more insights into the mechanisms and processes which underlie sentence comprehension. Therefore, they would be one step forward in understanding how their learners master reading comprehension. Moreover, this study can help students in that they would be more aware of their difficulties and ambiguities while reading. So that they would develop and use their own strategies to deal with temporary ambiguities they face with.

REFERENCES

[1] Altmann, G., & Steedman, M. (1988).Interaction with context during human sentence processing.*Cognition,* 30: 191-238.

[2] Borkissel- Schlesewky, I. D., & Friederici, A. D. (2007). Neuroimaging studies of sentence and discourse comprehension. In M., G. Gaskel (Ed.). *The Oxford Handbook of Psycholinguistics* (pp. 407-424). New York: Oxford University Press.

[3] Brown, K., & Miller, J. (1991).*Syntax: A linguistic Introduction to Sentence Structure.* London and New York: Routledge.

[4] Carroll, D. W. (2008). *Psychology of language* (5th Ed.). Canada: Thomson Wadsworth.

[5] Church, K. W. (1980). On memory limitations in natural language processing.Unpublished master's thesis, Massachusetts Institute of Technology (MIT), LCS, Cambridge.

[6] Cooper, W. E., & Jeanne-Cooper, P., (1980).*Syntax and speech*. Massachusetts: Harvard University Press

[7] Crain, S. & Steedman, M. J. (1985). On not being led up the garden path: The use of context by the psychological parser. In D. Dowty, L. Karttunen, & A. Zurichy (Eds.), *National Language Parsing* (pp. 320-58).Cambridge University Press.

[8] De Roeck, A. (1983). An underview of parsing. In M. King (Ed.), *Parsing Natural Language*. London: Academic Press.

[9] Ford, M., Bresnan, J., & Kaplan, R.M. (1982).A competence-based theory of syntactic closure.*The Mental Representation ofGrammatical Relations* (Bresnan, J., ed.). The MIT Press, pp. 727–796.

[10] Frazier, L. (1979). On comprehending sentences: Syntactic Parsing Strategies (Doctoral dissertation). University of Massachusetts, IndianaUniversity Linguistics Club.

[11] Frazier, L. (1987). Sentence processing [a tutorial review in Attention and performance XII: *The Psychology of Reading*]. Erlbaum, 559–586.

[12] Frazier, L., & Fodor, J. D. (1978). The sausage machine: A new two-stage parsing model. *Cognition* 6, 291-325.

[13] Garman, M. (1990).*Psycholinguistics*. New York: Cambridge University Press.

[14] Gibson, E., & Pearlmutter, N. (1998).*Constraints on sentence comprehension.*[Electronic version].*Trends in Cognitive Science, 2*, 262-268.

[15] Kimball, J. (1973). Seven principles of surface structure parsing in natural language. *Cognition* 2, 15–47.

[16] Kuperberg, G. R., Mcguire, P. K., & Bullmore, E. T., (2000).Common and distinct neural substrates for pragmatic, semantic, and syntactic processing of spoken sentences.*Journal of Cognitive Neuroscience,*12, 321-41.

[17] Mitchell, D. C. (1994). *Sentence parsing*. In Gernsbacher, M. A. (Ed.), *Handbook of psycholinguistics*.SanDiago, California: Academic Press.

[18] Scovel, T. (2001).Psycholinguistics. In R. Carter & D. Nunan (Eds.), *The Cambridge guide to teaching English to speakers of other languages* (pp. 80-87). Cambridge: Cambridge University Press.

[19] Staub, A., & Rayner, K. (2007). Eye movements and on-line comprehension processes. In M., G. Gaskel (Ed.)*The Oxford Handbook of Psycholinguistics* (pp. 327-342). New York: Oxford University Press.

[20] Taraban, R., & McClelland, J. L. (1988). Constituent attachment and thematic role assignment in sentence processing: Influences of content-based expectations. *Journnal of Memory and Language, 27,* 597-632.

[21] Traxler, M. (2012). *Introduction to psycholinguistics: Understanding language sciences.* UK: Wiley-Blackwell.

[22] Tyler, L. K., & Marslen-Wilson, W. D. (1977).The online effects of semantic context on syntactic processing. *Journal of Verbal Learning and Verbal Behavior, 6,* 683-692.

[23] Van Gompel, P. R. G., & Pickering, M. J. (2007).Syntactic parsing. In M., G. Gaskel (Ed.) *The Oxford Handbook of Psycholinguistics* (pp.289-307). New York: Oxford University Press.

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