



Persian and English Multiple Wh-questions in Contrast: A Study of Binary, D-linked, and Ternary Multiple Wh-Questions

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Abstract

In Chomsky's Government and Binding theory, a number of parameters have been the subject of a plethora of investigations. One of the parameters of UG which has received attention of linguists in the past decade or so is the *wh*-parameter. In addition to the variation between languages with respect to *single wh*-questions (i.e. *wh*-movement vs. *wh*-in-situ), it has been noted that languages also differ in the way they produce *multiple wh*-questions (MWQs). In English MWQs, there is a single strict constraint on the movement of *wh*-elements known as the Superiority effect, where the *wh*-phrase that C-commands the other moves to Spec-CP. In contrast, Persian is a language with a productive scrambling property, which demonstrates two basic strategies for the formation of MWQs: (i) multiple *wh*-in-situ, where *wh*-elements are not subject to the Superiority effect, (ii) optional multiple *wh*-fronting with *multiply filled specifiers* (i.e. [+MFS]), where *wh*-words are bound to the Superiority effect. There are specific conditions under which the violation of the Superiority effect in English MWQs disappears, and their ungrammaticality is ameliorated: D(iscourse)-linking and ternary (non-binary) *wh*-questions. As the overarching goal of the study, this paper examines the distributional pattern of *wh*-elements in Persian and English multiple *wh*-questions (MWQs) based on a Grammaticality

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Judgement (GJ) task administered to Persian speakers of English (PSEs) and native speakers of Persian (NSEs). More specifically put, the study intends to answer the two research questions: (i) How do native speakers of Persian distinguish among the six types of *wh*₂ elements in Persian binary multiple *wh*-questions (MWQs)?, and (ii) Are there any grammaticality differences between English native speakers' ratings of English binary, D-linked and ternary MWQs and Persian native speakers' ratings of translation-equivalent Persian binary, D-linked and ternary MWQs? Since the purpose of the present study was to simply characterize Persian speakers' and native English speakers' syntactic knowledge at one particular time, a one-shot design was used. Two groups of participants were included in the current study: (1) a group of native speakers of English (NSEs) and (2) a group of Persian speakers of English (PSEs). The NSE group included a pool of 30 American university students and professors who participated in the study through completing an online Google Docs version of the GJ task. Two types of tests were employed in the study: (i) an English GJ task which sought to obtain the judgements of native speakers of English (NSEs) as well as Persian speakers of English (PSEs) on three components investigating English MWQs: 30 binary MWQs, 15 D-linked MWQs, and 15 ternary MWQs, and (ii) a translation-equivalent Persian Grammaticality Judgment (GJ) task. Persian speakers of English (PSEs) took the two tests, but native speakers of English (NSEs) only took the English GJ task. The items pertaining to the Superiority effect in 30 binary MWQs examined the participants' judgments on different combinations of the first *wh*-element (*Wh*₁) and the second *wh*-element (*Wh*₂) in multiple *wh*-questions (e.g. <*who, what*>, <*what, where*>, <*where, what*>, and <*when, what*>, etc.). Also, in order to investigate NSEs' as well as PSEs' knowledge of the ameliorated Superiority violations, two other components were included in the English GJ task: 15 D-linked MWQs and 15 ternary MWQs, which were the D-linked/ternary equivalents for the 15 ungrammatical binary MWQs. The goal of these two components was to explore whether NSEs and PSEs considered the D-linked (e.g. *Which book did which person buy?*) and ternary MWQs (e.g. *What did who give to whom?*) more grammatical in comparison with their binary counterparts (e.g. **What did who buy?*). The data were analysed using hierarchical cluster analysis, and grammatical and ungrammatical MWQs were sharply distinguished into separate clusters in the resulting dendrogram. The results of the first research question revealed that Persian MWQs are divided into two major clusters in the relevant dendrogram: 19 grammatical ordered pairs, and 11 ungrammatical ordered pairs. Although Persian resists a neat classification of the six types of *wh*-elements with regard to the Superiority effect, the 7 ordered pairs <*who, what*>, <*who, where*>, <*who, when*>, <*what, where*>, <*what, when*>, <*where, what*>, and <*when, what*>, which were considered grammatical in English, are equally deemed grammatical by Persian speakers. The results of the second research question showed

significant differences in terms of the grammaticality of Persian/English binary and ternary MWQs, while there is generally no significant difference between NSEs' ratings of English D-linked MWQs and PSEs' ratings of the translation-equivalent Persian D-linked MWQs. The results of the study have pedagogical implications for teaching Persian to non-native speakers of Persian in terms of the order of teaching different types of Persian MWQs, the contexts for the use of such structures, and the proficiency level at which Persian MWQs could be taught to non-native speakers of Persian.

Keywords: Multiple *wh*-question, Superiority effect, *Wh*-movement, Grammaticality Judgement (GJ) Task

1. Introduction

In Chomsky's Government and Binding theory, a number of parameters (e.g. the *pro*-drop parameter, the Verb Movement parameter, the OV/VO – or Head Direction – Parameter, the Article Choice Parameter, the *Wh*-parameter) have been the subject of a plethora of investigations. One of the parameters of UG which has received attention of linguists in the past decade or so is the *wh*-parameter. The *wh*-parameter, like other parameters, is limited to two possibilities. In English, the *wh*-phrase in interrogative sentences should move to the front of the sentence (i.e. specifier position of CP). By contrast, in some languages, including Chinese, Japanese, Korean, and Persian, the *wh*-word does not move to Spec-CP and remains in situ (i.e. in the same place occupied by the word/phrase questioned about). In other words, English has the parametric value [+ *wh*-movement] and Chinese, Japanese, Korean, and Persian have the value [- *wh*-movement] (Radford, 2009).

In addition to the variation between languages with respect to *single wh*-questions (i.e. *wh*-movement vs. *wh*-in-situ), it has been noted that languages also differ in the way they produce *multiple wh*-questions (MWQs). Whereas some languages like Chinese and Japanese place all *wh*-elements in situ, others like English normally place only one *wh*-word in Spec-CP and the second *wh*-word remains in-situ, and still other languages such as Bulgarian and Polish move all *wh*-elements to clause-initial positions in MWQs (Rudin, 1988).

In English MWQs, there is a single strict constraint on the movement of *wh*-elements known as the Superiority effect, where the *wh*-phrase that C-commands the other moves to Spec-CP. In other words, English does not allow multiply filled Spec-CP (i.e. [-MFS]). In contrast, Persian is a language with a productive scrambling property (Karimi, 2005), which demonstrates two basic strategies for the formation of MWQs: (i) multiple *wh*-in-situ, where *wh*-elements are not subject to the Superiority effect, (ii) optional multiple *wh*-fronting with *multiply filled specifiers* (i.e. [+MFS]), where *wh*-words are bound to the Superiority effect. The examples (1) and (2) from English and Persian respectively show the variation between the two languages:

(1) a. *Who* bought *what*? (English MWQ, showing the Superiority effect)

b. **What* did *who* buy? (English MWQ, violating the Superiority effect)

(2) *Persian multiple wh*-in-situ, without Superiority effect:

a. pedar *chi*-yo be *ki* pishnahaad kard?
 father *what*-CASE to *whom* proposal did
What did the father suggest to *whom*?

Persian multiple wh-in-situ, without Superiority effect:

b. pedar be *ki* *chi*-yo pishnahaad kard?

father to *whom what*-CASE proposal did
What did the father suggest to *whom*?
 Persian optional [+MFS], showing the Superiority effect:
 c. *ki chi khaab* did?
who what dreamed about
Who dreamed about what?

Persian optional [+MFS], violating the Superiority effect:
 d. **chi ki khaab* did?
what who dreamed about
Who dreamed about what?

There are, however, specific conditions under which the violation of the Superiority effect in English MWQs disappears, and their ungrammaticality is ameliorated. According to Pesetsky (2000), two major conditions allowing the violation of the Superiority effect in English MWQs are D(iscourse)-linking and ternary (non-binary) *wh*-questions. D(iscourse)-linking refers to the change of monomorphemic *wh*-expressions (e.g. *who*, *what*, etc.) used in MWQs to a complex phrase of the form “*which+Noun*”, where the Superiority effect disappears (compare (3a) and (3b)):

- (3) a. **What did who read?* (MWQ violating the Superiority effect)
 b. *Which book did which man read?* (D-linked MWQ ameliorating the Superiority violation)

Ternary (non-binary) *wh*-question refers to another condition under which the Superiority effect is obviated in MWQs with more than two *wh*-elements (compare (4a) and (4b)):

- (4) a. **What did who give to Mary?* (MWQ violating the Superiority effect)
 b. *What did who give to whom?* (Ternary MWQ ameliorating the Superiority violation)

In Persian, however, the violation of the Superiority effect is ameliorated differently. For example, the addition of the object case marker *-ro/-yo* to the first *wh*-element of a MWQ can change the ungrammatical (5a) to the grammatical (5b) (Adli, 2010; Raghibdoust, 1993, 1994):

- (5) a. **chi ki kharid?*
What who bought
Who bought what?
 b. *chi-yo/-ro ki kharid?*
What-CASE who bought
Who bought what?

Based on the typology of English and Persian binary, D-linked and ternary MWQs, the present study intends to examine the following research questions:

RQ₁: How do native speakers of Persian distinguish among the six types of *wh* elements in Persian binary multiple *wh*-questions (MWQs)?

RQ₂: Are there any grammaticality differences between English native speakers' ratings of English binary, D-linked and ternary MWQs and Persian native speakers' ratings of translation-equivalent Persian binary, D-linked and ternary MWQs?

2. Literature Review

2.1. Multiple *Wh*-Questions (MWQs)

2.1.1. English Multiple *Wh*-Questions (MWQs) and the Superiority Effect

Originally put forward by Kuno and Robinson (1972, p. 474), the Superiority effect states that “a *wh*-word cannot be preposed, crossing over another *wh*”. In earlier Transformational Generative Grammar (TGG), Chomsky (1973, p. 101) defines the Superiority condition as a constraint on transformations according to which “no rule can involve X, Y in the structure ... X ... [... Z ...Y ...]... where the rule applies ambiguously to Z and Y, and Z is superior to Y.” Based on the Government Binding (GB) theory, the Superiority effect requires the *wh*-element that is structurally superior (i.e. c-commands the other *wh*-element) to move to Spec-CP. In the Minimalist Programme (MP), the Superiority effect is regarded as an economy condition that requires the *wh*-element closest to the target of movement (i.e. C⁰) to move first. Based on this syntactic constraint, sentence (6a) in the following is grammatical, but (6b) is not:

- (6) a. *Who* bought *what*?
 b. **What* did *who* buy?

In addition to *who-what* pair, other combinations are worth investigating. Multiple *wh*-questions containing *who-where* pair (with *where* as a complement), *who-where* pair (with *where* as an adjunct), and *who-when* pair are also grammatical, but *who-how* and *who-why* pairs are ungrammatical:

- (7) a. *Who* sat *where*? (where as a complement)
 b. *Who* sang *where*? (where as an adjunct)
 c. *Who* went *when*?
 d. **Who* came *how*?
 e. **Who* cried *why*?

Although the referential adjuncts *where*_{complement}, *where*_{adjunct}, and *when* can appear as the right-most *wh*-elements in MWQs (as in 7a-c), the non-

referential adjuncts *how* and *why* (as in 7d-e) cannot, since they are syntactically argued to be base-generated in Spec-CP (Hornstein, 1995; Rizzi, 1990). So, the right-most positions of *how* and *why* in (7d) and (7e) result in the ungrammaticality of the two sentences.

Semantically, the reason for the ungrammaticality of (7d) and (7e) lies in the type of interpretation/reading of the elicited answers in MWQs. The answers to MWQs fall into two types of readings: Single Pair (SP) reading and Pair List (PL) reading (Bošković, 1998). While some languages (e.g. Persian, Japanese) allow both SP and PL readings, English MWQs require PL answers, and SP answers are infelicitous. For example, the answer to the question “*Who bought what?*” should give a list of ordered pairs of buyers and things bought (e.g. *John bought a book, Peter bought a pencil, and I bought a pen*) and a SP answer (e.g. *John bought a book*) is not acceptable. However, in echo interpretation of English MWQs (i.e. where an interlocutor asks a speaker for repetition/clarification of paired pieces of information) SP readings are acceptable.

Taking SP/PL reading into account, the ungrammaticality of (7d) and (7e) can be attributed to the infelicitous readings of the answers given to these two questions. Whereas the *wh*-elements *who*, *what*, *where* and *when* can generate lists and yield PL answers, ‘*how*’ and ‘*why*’ cannot generate lists, and thus MWQs containing them as the *wh*-in-situ element are ungrammatical. Perhaps, in general, PL answers in MWQs that link persons (i.e. *who*) with things (i.e. *what*) – as in (6a) – are easier to imagine than PL answers in MWQs which link persons (i.e. *who*) with places (where) and times (when) – as in (7a-c); and these, in turn, are easier to imagine than PL answers in MWQs that link persons (i.e. *who*) with means/manners (i.e. *how*) or reasons (i.e. *why*) – as in (7d-e). This is also stated in Kuno and Takami’s (1993) Sorting Key Hypothesis, which regards the leftmost *wh*-word as the key for categorising relevant pieces of information in PL answers to MWQs. Based on this hypothesis, PL answers can’t be sorted by means/ manners or reasons; hence *how* and *why* can’t function as list generators in the left-most positions of MWQs. Even, some syntacticians maintain that the non-referential *wh*-elements *how* or *why* can neither be licensed as *wh*-in-situ elements in the right-most position of MWQs, nor they can be used as licensing *wh*-operators in the left-most position of MWQs (Stroik, 1995, 2009). The following examples show that all MWQs containing *how* and *why* are ungrammatical:

(8) a. *What did Chris read *why*?

b. *What did Chris read *how*?

(9) a. *Why did Chris read what?

b. *How did Chris read what?

As implied in the examples in (6) and (7), the distinction among the six types of English MWQs (i.e. *who*, *what*, *where*, *when*, *how*, *why*) depends on the

type of *wh*-in-situ element. The distinction usually displays asymmetries of different kinds: *subject/object asymmetry*, *adjunct/complement asymmetry*, and *complement/non-complement asymmetry*. The subject/object asymmetry is shown in (3) repeated here as (10) below:

- (10) a. Who bought *what*?
 b. *What did *who* buy?

In (10a), the subject *wh*-phrase is in Spec-CP, while the object *wh*-phrase remains in-situ and the sentence is grammatical with a PL reading. In contrast, in (10b), the object is in Spec-CP, while the subject remains in-situ, and the sentence is ungrammatical. Although no PL reading is permitted, it can only have an echo interpretation.

Besides subject/object asymmetry, MWQs involve adjunct/complement (argument) asymmetry of the *wh*-in-situ elements. Although the verbal complement *what* in (11a) yields a grammatical MWQ, the *how*-in-situ and *why*-in-situ adjuncts in (11b-c) yield ungrammatical questions:

- (11) a. How did John fix *what*?
 b. *What did John fix *how*?
 c. *What did John fix *why*?

The subject/object asymmetry together with the adjunct/complement asymmetry constitutes a more general complement/non-complement asymmetry in the distribution of *wh*-in-situ elements in MWQs (Huang, 1982). Simply put, *what* and *where*_{complement} can be used as *wh*-in-situ elements, whereas non-complements (i.e. subjects and adjuncts) *who*, *how* and *why* can't.

2.1.2. Persian Multiple Wh-Questions (MWQs)

Persian MWQs differs from MWQs in other languages with regard to their interpretation and the licit order of *wh*-elements. The investigation of the semantic and syntactic properties of Persian MWQs suggests that this language doesn't neatly resemble other languages, showing mixed properties of different languages.

As observed in the previous section, MWQs in *wh*-in-situ languages are essentially assumed to have SP readings rather than PL readings (Bošković, 1998; Hagstrom, 1998; Grohmann, 2000). However, Lotfi (2003) argues that the prediction is not supported by empirical data from Persian. Although this language is a *wh*-in-situ language, it seems to pattern with English rather than Japanese, Chinese, and Hindi. In order to empirically examine the availability of SP/PL readings in Persian, Lotfi administered a 5-point-scale questionnaire to a group of 40 adult Isfahani native speakers of Persian to rate the felicity of MWQs in each of the two dyadic conversational situations described in (12) and (13) in the following. In all cases, the Q-marker *yani* was used to signal the

interrogative force rather than *aya* because in informal Persian *yani* (or preferably no Q-marker at all) is used in *wh*-questions.

(12) *Situation I: SP reading*

You are in a store and off in the distance see somebody buying an article of clothing, but you do not see who it is and exactly what is being bought. You go to the shop assistant and ask:

A: *Yani ki chi xarid?*

Q who what bought

‘Who bought what?’

B: *Ali ye pirhan xarid.*

Ali a shirt bought

‘Ali bought a shirt.’ (Lotfi, 2003, p. 167)

(13) *Situation II: PL reading*

You are paying a social visit to a newly-wed couple in their apartment. While having a friendly conversation about their wedding presents, you ask about both *what* they got and *who* gave them each item:

A: *Yani ki chi ovord?*

Q who what brought

‘Who gave you what?’

B: *Ali ye sa’at ovord, Maryam ye angoshtar ovord, Mina ye goldun ovord...*

Ali a clock brought Maryam a ring brought Mina a vase brought

‘Ali gave us a clock, Maryam gave us a ring, Mina gave us a vase...’

(Lotfi, 2003, p. 168)

The Persian speakers’ ratings suggested that there is a very strong tendency in Persian to afford only PL readings to the extent that the PL reading of Persian MWQs like (13) was about 2.83 times more felicitous than their SP reading in (12). The results of the study disconfirmed the predictions made by Bošković (1998), Hagstrom (1998), and Grohmann (2000) as to the unavailability of PL reading in *wh*-in-situ languages.

The structure of Persian MWQs also differs from other languages with respect to the complement/non-complement asymmetry of the six types of *wh*-elements in the *wh*-in-situ position. In Persian, the *wh*-argument *chi* ‘what’ and *wh*-adjuncts *kojâ* ‘where’, *kei* ‘when’, *chetor(i)* ‘how’ are generally allowed to appear in the *wh*-in-situ position mainly due to the scrambling property in this language and the lack of strict syntactic constraints on MWQs, but the argument *ki* ‘who’, and the adjunct *cherâ* ‘why’ can’t usually appear in the *wh*₂ position in MWQs. As seen in (14a-d), the *wh*-argument *ki* ‘who’ should usually remain in the sentence initial position and doesn’t allow objects/non-subjects to move over it because *ki* ‘who’ has an inherent Focus feature, while the objects/non-subjects

lack this feature. Karimi (2005) maintains that the feature-driven *wh*-movement of Persian subjects to the initial position seems to support the existence of the Superiority effect in this language:

- (14) a. **chi ki kharid*
 what who bought
 b. **cherâ ki raft*
 why who went
 c. **chetor(i) ki raft*
 how who went
 d. **kojâ ki raft*
 where who went
 e. **kei ki raft*
 when who went

However, once the *wh*-argument *chi* ‘what’ in (14a) gets the accusative case marker *-ro/-yo* at the end, *ki* ‘who’ can remain in-situ:

- (15) *chi-yo ki kharid*
 what-CASE who bought

The *wh*-argument *chi* ‘what’ can freely be used with different *wh*-elements and in different positions of Persian MWQs, especially when it receives the accusative case marker. The *wh*-adjuncts such as *kojâ* ‘where’, *kei* ‘when’, and *chetor(i)* ‘how’ may also appear in different positions in Persian MWQs. The *wh*-adjunct ‘why’ shows a different behaviour from other *wh*-adjuncts and resembles the *wh*-argument *ki* ‘who’ in that it is used less freely in *wh*-in-situ of MWQs and usually yields ungrammatical sentences when used with other *wh*-adjuncts *kojâ* ‘where’, *kei* ‘when’, and *chetor(i)* ‘how’ in the *wh*-operator position.

2.2. Ameliorated Superiority Violation in MWQs

According to Pesetsky (2000), there are two conditions under which the violation of the Superiority effect in multiple *wh*-questions (MWQs) disappears and their ungrammaticality is ameliorated: (i) D(iscourse)-linking and (ii) ternary (non-binary/additional/third) *wh*-questions. The two conditions are investigated in the following sections in detail.

2.2.1. D(iscourse)-linked MWQs

Based on earlier observations by Karttunen (1977) and Bolinger (1978), D(iscourse) linking is a constraint on MWQs where a felicitous answer can only denote sets of entities for the *wh*-phrases which are supposed to be salient to both speaker and hearer. In other words, MWQs subject to such a constraint violate the Superiority effect when the answers to the question are presumed to

be drawn from a set of referents previously established in the discourse, forming part of the common ground shared by the interlocutors.

In English, there are two potential triggers for D-linking: (i) *lexical specification* (i.e. inherently D-linked *wh*-words like *which*) and (ii) *intonation*. Based on *lexical specification*, if monomorphemic *wh*-words (e.g. *who*, *what*, etc.) used in MWQs are changed to a complex phrase of the form “*which* + Noun”, the Superiority effect disappears, as shown in the following example where (16a) violates the Superiority effect, and (16b) ameliorates the Superiority violation through D-linking:

- (16) a. *What did who get?
 b. *Which medication did which patient get?*

Intonation is a second source of D-linking simple *wh*-words (e.g. *who*, *what*, etc.) in English MWQs, although these *wh*-elements are non-D-linked and induce superiority effects. However, even such simple *wh*-words can be interpreted as D-linked *wh*-elements in the right context and with appropriate kind of intonation (i.e. stress on the *wh*-word in situ and the verb), as shown in examples (17) and (18):

- (17) a. *What did who break?

b. I know that among all the disasters in that kitchen, Jane scorched the beans and Lydia put salt in the ice tea; but *whát* did *whó* bréak? I know that somebody broke something, so stop evading my question. (Bolinger, 1978, p. 108)

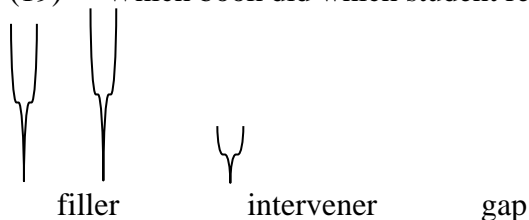
- (18) a. I wonder where what goes.

b. I know that we need to install transistor A, transistor B and transistor C, and I know that these three holes are for transistors, but I’ll be damned if I can figure out from the instructions *whére whát* goes! (Pesetsky, 1987, p. 109)

Although the *wh*-phrases in (17b) and (18b) are not inherently D-linked, the D-linking property emerges from the context, and as a result, the Superiority violations disappear. The link between semantics and the syntactic constraints on the movement of *wh*-elements in MWQs has so far remained opaque, as the relationship between the content of a D-linked *wh*-phrase and its acceptability has stood only at a descriptive level and no grammar-internal explanations for the violation of the Superiority effect in D-linked MWQs has been provided. Consequently, the examination of the D-linked MWQs has been recently claimed to involve the investigation of not only the syntactic dimensions of such structures but other significant psycholinguistic factors involved in processing long-distance dependencies in interrogative clauses (Boeckx & Grohmann, 2004; Featherston, 2005; Frazier & Clifton, 2002).

In English, *wh*-movement is one type of long-distance dependency in which the *wh*-word moves from its canonical position further to the right, often resulting in a kind of relationship between the displaced element and its canonical position known as ‘filler-gap dependency’ (FGD). Following Fodor (1978, 1989), the terms *filler* and *gap* have been used for the *moved element* and its *trace* respectively. Also, as shown in the MWQ in (19), *which student* introduces a new discourse referent intervening between the filler and its gap site; hence it is called the *intervener*:

(19) Which book did which student read ___?



In the current psycholinguistics literature, it is assumed that a link is set up between the filler and its relevant gap during real-time processing, and that difficulty in processing *wh*-questions depends partially on such processing constraints, which involve the following three preferences:

- I. Prefer *gaps* that are closer to their fillers
- II. Prefer *fillers* that have more accessible referents
- III. Prefer *interveners* that have more accessible referents

The acceptability of syntactic structures is determined at least partly by the *memory retrievability* and *processing difficulty* they involve (Fanselow & Frisch, 2004). FGDs are generally considered to impose a high level of processing difficulty, given the simultaneous requirements of storing a *filler*, identifying the appropriate *gap* site, and processing the *interveners* along the filler-gap path. Other factors contributing to the difficulty of processing a FGD include but are not limited to the linear or structural distance between the filler and its gap site (Gibson, 1998, 2000) and the processing load imposed by various referential entities between the two elements (Warren & Gibson, 2002). Additionally, Hofmeister (2007, 2008) and Hofmeister *et al.* (2007, 2013) argue that the informativity of a *wh*-phrase (i.e. the amount of the information expressed by a phrase) remarkably affects the overall processing difficulty of a FGD. Based on this, Hofmeister (2007, 2008) proposes a Memory Facilitation Hypothesis defined as follows:

Given two linguistic expressions that can each be felicitously used to describe some discourse entity *e*, the expression that encodes more syntactic and semantic information will facilitate the retrieval process initiated at all

subsequent (overt or covert) mentions of *e*, all else being equal. (Hofmeister, 2008, p. 4)

According to MFH, given two expressions denoting the same entity in discourse, the one with a higher ‘relative informativity’ will be easier to retrieve whenever the relevant discourse information is required to be re-accessed in discourse. The ‘relative informativity’ refers to the idea that “an expression x_1 is more informative than an expression x_2 if the semantic and syntactic information encoded by x_2 is a proper subset of the information encoded by x_1 ” (Hofmeister, 2008, p. 5).

Simply put, the studies conducted by Hofmeister and his colleagues (Hofmeister, 2007, 2008; Hofmeister *et al.*, 2007, 2013) suggest that linguistic elements that encode more lexical/semantic/syntactic information facilitate their own subsequent retrieval from memory. This can be obviously seen in the difference between phrases which are semantically identical but syntactically different (e.g. *which* vs. *which one of them*, *somewhere* vs. *some place*, *Rome’s destruction* vs. *the destruction of Rome*, etc.). In the same way, the acceptability differences in FGDs involving non-D-linked (or bare) and D-linked *wh*-elements (e.g. *who* vs. *which person*, *what* vs. *which book*, etc.) can be explained by in terms of their processing complexity. However, in sharp contrast to the findings of MFH, Donkers, Hoeks, and Stowe (2013) have recently argued that D-linked *wh*-elements are significantly more complex than bare *wh*-elements in MWQs. In other words, ‘*which+N*’ phrase, as they claim, is more effortful to process than the bare *wh*-element ‘*who*’ in questions including such interrogative phrases. Still, despite the plethora of studies on D-linked MWQs, no firm results are obtained regarding the validity of both grammar-internal and processing-based accounts of this phenomenon.

2.2.2. Ternary MWQs

Ternary (non-binary/additional/triple) *wh*-question refers to a condition where the Superiority effect is obviated in MWQs with more than two *wh*-expressions (Chomsky, 1981; Pesetsky, 2000), as suggested by the contrast between (20a) and (20b):

- (20) a. **What* did *who* give to Mary? (Detectable Superiority effect)
 b. *What* did *who* give to **whom**? (No detectable Superiority effect)

The violation of the Superiority effect in ternary MWQs is generally ameliorated in two ways: (i) when a third *wh*-phrase is c-commanded by the offending *wh*-pair, as in (21a), and (ii) when a third *wh*-phrase c-commands the offending *wh*-pair, as in (21b):

- (21) a. *What*₂ did *who*₁ buy **where**₃?
 b. **Who**₃ wonders *what*₂ *who*₁ bought?

Like binary English MWQs, where pair list (PL) answers were needed, ternary English MWQs also require “*triple list readings*”, as shown in (22b):

- (22) a. Who₁ gave what₂ to whom₃?
b. Dave gave the book to Sue, Frank gave the tie to Joe, and John gave the watch to Peter.

Very few studies have empirically addressed the Superiority effect in ternary English MWQs. Clifton, Fanselow, and Frazier (2006) conducted a two-phase empirical study, the first phase of which explored whether the addition of a third *wh*-element amnesties the Superiority violations in object-initial ternary English MWQs (e.g. *What did who buy where?*). Forty-eight undergraduate native speakers of English took part in individual computer-controlled speeded acceptability judgments. Based on the results of the first phase of this study, the Superiority violations were not improved by the addition of a third *wh*-word, regardless of whether the third *wh*-element was an adjunct or an argument. However, the violation of the Superiority effect was improved by the addition of a comma followed by a conjoined phrase (e.g., “, *and when*”), as shown by the contrast between (23a) and (23b):

- (23) a. What can who do about it when?
b. What can who do about it, and when?

In a similar study, Fedorenko and Gibson (2010) quantitatively evaluated the claim that adding a third *wh*-phrase to object-initial MWQs increases their grammaticality and ameliorates the violation of the Superiority condition. They departed from Clifton *et al.*'s study in two ways: (i) ternary English MWQs were given in supportive contexts where triple list readings were unambiguously implied, and (ii) the ternary questions were used as *embedded* MWQs rather than *main* questions. Twenty-eight native speakers of English took a 28-item off-line questionnaire including context-based scenarios followed by ternary MWQs. The participants were asked to rate the naturalness of the embedded MWQs on a scale from 1 (i.e. *not at all natural*) to 7 (i.e. *very natural*). In line with the results of Clifton *et al.*'s study (2006) and contrary to intuitive claims made in the literature (Chomsky, 1981; Pesetsky, 2000), the acceptability of ternary MWQs didn't significantly differ from the acceptability of their binary counterparts which violated the Superiority effect. Therefore, the overall results of this study also confirmed the view that adding a third *wh*-phrase does not actually ameliorate the Superiority violation in ternary English MWQs, even when judgements were elicited in supportive contexts.

3. Method

3.1. Design of the Study

Since the purpose of the present study is to simply characterize Persian speakers' and native English speakers' syntactic knowledge at one particular time, a one-shot design was used. This design is a common design employed in cross-sectional UG-based studies, where the respondents are recruited on a one-off basis. This study is also a *quantitative* one which involves a comparison between the performance of two groups of Persian speakers of English (PSE) and a group of native speakers of English (NSE) on Grammaticality Judgement (GJ) tasks seeking the participants' intuition about the Superiority effect in English and Persian binary MWQs and two ameliorated cases of Superiority violations in English and Persian MWQs (i.e. D-linked and ternary MWQs).

3.2. Participants

Two groups of participants were included in the current study: (1) a group of native speakers of English (NSEs) and (2) a group of Persian speakers of English (PSEs). The NSE group included a pool of 30 American university students and professors who participated in the study through completing an online Google Docs version of the relevant Grammaticality Judgment (GJ) task. The collected background information indicated that these participants were 9 males and 21 females, with American English as the variety of their English. All of them were involved in language studies other than linguistics or syntax (i.e. applied linguistics, TESOL, etc.). Their age ranged between 21 and 59, and their mean age was 32.7. They had different education levels: 6 BAs, 12 MAs, 5 PhD lecturers, 3 Assistant Professors, 3 Associate Professors and 1 Professor. The PSE group consisted of a cohort of 30 randomly assigned advanced PSEs, including 16 males and 14 females, ranging in age from 18 to 36 years, with an average age of 22.3. They included 9 MA students of TEFL and 21 BA students of Translation Studies and English Literature. The brief description of the background information of the two groups of participants can be given as follows in Table 1:

Table 1
Summary of the Participants' Background Information

Group	Number	Age range	Mean age	Education level
Native speakers of English (NSE)	30	21-59	32.7	BA, MA, PhD
Persian speakers of English (PSE)	30	18-36	22.3	BA, MA

3.3. Instruments

Two types of tests were employed in the study: (i) an English Grammaticality Judgment (GJ) task, and (ii) a translation-equivalent Persian

Grammaticality Judgment (GJ) task. Persian speakers of English (PSEs) took the two tests, but native speakers of English (NSEs) only took the English Grammaticality Judgment (GJ) task. Each instrument will be elaborated individually.

3.3.1. English Grammaticality Judgement (GJ) task

As a common tool of data elicitation in UG-based studies, a Grammaticality Judgement (GJ) task was used in the present study in order to determine the participants' tacit knowledge of three different but interrelated components: (i) binary MWQs, (ii) D-linked and (iii) ternary English multiple *wh*-questions (MWQs). The participants rated 60 MWQs for their grammaticality on a 4-point Likert scale ranging from 1 (*definitely incorrect*) to 4 (*definitely correct*). Since a 5-point or 7-point Likert scale with a zero midpoint confuses the participants and poses some difficulty as to the interpretation of a zero response as a "don't know" or as a midpoint option, a 4-point Likert scale was used instead.

The English Grammaticality Judgement (GJ) task consisted of three parts: (i) general background information (e.g. name, surname, age, sex, course of study, etc.), (ii) instructions, and (iii) sixty MWQs eliciting the participants' ratings of binary MWQs ($n = 30$), D-linked MWQs ($n = 15$), and ternary MWQs ($n = 15$). Since the task examined three different constructions at the same time, the components could be considered as distracters for each other; hence no other distracters were included in the GJ task.

Prior to conducting the main study, a pilot study was done to reveal and revise the flaws of the design, procedures and implementation of the English GJ task components. Also, as one of study's points of departure from previous studies addressing MWQs, the validity and reliability of the GJ task was investigated. The validity of the GJ task was established through inviting the comments of three native syntacticians and two language testing experts on whether the items elicited what the study intended to measure. The reliability (i.e. internal consistency) of the three components of the English GJ task were calculated separately for the three groups of participants involved in the study.

In order to determine the reliability of NSEs' and PSEs' ratings of binary/D-linked/ternary MWQs in the English GJ task, Cronbach's alpha (α) was calculated (Table 2). Ideally, the Cronbach alpha coefficient of a test should be above .70 (DeVellis, 2003). Therefore, because of the high reliability of the three components of the English GJ task, the same English GJ task and the data elicited thereof were used in the main study.

Table 2

Reliability of NSEs' and PSEs' Ratings of Binary/D-linked/Ternary MWQs in the English GJ Task

	Binary MWQs (n = 30)	D-linked MWQs (n = 15)	Ternary MWQs (n = 15)
NSEs (n = 30)	.81	.87	.84
PSEs (n = 30)	.78	.88	.74

The finalised English GJ task sought to obtain the judgements of native speakers of English (NSEs) as well as Persian speakers of English (PSEs) on three components investigating English multiple *wh*-questions (MWQs): (i) binary MWQs, (ii) D-linked MWQs, and (iii) ternary MWQs. The items pertaining to the Superiority effect in binary MWQs examined the participants' judgments on different combinations of the first *wh*-element (*Wh*₁) and the second *wh*-element (*Wh*₂) in multiple *wh*-questions. The different combinations of the ordered pairs *wh*₁ (i.e. *wh*-operator) and *wh*₂ (i.e. *wh*-in-situ) in the GJ task are shown in Table 3, yielding 36 different possible cases for combining the *wh*-operator and the *wh*-in-situ elements. Ordered pairs with identical *wh*₁ and *wh*₂ (e.g. <where₁, where₂>, <when₁, when₂>, <how₁, how₂>, <why₁, why₂>) were excluded from the GJ task since producing such MWQs seems to be unacceptable and unnatural; hence the inclusion of a total of 30 items in the GJ task.

As stated in the literature (Bley-Vroman & Yoshinaga, 2000; Hornstein, 1995), binary English MWQs with *who* appearing in the *wh*₂ position (e.g. *Where did *who* go?) are ungrammatical because subjects should have a superior position over the other *wh*-elements in the sentence. Also, the adjuncts *how* and *why* resist remaining in the *wh*₂ position (e.g. *What did he fix *how*?, *When did she cry *why*?) since they can't be used as appropriate list generators in Pair List (PL) answers. As shown in Table 3, there are 30 items involving the Superiority effect, with 15 items (i.e. MWQs with *who*, *how* and *why* as the *wh*-in-situ element) deemed definitely ungrammatical.

Table 3

Different *Wh*₁-*Wh*₂ Combinations in Binary English MWQs

<i>h</i> ₂ \ <i>h</i> ₁	Wh o ₂	Wh a _t ₂	Whe r _e ₂	Whe n ₂	How _ ₂	Wh y ₂
ho ₁		Who _ ₁ - What ₂	Who _ ₁ - Where ₂	Who _ ₁ - When ₂	*Wh o ₁ - How ₂	*Wh o ₁ - Why ₂
ha ₁	*Wh a _t ₁ - Who ₂		Who _ ₁ - Where ₂	Who _ ₁ - When ₂	*Wh a _t ₁ - How ₂	*Wh a _t ₁ - Why ₂
he ₁	*Wh e _r ₁ - Who ₂	Who _ ₁ - What ₂		Who _ ₁ - When ₂	*Wh e _r ₁ - How ₂	*Wh e _r ₁ - Why ₂
	*Wh y ₁	Who _ ₁ - What ₂	Who _ ₁ - Where ₂		*Wh y ₁ - How ₂	*Wh y ₁ - Why ₂

hen₁	en ₁ - Who ₂	n ₁ - What ₂	n ₁ - Where ₂		en ₁ - How ₂	en ₁ - Why ₂
	*Ho	How	How	How		*Ho
ow₁	w ₁ - Who ₂	₁ - What ₂	₁ - Where ₂	₁ - When ₂		w ₁ - Why ₂
	*Wh	Why	Why	Why		*Wh
hy₁	y ₁ - Who ₂	₁ - What ₂	₁ - Where ₂	₁ - When ₂	y ₁ - How ₂	

Table 4 lists 30 binary English MWQs combining the 6 types of *wh*-elements in different ordered pairs according to the type of *wh*₂ (i.e. *wh*-in-situ) elements:

Table 4
Binary MWQs Used in the English GJ Task

Type of <i>Wh</i> ₂	Binary MWQs
<i>who</i>	What did who bring?
	Where did who go?
	When did who see Peter?
	How did who fix the car?
	Why did who come to the party?
<i>what</i>	Who bought what ?
	Where did you buy what ?
	When did you buy what ?
	How did you do what ?
<i>where</i>	Why did he buy what ?
	Who went where ?
	What did you see where ?
	When did you see him where ?
<i>when</i>	How did he go where ?
	Why did you go where ?
	Who phoned when ?
	What did you eat when ?
	Where did you see him when ?
<i>how</i>	How do you study when ?
	Why does it rain when ?
	Who fixed the car how ?
	What did he fix how ?
	Where did John go how ?
<i>why</i>	When did you behave how ?
	Why did he behave how ?
	Who died why ?
	What did you say why ?
	Where should you stop your car why ?
	When did she cry why ?
	How did you leave why ?

Also, in order to investigate NSEs' as well as PSEs' knowledge of the ameliorated Superiority violations, two other components, claimed to ameliorate the Superiority violation in binary MWQs, were included in the English GJ task: 15 D-linked MWQs and 15 ternary MWQs, which are the D-linked/ternary equivalents for the 15 ungrammatical binary MWQs. As stated in research question 2, the goal of these two components is to explore whether NSEs and PSEs considered the D-linked (e.g. *Which book did which person buy?*) and ternary MWQs (e.g. *What did who give to whom?*) more grammatical in comparison with their binary counterparts (e.g. **What did who buy?*). Tables 5 and 6 respectively illustrate the list of D-linked and ternary MWQs used in the English GJ task:

Table 5
D-linked MWQs Used in the English GJ Task

Type of <i>Wh</i> 2	Binary MWQs	D-linked counterparts
<i>who</i>	*What, Who	Which book did which student read?
	*Where, Who	At which beach did which tourist swim?
	*When, Who	On which evening did which student see a movie?
	*How, Who	With which tools did which mechanic fix the car?
	*Why, Who	For what reason did which student leave the school?
<i>how</i>	*Who, How	Which person behaved in which manner ?
	*What, How	Which tool works in which way ?
	*Where, How	In which place should we behave in which manner ?
	*When, How	At which time do you talk in which manner ?
	*Why, How	For what reason did he behave in which manner ?
<i>why</i>	*Who, Why	Which customer left the shop for what reason ?
	*What, Why	Which book did you buy for what reason ?
	*Where, Why	In which country do people live longer for what reason ?
	*When, Why	At which time do you feel sad for what reason ?
	*How, Why	In which manner did they leave the shop for what reason ?

Table 6
Ternary MWQs Used in the English GJ Task

Type of Wh2	Binary MWQs	Ternary counterparts
<i>who</i>	*What, Who	What did who give to <u>whom</u> ?
	*Where, Who	Where did who take <u>what</u> ?
	*When, Who	When did who buy <u>what</u> ?
	*How, Who	How did who fix <u>what</u> ?
	*Why, Who	Why did who read <u>what</u> ?
	<i>how</i>	*Who, How
*What, How		What did you explain how to <u>whom</u> ?
*Where, How		Where did you find out how you should do <u>what</u> ?
*When, How		When did you show how you can do <u>what</u> ?
*Why, How		Why did you speak how to <u>whom</u> ?
<i>why</i>		*Who, Why
	*What, Why	What happened why to <u>whom</u> ?
	*Where, Why	Where did you show them why you did <u>what</u> ?
	*When, Why	When did you understand why you lost <u>what</u> ?
	*How, Why	How did you explain why you chose <u>what</u> ?

3.3.2. Persian Grammaticality Judgement (GJ) task

In addition to the English GJ task, a translation-equivalent Persian GJ task was given to Persian speakers of English (PSEs). As put by research question 1, the Persian GJ task intended to explore whether there was any clear-cut distinction among the different combinations of *wh₁-wh₂* (i.e. *wh*-operator/*wh*-in-situ) in binary Persian MWQs. Put simply, the purpose is to investigate if Persian patterns with English in distinguishing *who*, *how*, and *why* from *what*, *where*, and *when* as the *wh*-in-situ elements in multiple *wh*-questions. Moreover, binary, D-linked and ternary MWQs were compared across Persian and English GJ tasks (i.e. research question 2). The Persian GJ task was the same as the English GJ task, with 60 MWQs using a 4-point Likert scale form 1 (*definitely incorrect*) to 4 (*definitely correct*). The task consisted of three parts:

(i) general background information, (ii) instructions, and (iii) sixty MWQs eliciting the participants' ratings of binary MWQs (n = 30), D-linked MWQs (n = 15), and ternary MWQs (n = 15).

As in the case of English GJ task, the validity and reliability of the Persian GJ task was investigated in a pilot study. The validity of the Persian GJ task was established through inviting the comments of two professional translators and two language testing experts on whether the items of the task actually elicited what the study intended to measure. Also, as shown in Table 7, the reliability of elementary and advanced PSEs' ratings of binary/D-linked/ternary MWQs in the Persian GJ task were calculated using Cronbach's alpha (α). Due to the high reliability of the three sections of the Persian GJ task in the ratings of both PSE groups, the piloted Persian GJ task was used in the main phase of the study.

Table 7
Reliability of PSEs' Ratings of Binary/D-linked/ Ternary MWQs in Persian GJ Tasks

	Binary MWQs (n = 30)	D-linked MWQs (n = 15)	Ternary MWQs (n = 15)
PSEs (n = 30)	.90	.90	.90

3.4. Procedures

3.4.1. Task Administration Procedure

The English and Persian GJ tasks were conducted in paper-and-pencil format during two sessions. In order to prevent any direct carry-over from the Persian GJ task to the English GJ task, the PSEs took the English GJ task first and then the Persian GJ task. Since the GJ tasks were timed ones, the PSEs were required to fill the English GJ task (i.e. both GJ task items as well as the retrospective analysis) within 20 minutes and the Persian GJ task within 10 minutes. The NSEs also took the same English GJ task and were required to finish it within 5 minutes.

3.4.2. English GJ Task Scoring Procedure

Two different scoring schemes were employed for analysing NSEs' and PSEs' data involving the English GJ task: (i) *raw scores* or *raw ratings* and (ii) *weighted scores* or *weighted ratings*. *Raw scores* were identical with the actual number assigned to each point of the 4-point Likert scale (1 = *definitely incorrect*, 2 = *probably incorrect*, 3 = *probably correct*, and 4 = *definitely correct*). *Weighted scores* were based on different weightings given to each point of the 4-point scale in the English GJ task. In order to determine the participants' *weighted scores*, separate scoring procedures were used for

grammatical and ungrammatical MWQs. The scoring scheme for the 4-point Likert scale used in the English GJ task was the following:

Table 8
The Scheme of Weighted Scores on the English GJ Task

Grammatical MWQs	Ungrammatical MWQs
<i>Definitely correct</i> = 4	<i>Definitely incorrect</i> = 4
<i>Probably correct</i> = 3	<i>Probably incorrect</i> = 3
<i>Probably incorrect</i> = 2	<i>Probably correct</i> = 2
<i>Definitely incorrect</i> = 1	<i>Definitely correct</i> = 1

4. Results and Discussion

4.1 Results

4.1.1. Persian Binary MWQs

The first research question addressed how Persian speakers of English (PSEs) distinguish among the six types of *wh*₂ elements (i.e. *ki* ‘who’, *chi* ‘what’, *kojâ* ‘where’, *kei* ‘when’, *chetor* ‘how’, and *cherâ* ‘why’) in binary Persian MWQs. Table 9 illustrates the relevant descriptive statistics including the sum, mean, standard deviation (SD), and the frequency and percentage of grammatical/ungrammatical ratings for the 30 Persian MWQs. The 18 highlighted MWQs mark the grammatical MWQs which have means above the midpoint score (i.e. 2.5). It is interesting that Persian MWQs highly resemble English MWQs in that *what*-type and *where*-type MWQs have relatively higher means than *who*-type, *when*-type, *how*-type and *why*-type MWQs.

Table 9
Descriptive Statistics for Persian Speaker' Ratings of Persian MWQs

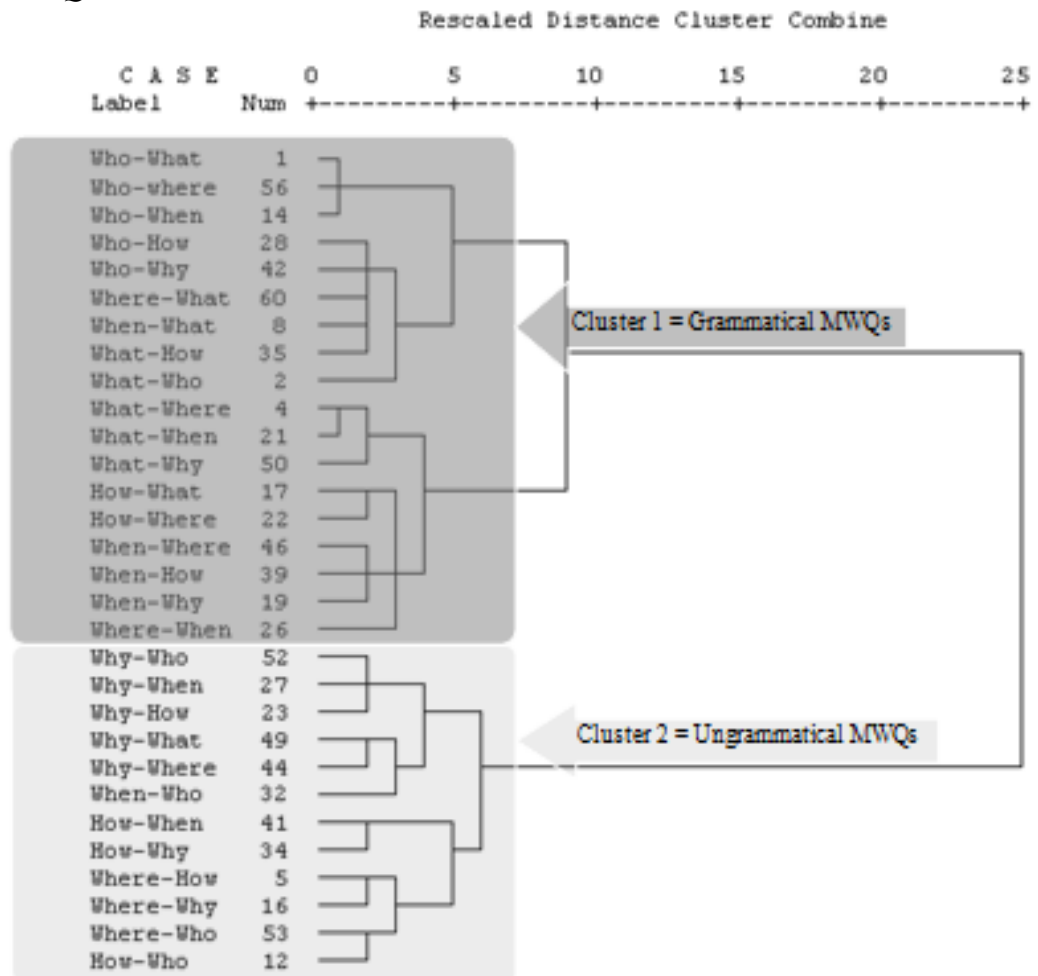
Type of <i>Wh</i> ₂ element	MWQs	Sum	Mean	SD	Frequency and Percentage of Grammaticality	Frequency and Percentage of Ungrammaticality
<i>ki</i> (<i>who</i>)	What, Who	181	3.02	1.00	43 (71.7 %)	17 (28.3 %)
	Where, Who	117	1.95	1.11	15 (25 %)	45 (75 %)
	When, Who	159	2.65	1.10	34 (56.6 %)	26 (43.3 %)
	How, Who	111	1.85	.82	12 (20 %)	48 (80 %)
	Why, Who	119	1.98	1.08	18 (30 %)	42 (70 %)
<i>chi</i> (<i>what</i>)	Who, What	225	3.75	.51	58 (96.6 %)	2 (3.3 %)
	Where, What	182	3.03	.96	42 (70 %)	18 (30 %)
	When, What	187	3.12	.94	45 (75 %)	15 (25 %)
	How, What	165	2.75	.97	33 (55 %)	27 (45 %)
	Why, What	158	2.63	1.11	34 (56.6 %)	26 (43.3 %)
	Who, Where	226	3.77	.59	57 (95 %)	3 (5 %)

<i>kojâ (where)</i>	What, Where	176	2.93	1.00	42 (70 %)	18 (30 %)
	When, Where	170	2.83	1.04	38 (63.3 %)	22 (36.6 %)
	How, Where	177	2.95	.99	41 (68.3 %)	19 (31.7 %)
	Why, Where	133	2.22	1.03	23 (38.3 %)	37 (61.7 %)
<i>kei (when)</i>	Who, When	214	3.57	.74	55 (91.7 %)	5 (8.3 %)
	What, When	173	2.88	1.03	39 (65 %)	21 (35 %)
	Where, When	147	2.45	1.13	27 (45 %)	33 (55 %)
	How, When	141	2.35	.95	25 (41.7 %)	35 (58.3 %)
	Why, When	115	1.92	1.08	14 (23.3 %)	46 (76.7 %)
<i>chetor (how)</i>	Who, How	195	3.25	.86	50 (83.3 %)	10 (16.7 %)
	What, How	184	3.07	.94	42 (70 %)	18 (30 %)
	Where, How	126	2.10	.99	18 (30 %)	42 (70 %)
	When, How	170	2.83	1.04	36 (60 %)	24 (40 %)
	Why, How	137	2.28	1.07	25 (41.7 %)	35 (58.3 %)
<i>cherâ (why)</i>	Who, Why	174	2.90	1.08	40 (66.7 %)	20 (33.3 %)
	What, Why	148	2.47	1.11	29 (48.3 %)	31 (51.7 %)
	Where, Why	109	1.82	.83	10 (16.7 %)	50 (83.3 %)
	When, Why	157	2.62	1.04	36 (60 %)	24 (40 %)
	How, Why	116	1.93	.94	16 (26.7 %)	44 (73.3 %)

In addition to the descriptive statistics, a set of inferential statistics were used in order to explore whether Persian speakers' ratings of Persian MWQs turns out to yield a clear clustering pattern. Therefore, a hierarchical cluster analysis was performed to explore whether Persian MWQs are organised into meaningful clusters according to their grammaticality status and the type of *wh*2 element. As seen in the dendrogram in Figure 1, 18 ordered pairs are grouped together as grammatical MWQs in cluster 1, and 12 ordered pairs (i.e. mostly MWQs with non-complements *who*, *when*, *how*, and *why* in the *wh*2 position) have merged as ungrammatical MWQs in cluster 2. Checking the results in Figure 1 against the data in Table 9, it can be seen that in cluster 1 of the dendrogram in Figure 1 (i.e. grammatical MWQs), all MWQs have means above 2.5, except for the ungrammatical ordered pairs <*where*, *when*> and <*what*, *why*>.

As for the clustering pattern of MWQs in the resulting dendrogram, it can be said that both clusters contain MWQs with different types of *wh*-in-situ elements; hence unlike English MWQs, no definite clustering pattern is obtained for Persian MWQs. However, the interesting point is that MWQs with complements *what* and *where* in the *wh*2 position are exclusively grouped in cluster 1 of the dendrogram, and no instances of these types of MWQs can be found in cluster 2. This could be a good piece of evidence for the relatively high acceptability of *what*-type and *where*-type Persian MWQs in comparison with other types of MWQs. Also, the distance between clusters 1 and 2 is great, showing the highly distinctive grammaticality status of the MWQs included in the two clusters.

Figure 1
Dendrogram Using Hierarchical Cluster Analysis for PSEs' Ratings of Persian MWQs



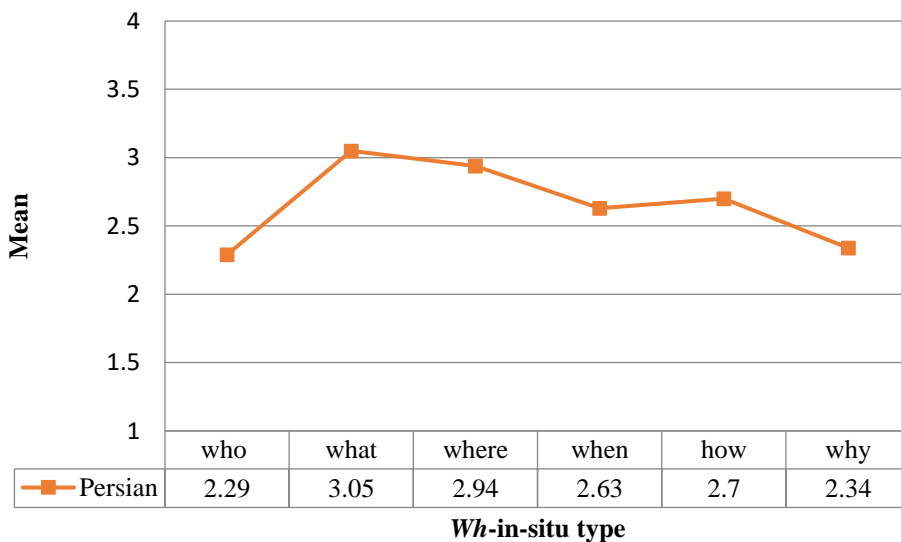
In order to explore how Persian speakers distinguish among the different types of *wh2* elements in Persian MWQs, the mean and *SD* of their ratings of the six types of MWQs in the Persian GJ task were calculated (Table 10):

Table 10
 Descriptive Statistics for PSEs' Ratings of 6 Types
 of Persian MWQs

Type of <i>wh</i> 2 element	Mean	SD
<i>ki</i> (<i>who</i>)	2.29	1.12
<i>chi</i> (<i>what</i>)	3.05	0.99
<i>kojâ</i> (<i>where</i>)	2.94	1.06
<i>kei</i> (<i>when</i>)	2.63	1.13
<i>chetor</i> (<i>how</i>)	2.7	1.07
<i>cherâ</i> (<i>why</i>)	2.34	1.08

Addressing the main thrust of the research question put forward in this section, the mean differences among the six types of *wh*-in-situ elements in Persian binary MWQs is graphically illustrated in Figure 2. As illustrated in Figure 2, only *who*-type and *why*-type *wh*-in-situ elements have means below the midpoint cut-off score of 2.5 in binary MWQs of Persian. Additionally, only *what*-type and *where*-type *wh*-in-situ elements have means above the midpoint cut-off score of 2.5. Taking these commonalities into consideration, it can be said that with regard to the 6 types of *wh*-in-situ elements in binary MWQs, the major ungrammaticality lies in *when*-type, *how*-type, and *why*-type MWQs.

Figure 2
 Mean Differences Among 6 types of *Wh*-in-situ Elements in Persian Binary MWQs



4.1.2. Binary, D-linked, and Ternary MWQs in Persian vs. English

The second research question explores if there are any grammaticality differences between NSEs' ratings of English binary MWQs, D-linked MWQs and ternary MWQs and PSEs' ratings of translation-equivalent Persian binary

MWQs, D-linked MWQs and ternary MWQs. The purpose of the research question is to work out the differences between the two languages. Based on this research question, the following null hypotheses were respectively formed to compare the differences between binary, D-linked, and ternary MWQs of English and Persian, each of which is addressed in the following sections:

H0₁: There is no difference between NSEs' ratings of English binary MWQs and PSEs' ratings of translation-equivalent Persian binary MWQs.

H0₂: There is no difference between NSEs' ratings of English D-linked MWQs and PSEs' ratings of translation-equivalent Persian D-linked MWQs.

H0₃: There is no difference between NSEs' ratings of English ternary MWQs and PSEs' ratings of translation-equivalent Persian ternary MWQs.

4.1.2.1. *English and Persian Binary MWQs*

Based on the current null hypothesis, there is *no* difference between NSEs' ratings of English binary MWQs and PSEs' ratings of translation-equivalent Persian binary MWQs. The descriptive statistics (i.e. sum, mean, and *SD*) of 30 binary English MWQs and their translation-equivalent Persian counterparts are illustrated in Table 11 in the following. A closer examination of Table 11 shows that 23 binary English MWQs (i.e. especially those with *how* and *why* in the *wh*₂ position) have means below the midpoint score (i.e. 2.5), whereas 12 binary Persian MWQs have means below the midpoint score. In other words, while NSEs consider only 7 English binary MWQs grammatical, PSEs consider 18 Persian binary MWQs grammatical. Yet, in order to test the differences more objectively, 30 paired samples *t*-tests were conducted to investigate if there were really significant differences in NSEs' raw ratings of binary English MWQs and PSEs' raw ratings of binary Persian MWQs. Since the number of NSEs and PSEs together equals 60, the degree of freedom would be 59 (i.e. *df* = 59). The alpha decision level is set at 0.05.

As shown in Table 11, the results of the *t*-tests indicate that 20 out of 30 paired samples *t*-tests comparing binary English MWQs and their translation-equivalent Persian counterparts show significant differences at the .05 level, and 10 paired samples *t*-tests don't differ significantly. Therefore, since the majority of the paired samples *t*-tests (i.e. 20 out of 30 items) show significant differences between English and Persian binary MWQs, the current hypothesis is safely rejected, meaning that there *is* generally significant difference between NSEs' ratings of English binary MWQs and PSEs' ratings of translation-equivalent Persian binary MWQs.

Table 11

NSEs' Ratings of English Binary MWQs vs. PSEs' Ratings of Persian Binary MWQs

Type of <i>wh2</i>	MWQ	English binary MWQs (n=30)		Persian binary MWQs (n=30)		<i>t</i> (59)	<i>p</i> -value
		Mean	<i>SD</i>	Mean	<i>SD</i>		
<i>Who</i>	What, Who	1.67	.922	3.02	1.000	6.19	.00*
	Where, Who	2.40	1.133	1.95	1.111	1.78	.08
	When, Who	2.33	1.093	2.65	1.102	1.29	.20
	How, Who	2.33	1.093	1.85	.820	2.53	.02*
	Why, Who	2.13	1.196	1.98	1.081	.60	.55
<i>What</i>	Who, What	3.97	.183	3.75	.508	2.26	.03*
	Where, What	3.63	.718	3.03	.956	3.03	.00*
	When, What	3.73	.521	3.12	.940	3.33	.00*
	How, What	2.27	.907	2.75	.968	2.28	.02*
	Why, What	2.37	1.129	2.63	1.119	1.06	.30
<i>Where</i>	Who, Where	3.93	.254	3.77	.593	1.47	.14
	What, Where	2.97	.928	2.93	1.006	.15	.88
	When, Where	2.20	.805	2.83	1.044	2.91	.00*
	How, Where	2.17	.950	2.95	.999	3.56	.00*
	Why, Where	2.33	1.124	2.22	1.027	.50	.62
<i>When</i>	Who, When	3.53	.507	3.57	.745	.22	.83
	What, When	3.10	.923	2.88	1.027	.97	.33
	Where, When	1.73	.740	2.45	1.126	3.15	.00*
	How, When	1.53	.730	2.35	.954	4.12	.00*
	Why, When	1.50	.777	1.92	1.078	1.88	.06
<i>How</i>	Who, How	2.27	.907	3.25	.856	5.03	.00*
	What, How	1.63	.765	3.07	.936	7.25	.00*
	Where, How	1.43	.679	2.10	.986	3.32	.00*
	When, How	1.90	.960	2.83	1.044	4.10	.00*
	Why, How	1.33	.606	2.28	1.075	4.48	.00*
<i>Why</i>	Who, Why	1.77	.971	2.90	1.085	4.83	.00*
	What, Why	1.43	.626	2.47	1.112	4.72	.00*
	Where, Why	1.20	.484	1.82	.833	3.74	.00*
	When, Why	1.27	.521	2.62	1.043	6.67	.00*
	How, Why	1.23	.504	1.93	.936	3.82	.00*

Note. The asterisk (*) shows that the mean difference is significant at the 0.05 level.

4.1.2.2. English and Persian D-linked MWQs

Based on the present hypothesis, there is *no* difference between NSEs' ratings of English D-linked MWQs and PSEs' ratings of translation-equivalent Persian D-linked MWQs. Table 12 shows the sum, mean, and *SD* of 15 D-linked English MWQs and their translation-equivalent Persian counterparts. As seen in Table 12, English and Persian D-linked MWQs have relatively identical grammaticality status, with the majority of them being grammatical; 12 English D-linked MWQs are regarded as grammatical (i.e. the means are above 2.5) by

NSEs, and all Persian D-linked MWQs are similarly considered grammatical by PSEs. However, in order to objectively examine if there were really significant differences in NSEs' raw ratings of English D-linked MWQs and PSEs' raw ratings of Persian D-linked MWQs, 15 paired samples *t*-tests were conducted. As the number of NSEs and PSEs together equals 60, the degree of freedom would be 59 (i.e. $df = 59$). The alpha decision level is set at 0.05.

Table 12

NSEs' Ratings of English D-linked MWQs vs. PSEs' Ratings of Persian D-linked MWQs

D-linked MWQs	English D-linked MWQs (n=30)		Persian D-linked MWQs (n=30)		<i>t</i> (59)	<i>p</i> -value
	Mean	SD	Mean	SD		
	Which book - Which student?	3.57	.858	3.53		
At which beach - Which tourist?	3.10	1.029	3.08	1.062	.07	.94
On which evening - Which student?	3.13	.860	2.95	.982	.87	.39
With which tools - Which mechanic?	3.30	.794	3.13	.929	.84	.40
For what reason - Which student?	2.67	.922	2.95	.928	1.37	.17
Which person - In which manner?	3.97	.183	3.67	.572	2.80	.00*
Which tool - In which way?	3.57	.679	3.43	.831	.76	.45
In which place - In which manner?	3.20	.925	3.55	.790	1.87	.06
At which time - In which manner?	2.93	.944	3.05	.910	.57	.57
For what reason - In which manner?	2.43	.971	2.60	1.028	.74	.46
Which customer - For what reason?	3.60	.498	3.38	.865	1.27	.21
Which book - For what reason?	3.43	.817	3.48	.792	.28	.78
In which country - For what reason?	2.43	.898	3.47	.791	5.59	.00*
At which time - For what reason?	2.60	.932	3.18	.965	2.73	.00*
In which manner - For what reason?	2.23	.817	2.80	.860	3.00	.00*

Note. The asterisk (*) shows that the mean difference is significant at the 0.05 level.

Table 12 clearly illustrates that only 4 out of 15 paired samples *t*-tests comparing English D-linked MWQs and their Persian counterparts show significant differences at the .05 level. Based on this, since the majority of the paired samples *t*-tests (i.e. 11 out of 15 items) don't show any significant differences between English and Persian D-linked MWQs, the current null hypothesis is not rejected, showing that there *is* generally no significant difference between NSEs' ratings of English D-linked MWQs and PSEs' ratings of the translation-equivalent Persian D-linked MWQs.

4.1.2.3. English and Persian Ternary MWQs

The current hypothesis assumes that there is *no* difference between NSEs' ratings of English ternary MWQs in the English GJ task and PSEs' ratings of translation-equivalent Persian ternary MWQs in the Persian GJ task. The sum, mean, and *SD* of 15 ternary English MWQs and their translation-equivalent Persian counterparts are shown in Table 13. Five out of fifteen

English ternary MWQs are deemed ungrammatical (i.e. the means are below 2.5), whereas 4 Persian ternary MWQs are judged as ungrammatical. In order to objectively see if NSEs' raw ratings of English ternary MWQs differ from PSEs' raw ratings of Persian ternary MWQs, 15 paired samples *t*-tests were conducted. As in the previous hypothesis, the degree of freedom would be 59 (i.e. *df*=59), and the alpha decision level is set at 0.05.

Table 13
NSEs' Ratings of English Ternary MWQs vs. PSEs' Ratings of Persian Ternary MWQs

Ternary MWQs	English ternary MWQs (n=30)		Persian ternary MWQs (n=30)		<i>t</i> (59)	<i>p</i> -value
	Mean	<i>SD</i>	Mean	<i>SD</i>		
What - Who - Whom?	3.33	.994	3.27	1.023	.29	.77
Where - Who - What?	3.27	.944	2.40	1.077	3.74	.00*
When - Who - What?	3.40	.814	2.40	1.045	4.59	.00*
How - Who - What?	2.87	1.042	2.52	1.033	1.51	.13
Why - Who - What?	2.73	1.112	2.13	1.033	2.53	.01*
Who - How - What?	2.57	1.104	2.70	1.046	.56	.57
What - How - Whom?	1.37	.718	2.83	.960	7.39	.00*
Where - How - What?	3.10	.995	3.47	.812	1.87	.04*
When - How - What?	2.20	1.064	2.87	.947	3.02	.00*
Why - How - Whom?	1.37	.850	1.77	.909	2.01	.04*
Who - Why - What?	3.30	1.088	3.12	1.010	.79	.43
What - Why - Whom?	1.60	.932	2.50	1.112	3.81	.00*
Where - Why - What?	2.73	1.112	2.95	.946	.96	.34
When - Why - What?	2.30	1.055	2.83	1.044	2.28	.03*
How - Why - What?	2.83	1.147	3.05	1.032	.90	.37

Note. The asterisk (*) shows that the mean difference is significant at the 0.05 level.

As illustrated in Table 13, the results of the *t*-tests indicate that 9 out of 15 paired samples *t*-tests comparing English ternary MWQs and their translation-equivalent Persian counterparts differ significantly at the .05 level. Therefore, since the majority of the paired samples *t*-tests (i.e. 9 out of 15 items) show significant differences between English and Persian ternary MWQs, the current hypothesis is safely rejected, suggesting that there *is* generally significant difference between NSEs' ratings of English ternary MWQs and PSEs' ratings of translation-equivalent Persian ternary MWQs.

4.2. Discussion

4.2.1. Persian Binary MWQs

The first research question concerned the way native speakers of Persian distinguish among the six types of *wh*-in-situ (or *wh*₂) elements in Persian binary MWQs. In Persian binary MWQs, much like English binary MWQs,

MWQs with *what* and *where* in the *wh*₂ position have higher means than the other types of MWQs, and all instances of these MWQs are grouped in a single cluster in the resulting dendrogram (Figure 1). Persian MWQs are divided into two major clusters in the relevant dendrogram: 19 grammatical ordered pairs, and 11 ungrammatical ordered pairs. Although Persian resists a neat classification of the six types of *wh*-elements with regard to the Superiority effect, the 7 ordered pairs <*who*, *what*>, <*who*, *where*>, <*who*, *when*>, <*what*, *where*>, <*what*, *when*>, <*where*, *what*>, and <*when*, *what*>, which were considered grammatical in English, are equally deemed grammatical by Persian speakers.

As a multiple *wh*-in-situ language, Persian allows the *wh*-argument *chi* ‘what’ and *wh*-adjuncts *kojâ* ‘where’, *kei* ‘when’, *chetor(i)* ‘how’ to appear in the *wh*-in-situ position mainly due to the scrambling property in this language and the lack of strict syntactic and semantic constraints on MWQs. However, unlike the other types of *wh*-elements the adjuncts *ki* ‘who’, and *cherâ* ‘why’ can’t usually appear in the *wh*₂ position in MWQs.

The obligatory occurrence of *ki* ‘who’ in the initial sentence position and the fact that arguments/adjuncts don’t move over it show that this *wh*-element, as distinct from arguments/adjuncts, has an inherent Focus feature. This is in line with Karimi (2005), who maintains that the feature-driven *wh*-movement of Persian subjects to the initial position seems to support the existence of the Superiority effect in this language. However, the Superiority effect can sometimes be violated. For example, in the ungrammatical sentence **Chi ki kharid?* the subject *ki* ‘who’ can remain in the *wh*₂ position when the accusative case marker *-ro/-yo* is added at the end of the object *chi* ‘what’: *Chi-ro ki kharid?*

The *wh*-argument *chi* ‘what’ can freely be used with different *wh*-elements and in different positions of Persian MWQs, especially when it receives the accusative case marker. The *wh*-adjuncts such as *kojâ* ‘where’, *key* ‘when’, and *chetor(i)* ‘how’ may also appear in different positions in Persian MWQs. The *wh*-adjunct ‘why’ shows a different behaviour from other *wh*-adjuncts and resembles the *wh*-argument *ki* ‘who’ in that it is used less freely in *wh*-in-situ of MWQs and usually yields ungrammatical sentences when used with the *wh*-adjuncts *kojâ* ‘where’, *kei* ‘when’, and *chetor(i)* ‘how’ in the *wh*-operator position.

Due to the complex nature of Persian MWQs, no definite classification can be presented for the constraints on these structures. Taking this into account, one should be careful that the analysis presented here is based on the decontextualised MWQs elicited in the Persian GJ task. So, if used in appropriate contexts, most of the ungrammatical ordered pairs in binary MWQs of Persian, just as in the case of English, would most probably be considered grammatical.

4.2.2. Binary, D-linked, and Ternary MWQs in English vs. Persian

The second research question examined if there were any grammaticality differences between NSEs' ratings of English binary MWQs, D-linked MWQs and ternary MWQs and PSEs' ratings of translation-equivalent Persian binary MWQs, D-linked MWQs and ternary MWQs. There was significant difference between NSEs' ratings of most of the English *binary* MWQs and PSEs' ratings of translation-equivalent Persian binary MWQs. Interestingly enough all binary MWQs with *how* and *why* in the *wh2* position showed significant differences across English and Persian. This could be a good piece of evidence for the great difference between the two languages with regard to the use of these two types of *wh*-elements in the *wh2* position of the binary MWQs. The difference between the MWQs of the two languages has significant effects on PSEs' ratings of English binary MWQs to the effect that even advanced PSEs can't judge *how*-type and *why*-type MWQs as well as NSEs. Such non-native-like ratings could be due to (i) the scrambling property of Persian where all types of *wh*-elements could move freely in *wh1* and *wh2* positions in Persian binary MWQs, and also (ii) due to the syntax-semantics interface, where the syntactic and semantic properties of English MWQs interact and L2 learners stop short of processing the two properties simultaneously. More simply, the PSEs fail to undertake multi-tasking while judging the Superiority effect in English binary MWQs.

Unlike binary MWQs, there was no significant difference between NSEs' ratings of English *D-linked* MWQs and PSEs' ratings of the translation-equivalent Persian D-linked MWQs. The high acceptability rates for D-linked structures in both English and Persian could arise from the Memory Facilitation Hypothesis (MFH), on the basis of which linguistic elements that encode more information facilitate their own subsequent retrieval from memory. This finding is consistent with the results of the studies conducted by Hofmeister (2007, 2008), Hofmeister *et al.* (2007, 2013).

Similar to binary MWQs, *ternary* MWQs also differed significantly across English and Persian. The inherent complexity of ternary MWQs makes grammaticality judgements on such structures highly intuitive to the extent that even advanced learners of English may fail to judge them as well as native speakers. The major reason for the complexity of this type of MWQ could be simply the number of *wh*-elements which should be processed in such filler-gap dependencies (FGDs).

5. Conclusion and Implications

Based on the results of the first research question, Persian MWQs resist a neat classification due to scrambling property of *wh*-elements in this language. However, *who* and *why* can't often appear in the *wh*-in-situ position. In addition, the results of the second research question revealed that English and Persian *D*-

linked MWQs didn't differ in terms of grammaticality, but *binary* and *ternary* MWQs differed significantly across the two languages. Actually, the findings of the current study lend support to the Memory Facilitation Hypothesis (MFH). Based on this hypothesis, linguistic elements that encode more lexical/semantic/syntactic information facilitate their own subsequent retrieval from memory. This can be obviously seen in the hierarchy obtained for the acquisition of binary, D-linked, and ternary MWQs:

The hierarchy for the acquisition of three types of MWQs:

D-linked MWQs > binary MWQs > ternary MWQs

The informativity of “*which* + N” structure in D-linked MWQs remarkably affects the overall processing difficulty of this type of MWQs. MWQs including two and three bare *wh*-phrases are in turn considered more complex, suggesting that they would require more effortful processing than D-linked MWQs. Therefore, non-linguistic factors (e.g. the capacity of the working memory) should be taken into account for the investigation of filler-gap dependencies (FGDs) in binary, D-linked, and ternary English MWQs.

The findings of the present study have *theoretical*, *empirical* and *pedagogical* implications. At the *theoretical* level, it is highly interesting that the investigation of the acquisition of binary MWQs at the syntax-semantics interface, and also the processing accounts presented for the acquisition of D-linked and ternary MWQs could potentially lead to the partnership of researchers from different disciplines. This means that the examination of the acquisition of complex structures (e.g. MWQs) requires a sophisticated treatment of formal linguistics as well as processing accounts which involve other cognitive domains. In other words, the future of this area of L2 acquisition research rests in collaborations between formal and cognitive linguists, who should take into accounts not only the role of processing, working memory and other cognitive determinants of linguistic behaviour but also the detailed and complex analysis of the formal aspects of linguistic structures.

The acquisition of the Superiority effect and ameliorated Superiority violations also has *empirical* implications for generative perspective on SLA. The findings of this study broadened our current knowledge of the operation of Universal Grammar and the processes involved in acquisition of complex and abstract structures (e.g. MWQs). In fact, it could be implied that Language Acquisition Device (LAD) helps learners to use their complex, abstract, and tacit knowledge of the functional category C, its relevant *wh*-feature and the strong value of the *wh*-feature in their L2 acquisition process while judging the (un)grammaticality of English MWQs.

With regard to *pedagogical* issues, the results of the study could have implications for teaching Persian to non-native speakers of Persian. In fact, the comparison of Persian native speakers' intuition with those of English native speakers' would more-or-less clarify how (i.e. explicitly or implicitly), in what

order, in which contexts, and in which proficiency level the syntax/ semantics of Persian MWQs could be taught to non-native speakers of Persian.

Prior to conducting the study and while doing it, some major problems were encountered. Due to some empirical constraints, the study has some shortcomings, some of which are the following:

1. Only 30 native speakers of English were qualified to be included in the final pool of native speaker participants.
2. Only one simple instance of each ordered pair was included in the English/Persian GJ task to represent binary MWQs.
3. The data elicited from native speakers only included native speakers of *American* English to the exclusion of the other varieties of English.
4. The D-linked and ternary counterparts of binary English MWQs only included cases in which *who*, *how*, and *why* were used as the *wh*₂ element. So, it will be worth investigating the grammaticality of D-linked and ternary MWQs with other types of *wh*-elements in the *wh*₂ position.

Despite the relative success of the study, much remains to be done in future studies on the L2 acquisition of MWQs:

1. In order to fully understand the syntactic constraints on the L2 acquisition of English MWQs by Persian speakers of English, contrastive analyses of CP, *wh*-features, and the strength of *wh*-feature in English and Persian need to be conducted.
2. As there is significant dearth of studies on the ameliorated Superiority violations, future studies should also focus on the acquisition of D-linked and ternary MWQs by speakers of languages with different MWQ typology.
3. The psycholinguistic factors involved in processing binary, D-linked and ternary MWQs need to be further examined. This could be done through empirical psycholinguistic experiments comparing the reading times and the acceptability judgements of MWQs.
4. A further strain of research could examine the effect of explicit/implicit teaching of grammatical binary MWQs to see if inclusion of such structures in an EFL syllabus could help non-native learners to acquire the syntactic and semantic constraints on the production/ recognition of such structures.

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چکیده

مقاله حاضر الگوی توزیع عنصر پرسش‌واژه را در پرسش‌های چندگانه فارسی و انگلیسی، بر اساس آزمون قضاوت دستوری که برای فارسی‌زبانان و انگلیسی‌زبانان اجرا می‌شود، بررسی می‌کند. آزمون قضاوت دستوری، قضاوت ۳۰ انگلیسی‌زبان و ۳۰ فارسی‌زبان را درباره اصل برتری در ۳۰ پرسش دوگانه در سوالات چندگانه از قبیل <who, what> و <where, what>، <what, where> و ... را مورد بررسی قرار می‌داد. همچنین، به منظور بررسی دانش فارسی‌زبانان و انگلیسی‌زبانان در مورد کاهش نقض اصل برتری، ۱۵ پرسش متن وابسته، و ۱۵ پرسش سه گانه در آزمون قضاوت دستوری گنجانده شد. داده‌ها با استفاده از تحلیل خوشه‌ای سلسله‌مراتبی مورد بررسی قرار گرفتند و در دندروگرام حاصله، پرسش‌های چندگانه دستوری و غیردستوری زبان فارسی به وضوح به خوشه‌های مجزا تفکیک شدند. نتایج اولین سوال تحقیق نشان داد که <who what>، <what, where>، <what, when>، <who, where>، <where, what> که در زبان انگلیسی به صورت دستوری در نظر گرفته شده بودند، از نظر فارسی‌زبانان به همان اندازه دستوری تلقی می‌شوند. نتایج سوال دوم تحقیق، تفاوت‌های قابل توجهی دستوری بین پرسش‌های دوتایی و سه تایی در زبان فارسی و انگلیسی نشان داد، در حالی که در کل، تفاوت معناداری بین قضاوت فارسی‌زبانان و انگلیسی‌زبانان درباره پرسش‌های متن وابسته فارسی و انگلیسی نبود. نتایج مطالعه، از نظر ترتیب تدریس انواع پرسش‌های چندگانه و سطح بسندگی لازم برای تدریس چنین پرسش‌هایی، دارای نتایج آموزشی برای آموزش زبان فارسی به غیر فارسی‌زبانان است.

کلیدواژه‌ها: پرسش‌های چندگانه، اصل برتری، جابه‌جایی پرسش‌واژه، آزمون قضاوت دستوری

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