

The Use of Category Shifts in the Translation of Scientific Texts

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Abstract: The aim of this study is to provide an in-depth analysis of the utilization of category shifts in the process of translating two scientific texts: The Science Book: Big Ideas Simply Explained by John Farndon and Spaceflight: A Concise History by Michael J. Neufeld. The study addresses the following research questions: 1) What are the types of category shifts used by Arab translators to translate scientific texts into Arabic, and 2) To what extent do the translations convey the intended meaning of the source texts and bridge the linguistic gap between the two languages (English and Arabic). The research draws on Catford's (1965) classification of category shifts. It adopted a qualitative approach in analyzing each instance of shifts that corresponds to a particular type of category shifts. The findings of the study revealed that four types of category shifts were used by Arab translators to translate the scientific texts from English into Arabic. It was also found that the use of these shifts was governed by the huge linguistic gap between the two languages. The results of this research should contribute to the growing body of literature that recognizes the importance of specialized translation. In fact, so far, very little attention has been paid to the utilization of shifts in Scientific texts. Therefore, this study makes a major contribution to research on shift in translation by unveiling the linguistic problem that arise during the translation of scientific texts and their impact on the translators' choices, especially in Arabic context.

Keywords: category shifts, Catford, linguistic gap, scientific terminology, tense, translation.

1. Introduction

It is evident that scientific translation from English into Arabic and vice versa has grown in importance in recent times. It goes without saying that the translation of specialized texts (e.g., scientific texts) from one language into another poses a major challenge for translators. However, as many countries undergo large-scale modernization, the demand for this type of translation is increasing. Based on this demand, there have been some notable efforts by some institutions and individuals to enrich the content that is available in different languages and meet the needs of readers who want to know more about the history of science and the latest scientific theories and inventions.

As stated before, the process of translating scientific texts is challenging due to the huge linguistic gap between languages. In order to bridge this gap, different translation strategies are utilized by translators. The use of these techniques, in some cases, leads to shifts in translation that occur as a result of the efforts made by these translators to reproduce the original text in the target language. This study examines various examples taken from the Arabic translation of two selected scientific texts. The study explores the types shifts occurred in the process of translating scientific texts from

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English into Arabi and the factors that govern the use of these types. It draws on Catford's (1965) classifications of shifts and seeks to answer the following questions:

1-What are the types of category shifts used by Arab translators to translate scientific texts into Arabic?

2-To what extent do the translations convey the intended meaning of the source

texts and bridge the linguistic gap between the two languages (English and Arabic)?

The analysis of the selected scientific texts is based on one main feature: translation shift (particularly category shift). The reasons behind the selection of this feature for analysis is that translation shifts are commonly used by Arab translators in scientific texts because of the huge linguistic gap between English and Arabic languages. A closer review of the literature on the translation of scientific texts and the use of shifts in these texts revealed that there is a need for further studies that enhance our knowledge of translators' choices and decisions. This study should contribute to the understanding of treatment of scientific texts, especially among two different languages: English and Arabic.

2. Literature review

The concept of shift in translation

The term "shift" in translation refers to small changes in language that occur during the process of translating a source text (Munday, 2008, p. 55). The term shift was coined by Catford (1965). Catford's definition of translation shift is based on the important distinction he draws between formal correspondence and textual equivalence. According to Catford, translation shift occurs when there is a departure from formal correspondence in the process of translating from the ST to the TL (1965, p. 73). Catford (1965, p. 141) states that, there are two major types of shifts: level shifts, which relate to a shift in the level of equivalence between corresponding SL and TL items and category shifts, and category shifts, which are further subdivided into four categories: structure shifts, unit shifts, class shifts and intra-system shifts. For the purpose of the current study a detailed analysis of category shifts is provided.

Category shifts

According to Catford (1965, p. 76), category shifts - originally developed by Halliday (1961)- are a type of translation shift that deviates from a strict word-for-word translation. This word refers to either unbounded or rank-bound translation, both of which are often employed in free translation depending on the most appropriate rank. Category shifts can be classified into four types: structure shifts, unit shifts (rank changes), class shifts and intra-system shifts (Catford, 1965, p. 141):

(1) Structure shifts: These shifts are the most commonly used type in translation, which involve changes in grammatical structure (Munday, 2008, p.61). They occur when the target structure contains different classes of elements, or the same classes of elements but in a different arrangement. According to Catford (1965, p. 77), structure shifts are the most common of the category shifts that occur in translation between languages.

(2) Class shifts: These shifts involve changes in the part of speech of a word. According to Catford (1965, p. 78), class shifts occur when the TT uses an equivalent item to the relevant item in the SL text but this item belongs to a different word class. This type of shift produces a change in word class

between the ST and the TT; this may include shifts between nouns, verbs, pronouns, adjectives and adverbs.

(3) Unit Shifts or rank shifts: These shifts occur when the translation equivalent in the target language is at a different hierarchical level than in the source language (Munday, 2008, p. 61). Catford (1965, p. 79) states that unit shifts are changes in the unit of language. Specifically, this is a translation strategy in which a unit of the ST is represented by a different unit in the TT, such as a word shifting into a phrase, a phrase into a word, or a phrase into a clause. Therefore, this type of shift involves a change in rank, with a unit of a certain rank in the ST corresponding to a unit of a different rank in the TT.

(4) Intra-system shift: These shifts occur when the SL and TL have corresponding systems in the relevant case, but the TT contains a non-corresponding item with respect to the SL.

Optional shifts and obligatory shifts

Toury (1995, p. 57) argues that shifts are a universal aspect of translation. He divides shifts into two categories: obligatory and non-obligatory, which is similar to Pekkanen's categorization. Obligatory shifts are changes in translation that cannot be avoided without resulting in an unnatural or grammatically incorrect translation. These shifts are often necessary due to differences in syntax, semantics, and phonology between languages, as well as cultural differences (Pekkanen, 2010, 37). On the other hand, optional shifts in translation, according to Klaudy (1997: 83), are influenced by the way texts are structured and the stylistic preferences of translators. While not inevitable, they can improve the flow and readability of the translated text. For Pekkanen, the key factor is the translator's ability to choose how to approach the translation. Since it is difficult to draw a clear line between the obligatory and optional shifts in translation, in some cases, it may be difficult to determine whether a particular shift is obligatory or optional.

Optional shifts in translation can be categorized into several groups, including expansion which is the most commonly used type of shift in translation. Expansion can be divided into two main sub-categories. The first involves replacing a unit in the source text with a longer one in the target language. The second sub-category involves adding a new element, such as a sentence, clause, phrase, or word, to the target text in order to provide additional information that was not included in the original text (Pekkanen, 2007, p.10).

Another category of optional shifts is contraction shift. This type of optional shift occurs during the translation process, where a unit from the source text is shortened or contains less information in the target language. This results in a shorter target unit compared to the source unit (Mináriková, 2012, p. 47). The third category of optional shifts is shifts in order. This category has four subcategories: subject, verb and object, expressions of time and place, and clauses and other changes (Pekkanen 2010).

Criticism of Catford's linguistic approach

Catford is known for his contribution to the field of translation studies through his concept of shifts of translation. However, Catford received harsh criticism for holding a largely linguistic theory of translation. According to Snell-Hornby (1988), translation should not be solely based on linguistics, but should also consider cultural, situational, and historical factors (p. 19-20). She criticizes the

definition of textual equivalence by Catford and describes it as "circular". Snell-Hornby also argues that Catford relied heavily on bilingual informants which, in many cases, sound "inadequate". She also stresses that his example sentences are out of context (cited in Leonardi, 2007, p. 87). Malmkjaer (2005, p. 24) notes that Catford's definition of translation as the substitution of a SL textual element with a TL equivalent textual element (p. 20) should not be interpreted as equivalent in meaning.

After Catford's theory of translation was introduced, some criticisms were raised, and in response, a new type of shift was added to his analysis system. In 1970, Frantiek Miko adopted the term "shift of expression" to describe the change in style during translation. Anton Popovi distinguishes the shift of expression into two sub-categories: constitutive shifts and individual shifts. In the 1980s, functional theories of translation emerged, focused on the shift of function and purpose in a translated text, and their methods of analysis were more relevant in real world situations. Translation has evolved from a strict one-dimensional linguistic approach to a more multi-dimensional socio-cultural approach.

In summary, since Catford's time, numerous scholars have introduced various types of shifts in translation analysis. As a result, the concept of "Translation Shift" has become well-known and frequently used by translators worldwide.

Scientific translation

Scientific translation is a specialized and intricate form of translation that involves translating scientific and technological terms from one language to another, including fields such as medicine, chemistry, physics, and computer science. This type of translation can be challenging for non-experts, particularly given the frequent changes in scientific terminology. Byrne (2006) stresses that scientific translation involves more than simply translating the language and style of the source text; its primary goal is to convey information in a clear, concise, and accurate manner.

The nature of scientific texts

Scientific texts have some distinct characteristics such as the use of specific terms, objectivity, and accuracy. They also share common features such as simple structures, explicitness, and impersonality. Lee-Jahnke (1998, pp. 83-84) provides guidance on how to translate scientific and technical texts, emphasizing the importance of a translator having scientific knowledge and being able to research the subject matter. Translating scientific texts presents a significant linguistic challenge, with terminology being a key principle in scientific knowledge.

Gerhard and Wright (2001) have produced a handbook for terminologists, translators, and lexicographers. According to Gerhard and Wright (2001), terminologists typically concentrate on assigning names to terms and must take into account different mechanisms that determine the formation of specialist terms, including affixation, prefixation, backformation, compounding, deprecation, borrowing, and neologisation (2001: 813).

Semantic translation of scientific texts

Newmark's approach to translation (1988, 1991) addresses two types of translation, namely semantic and communicative. Semantic translation aims to replicate the forms of the source text in the target language, focusing on formal correspondence between the two. This approach is used in genres that are biased towards the source text and involves rendering the contextual aspects of the ST based on the semantic and syntactic features of the TT. It resembles Nida's formal correspondence, which puts much emphasis on the form and content of the ST. Newmark's semantic translation is mainly concerned with phonetic level (transliteration), morphological level (calque), and lexical level (gloss translation), which respectively focus on the structure of the text in relation to these three levels.

Transliteration is the process of taking a word from one language and writing it in the alphabet of another language. It is commonly used in scientific translation and follows the phonetic rules of the target language. To assimilate the structure of the target language, transliterated words are often naturalized. In the case of Arabic, naturalization of loanwords involves adding affixes to the foreign words without altering their roots, in order to better suit the nature of the Arabic language, such as transliterating the word 'technology' as "تكنولوجيا". According to Ghazzala (1995), it is preferable to use pure Arabic terms rather than transliteration or naturalization. For instance, the word "تقنية" can be used to convey the meaning of "technology". Baker (1987) rejects transcription and naturalization as they pose a threat to the position of Arabic. These strategies do not provide an explanation of the meaning of the words in Arabic.

Challenges for translating English scientific terms

Translating scientific terms from English to Arabic presents significant linguistic challenges. It is considered an intellectual challenge that requires expertise in both the source and target languages. In particular, the fields of science and medicine pose difficulties due to the limited vocabulary available in Arabic. This shortage of specialized terminology in Arabic makes scientific translation a challenging task that requires mastery of both languages.

Arabic and English belong to different language families, with Arabic being a Semitic language and English being a Germanic language. These differences have a significant impact on scientific translation, particularly in terms of vocabulary, grammar, and other language features. According to El Hassnawi (2010, p.6), there is a pressing need to introduce new terms in Arabic to better serve scientific terminology, while English is a highly sophisticated language.

To solve the common problems that arise as a result of the complicated features of scientific texts, different strategies can be employed to ensure accuracy and clarity of the translated text. One of these techniques is word coinage which is used to create new words when there are no natural equivalents in the host language for foreign concepts or terms. Pinchuck (1997, p. 53) explains that languages may have gaps in their lexicon, where one language lacks words for concepts expressed in another language. The word coinage method involves two main processes: derivation and revival.

Another strategy is transcription, also known as Arabization. It involves writing English scientific terms using the Arabic alphabet, sometimes with modifications. However, this method does not benefit the Arabic language and does not enrich its vocabulary. Ghazala (1995) argues that this method should only be used when an equivalent term cannot be found in Arabic.

The naturalization method is also a common technique when tackling scientific texts. This method can be seen as an advancement of the transcription method, where English terms are adapted to fit the Arabic word structure. This involves adding new affixes to foreign terms to adjust them to Arabic morphology. Ghazala (1995) suggests that naturalization is better than transcription, but it still falls short in providing appropriate translations for scientific terms.

3. Methodology

This study examines the different category shifts used by Arab translators to translate scientific texts from English into Arabic. The study unveils the factors that might affect the translators' utilization of these shift. This section sheds light on the data used in the current study and the adopted research approach and theoretical framework.

3.1. Data

The current study provides in-depth analysis of 30 examples taken from two scientific books entitled *The Science Book: Big Ideas Simply Explained* by John Farndon and *Spaceflight: A Concise History* by Michael J. Neufeld. John's book was published in 2014. It covers the history of science in six chapters and aims to explore how scientists have attempted to understand the universe, and how scientific discoveries have been achieved. On the other hand, Michael's book was published in 2018. The book provides a concise history of spaceflight, tracing the full spectrum of activities that humans have developed in space. The rationale for choosing these scientific books and their Arabic translations is that they are rich in different challenging features of scientific texts that pose problems for translators.

3.2. Methodological Approach

There were different stages of collecting and analyzing the data for this study. The first stage involved recording all instances of category shifts – 30 English examples (along with their Arabic translations) were chosen for the analysis. In the second stage, a classification of category shifts was identified based on the proposed typology by Catford's (1965). In addition, the ST and TT are presented in tables in two columns. The back translation is also provided both in the tables and in the analysis of the examples.

In seeking answers to the research questions, the current research uses Catford's (1965) classification of category shifts as a theoretical framework. The study also adopted a qualitative approach in identifying each instance of shifts that represented a particular type of category shifts. There was in-depth analysis of the selected examples in order to examine the Arab translators' strategies and explore the factors that governed their choices.

Data analysis

. This section provides a detailed discussion of category shifts that are found in the selected data. The analysis will investigate the use of four subcategories, namely structure shifts, unit shifts (rank changes), class shifts, and intra-system shifts. Each category is analysed with a number of examples that demonstrate the translators' translation decisions.

Structure Shift

. *Structure shifts*, as stated before, are defined by Catford (1965, p. 77) as the changes that occur in the grammatical structure of a sentence when translating from one language into another. They occur when the linguistic system of the TL contains different classes of elements, or similar classes of elements but in a different arrangement. Structure shifts, according to Catford (1965, p. 77), are the most common of the category shifts that occur in translation between languages. In line with this view, Arab translator used this type of shift in many instances due to the huge linguistic gap between the SL and TL. Example 1 illustrates this.

Table 1. Example 1

ST		TT
A logical system for the scientific process was first put forward by the English philosopher Francis Bacon in the early 17th century.		كان الفيلسوف الإنجليزي فرانسيس بيكون أول من طرح نظامًا منطقيًا للتجربة العلمية في أوائل القرن السابع عشر.
Back Translation	The English philosopher Francis Bacon was the first to put forward a logical system for the scientific process in the early 17 th century.	

In the above example, there is a shift in word order between the ST and the TT. Specifically, the grammatical structure is O+V+S in the SL sentence and V+S+O in the TL sentence. This strategy was consistent throughout the process of translating the text from English into Arabic. For instance, in some examples (see appendix A1.1), translators tended to use shift in word order where the grammatical structure in the ST (S+V+C) has been shifted to (V+S+C). For a complete list of similar examples, please refer to Appendix (A1).

A shift from passive voice into active voice also occurred in Example 1, in which ‘was first put forward’ was rendered into Arabic as كان أول من طرح (was the first to put forward). Nevertheless, the meaning of the ST is preserved in the TT. The reason for this shift is that Arabic structure, in general, favours the active over the passive, unless the agent is not specified, which is not the case in this instance. In a study that addresses some common problems related to the translation of passive English sentences into Arabic, Khalil (1993, p. 69) argues that Arabic translators either "shift the English passive sentence into an active sentence in Arabic, or translate the sentence word for word into an Arabic passive sentence in which the agent is not suppressed". In another study, Rosenhouse states that if the agent is known, Arabic tends to use an active structure (1988, p. 101).

Sometimes, shifts can be made by translating the active voice in the English sentence into a passive voice in the Arabic sentence. According to Buckley (2004, p. 610), the passive voice is employed in circumstances where there is uncertainty about the agent responsible for the action, when it is preferable to avoid identifying the agent, or when the focus needs to be on the subject being acted upon rather than the one performing the action. Consider Example 2.

Table 2. Example 2

ST		TT
It gave new public credibility to spaceflight...		مُنحت مصداقية جماهيرية جديدة لرحلات الفضاء...
Back Translation	A new public credibility was given to spaceflight	

In the previous example, the English sentence is in the active voice, ‘it gave new public credibility to spaceflight’, but it was shifted to the passive voice in the TT مُنحت مصداقية جماهيرية جديدة لرحلات الفضاء, (A new public credibility was given to spaceflight). This kind of shift was applied in numerous places throughout the translation process of the ST. This is evident in appendix (A1.2) in which the passive

voice ‘were shown’ in the ST was shifted to the active voice بَيَّن (shows) in the TT. Appendix (A1) contains a comprehensive list of comparable examples.

Shift can also occur as a result of the fact that Arabic, in some cases, lacks tense-to-tense equivalence with English. Example 3 illustrates this.

Table 3. Example 3

ST	TT
Gene therapy has moved from a hope into reality, and the first mammal has been cloned.	انتقل العلاج الجيني من مجرد حلم إلى واقع ملموس، واستُنسخ أول حيوان ثديي.
Back Translation	Gene therapy moved from a hope into a reality, and the first mammal was cloned.

In the above example, the uses of the present perfect tense in the ST ‘has moved’ and ‘has been cloned’ were replaced with verbs in the past simple tense in the TT: انتقل (moved) and استُنسخ (was cloned). Since there is no equivalent in Arabic for the English present perfect tense, uses of this tense have to be translated into the Arabic past simple (Ghazala 2008, p. 61). This kind of shift was adopted in the translation of similar examples found in the data. For example, in Appendix (A2.1) the past perfect tense in the ST ‘had seen’ was translated into the past simple tense اطلع (saw) in the TT.

Sometimes, translators depend on the context when translating from English into Arabic because English and Arabic languages are not the same when it comes to tense. Example 4 below explains this.

Table 4. Example 4

ST	TT
rockets needed air to push against.	الصاروخ يحتاج إلى هواء كي يندفع للأمام.
Back Translation	The rocket needs air to push against.

In the previous example, the past simple tense in the ST is shifted into the present simple tense in the TT. The verb ‘needed’ was translated into Arabic as يحتاج instead of احتاج. According to Ziadeh and Winder (2019, p. 21), Arabic verbs only have two "tenses," perfect and imperfect, which do not primarily indicate time but rather whether an action is complete or incomplete. The perfect tense denotes completed action, while the imperfect tense denotes incomplete action, regardless of time. Although the Arabic perfect tense is often equivalent to the English past tense and the imperfect tense is often equivalent to the English present or future tense, the exact equivalents depend on the context.

Several examples were treated in the same way as Example 4. Appendix (A.2) provides an additional example of the use of this strategy in the translation process of the ST. For instance, in Appendix (A2.2), the verb ‘included’, which is in the past tense, was replaced by a verb in the present simple tense in the TT: يضم (includes).

Class Shift

. According to Catford (1965, p. 78), *class shifts* occur when the TT uses an equivalent item to the relevant item in the SL text, but this item belongs to a different word class. This type of shift produces a change in word class between the ST and the TT; this may include shifts between nouns, verbs, pronouns, adjectives and adverbs.

Catford (2000, p. 145) argues that since class is logically dependent on structure, it is evident that shifts in structure often result in shifts in class. Example 5 illustrates a type of class shift that occurs in the translation of the ST.

Table 5. Example 5

ST	TT
Much of it was a dry mathematical treatise on basic principles.	كان معظم الورقة عبارة عن بحثٍ رياضيٍّ صِرَف حول المبادئ الأساسية.
Back Translation	Much of the paper was a dry mathematical treatise on basic principles.

In the example above, there is a shift in the word class from the pronoun ‘it’ into the noun الورقة (the paper). This is a common practice adopted by translators to convey meaning accurately and fluently in the target language, especially when the source and target languages have different grammatical structures. The text underwent several instances of this type of shift during the translation process (see Appendix B). For instance, in Appendix (B 4), a shift occurred between the pronoun ‘it’ in the ST and the noun الكتاب (the book) in the TT.

The analysis of the data showed that other forms of class shift were utilized in the process of translating the ST into the TL. One of these forms is verb to noun transposition. This is evident in Example 6, in which the verb ‘discover’ in the ST undergoes a shift into the form of the noun اكتشاف (discovering). This shift is obligatory in order to adapt the word to the linguistic system of the TL. Translating the sentence while maintaining the ST part of speech for this word would, in this case, make the sentence seem unnatural to the TT reader. According to Catford (1978, p. 76), the translation shift is employed in order to achieve naturalness in the TT.

Table 6. Example 6

ST	TT
Science is an ongoing search for truth—a perpetual struggle to discover how the universe works.	العلم بحثٌ دائمٌ عن الحقيقة، وصراعٌ مستمرٌ لاكتشاف طريقة سير الكون.
Back Translation	Science is an ongoing search for truth and a perpetual struggle for discovering the way the universe works.

Throughout the translation process, this particular type of shift was implemented in many different parts of the text. In Appendix (B2), for instance, the verb ‘search’ in the ST was shifted into the form of the noun البحث (search) in the TT.

Obligatory shifts differ from non-obligatory shifts, the latter being related to the translator's cultural, stylistic and normative choices. Consider Example 7 below:

Table 7. Example 7

ST	TT
Experiments may test a theory, or be purely speculative .	قد تختبر التجارب صحة نظرية ما، أو قد تكون مجرد تخمينات.
Back Translation	Experiments may test a theory, or be purely speculations.

In Example 7, the adjective 'speculative' in the ST is shifted into the form of the noun تخمينات (speculations) in the TT. This shift is optional, since the translator could have maintained the same word category in the TT by using the adjective تخمينية, which represents the formal correspondence of the ST word. Thus, the shift here arises as a result of the translator's discretion. The same technique was adopted translation of the adjective 'lunar' into Arabic as القمر (the moon). For more examples, please see Appendix (B3). According to Koster (2002, p. 34), the relationship between an original text and its translation is represented by a 'network of correspondences and shifts'. This indicates that the use of shift in some cases is inevitable in the process of translation from one language into another, and may be non-obligatory in other cases, as in the previous example.

Closer inspection of the data showed that translators, in some instances, may resort to class shift to improve the naturalness and readability of the target text for the intended audience. Consider Example 18.

Table 8. Example 8

ST	TT
He had become a spaceflight fanatic after attempting to read Oberth's mathematically challenging book.	أصبح مهووساً برحلات الفضاء بعد محاولته قراءة كتاب أوبرث الرياضي المَعَقَّد.
Back Translation	He became obsessed with spaceflight after trying to read Oberth's mathematical challenging book

In Example 8, the adverb 'mathematically' in the ST was shifted into the form of the adjective الرياضي (mathematical) in the TT. Similarly, in another example (see Appendix B1), the adverb 'famously' in the ST replaced by the adjective مشهورة (famous) in the TT. This procedure is adopted to suit the context and the intended meaning of the source text. According to Nida and Taber (1982, p. 6), changing the form of a message is necessary to maintain its content. They suggest that these changes are crucial for enhancing the text and making it more suitable for the target language readers.

Unit Shift

. Catford (1965, p. 79) states that *unit shifts* are changes in the unit of language. Specifically, this is a translation strategy in which a unit of the ST is represented by a different unit in the TT,

such as a word shifting into a phrase, a phrase into a word, or a phrase into a clause. Therefore, this type of shift involves a change in rank, with a unit of a certain rank in the ST corresponding to a unit of a different rank in the TT. Example 9 illustrates this kind of shift.

Table 9. Example 9

A young German named Albert Einstein proposed his theory of relativity	طرح شاب ألماني يُدعى ألبرت أينشتاين نظريته النسبية.
Back Translation	A young German named Albert Einstein proposed his relativity theory.

In Example 9, a unit shift occurred in which the word in the ST was replaced with to a morpheme in the TT. Specifically, ‘his’ in the ST was substituted with the bound morpheme هـ at the end of the word نظريته (his theory). This shift is obligatory, since the equivalent of the masculine pronoun ‘his’ in Arabic is the bound morpheme هـ. In a similar example (see Appendix C1) the word ‘his’ in the ST was placed by the morpheme هـ at the end of the word طلابه in the TT.

Unit shifts can also occur between a word in the ST and a phrase in the TT. Example 10 provides further illustration.

Table 10. Example 10

Discoveries may be made simultaneously by scientists working independently .	يمكن أن تظهر اكتشافات عدّة في وقت واحد لعلماء يعملون كلٌّ على حدة.
Back Translation	Discoveries may be made at the same time by scientists working each on their own.

In the above example, two cases of unit shift from a word into a phrase could be observed. First, the ST word ‘simultaneously’, which is an adverb, was rendered into the TL as a prepositional phrase, في وقت واحد (at the same time). The second case of unit shift occurred in the translation of the adverb ‘independently’ in the ST using the prepositional phrase كل على حدة (each on their own). Similarly, in another instance (see Appendix C5) the adverb ‘reluctantly’ in the ST was rendered into the TL as the prepositional phrase على مضض. Larson (1998, p. 170) states that ‘it is essential that the translator accept the fact that a single source language word may be translated by one word or by a number or words in the receptor language’.

According to Jakobson (1959/2004, p.139), there is usually no complete equivalence between the units of language in a translation between two languages. Therefore, it is very common to find a word in the ST translated as a phrase in the TT. Example 11 illustrates this.

Table 11. Example 11

... demonstrating that the rocket worked in a vacuum vessel.	... إثبات أن الصاروخ يعمل في وعاءٍ مُفَرَّغٍ من الهواء.
Back Translation	... proving that the rocket works in a vessel devoid of air.

In Example 11, the ST word ‘vacuum’, which is a noun, is translated into the TL as an adjective phrase مفَرَّغٍ من الهواء (devoid of air). The purpose of this shift is to convey meaning and avoid ambiguity in the target text. In another example (see Appendix C2), the same strategy was used to replace the adjective ‘testable’ with the adjective phrase قابلة للاختبار (able to be tested).

The analysis of the data revealed that, in some instances, unit shifts occurred between a phrase in the ST and a word in the TT. Consider Example 12.

Table 12. Example 12

... in tandem with space-based and Earth-bound telescopes	... بالتزامن مع التليسكوبات الفضائية والأرضية
Back Translation	... in conjunction with space and ground telescopes

In the previous example, the ST phrases ‘space-based’ and ‘earth-bound’ were translated into the TL as الفضائية (space) and الأرضية (ground). Throughout the translation process of the ST into Arabic, the use of this strategy was consistent. An example of this can be seen in Appendix (C2), in which the prepositional phrase ‘make a production’ in the ST was shifted to the word ‘تنبؤ’ (predict). According to Bell (1991, p. 6), shifting from one language to another, by definition, involves altering the forms used in the original language. This is because English and Arabic have different structures and rules, and what is expressed as a phrase in one language can be expressed as a single word in the other language.

Intra-System Shift

. An *intra-system shift* occurs when the SL and TL have corresponding systems in the relevant case, but the TT nevertheless contains a non-corresponding item with respect to the SL. Example 13 provides a good illustration of this type of shift.

Table 13. Example 13

Almost every advance depends in some measure on previous work and theories.	كل تقدّم تقريبًا يعتمد إلى حدٍ ما على ما سبقه من أعمال ونظريات.
Back Translation	Almost every advance depends in some measure on previous works and theories.

In the previous example, the singular noun ‘work’ in the ST is shifted into the plural form أعمال (works) in the TT. This shift is made to sustain the TL style. This is also evident in Appendix (D3) in which ‘dream’ was translated into Arabic as أحلام (dreams). Kadhim (2008, p. 82) states that shifts in translations between English and Arabic often occur due to the translator’s tendency to maintain a consistent style throughout the Arabic text.

There are some cases where a plural noun in the ST is shifted into a singular noun in the TT because it is more appropriate to use it in the singular form in these contexts. Example 14 illustrates this.

Table 14. Example 14

rockets needed air to push against.	الصاروخ يحتاج إلى هواء كي يندفع للأمام.
Back Translation	The rocket needs air to push against.

In the above example, the plural noun ‘rockets’ in the ST is shifted into the singular form الصاروخ (the rocket) in the TT. Similarly, ‘origins’ was rendered into Arabic as أصل (origin), see Appendix (D1). According to Farrokh (2011, p. 79), shifts occur as a result of translators' efforts to achieve naturalness in translating between different languages.

Intra-system shifts may also involve a change from a definite word in the ST to an indefinite one in the TT, or vice versa. Consider Example 1.15:

Table 15. Example 15

All truths are easy to understand once they are discovered; the point is to discover them.	"كلُّ الحقائق يسهل فهمها إن اكتُشفت؛ فالمهم هو اكتشافها."
Back Translation	All the truths are easy to understand once they are discovered. What is important is to discover them.

Example 15 includes an intra-system shift from the indefinite noun ‘truths’ in the ST to the definite noun in the TT الحقائق (the truths). In a similar way, the indefinite noun ‘story’ in the ST is shifted

into the definite noun *القصة* (the story) in the TT (see Appendix D4). Due to English grammatical rules, the definite article is not used before this abstract word in the ST, while the Arabic definite article *الـ* is attached to the equivalent word in the TT. This shift is obligatory as a result of the conflicting demands of SL and TL structure.

Intra-system shifts sometimes occur from an indefinite word in the ST to a definite one in the TT as illustrated in Example 16.

Table 16. Example 16

Moreover, liquid oxygen (LOX) and liquid hydrogen would produce the almost highest possible energy output.		بالإضافة إلى ذلك، سيُنتج الأكسجين السائل والهيدروجين السائل أعلى مُخرَج طاقةٍ ممكن تقريبًا.
Back Translation	In addition, liquid oxygen and liquid hydrogen will produce roughly the highest possible energy output	

In Example 16, the superlative adjective ‘highest’ is preceded by the definite article ‘the’ in the ST, whereas in the TT it is shifted to the indefinite word *أعلى* (highest). Similarly, the definite noun ‘the idea’ in the ST is translated into the indefinite noun *فكرة* (idea) in the TT (see Appendix D2). According to Baker (2001, p. 85), when translating, grammar can sometimes restrict translators and force them to follow a certain path that may or may not align with the source text. This implies that translators are not always obliged to adhere to the grammatical rules of the source language, as these rules differ from one language to another.

4. Discussion

The findings of the current study are presented in this section. These findings are related to the different types of category shifts found in the data and the translators' effort to bridge the linguistic gap between the SL and TL. The section addresses the following research questions:

1-What are the types of category shifts used by Arab translators to translate scientific texts into Arabic?

2-To what extent do the translations convey the intended meaning of the source texts and bridge the linguistic gap between the two languages (English and Arabic)?

Types of category shifts used by Arab translators

. The analysis of the data showed that Arab translators used four types of category shifts to translate scientific texts from English into Arabic, including structure shifts, class shifts, unit shifts, and intra-system shifts. The cultural and linguistic differences between the SL and TL necessitated the use of these shifts to ensure that the translated texts are appropriate and understandable to the target audience.

Structure shift was used by Arab translators in relation to different grammatical aspects: word order, tense, and active and passive voices. Structure shifts occurred in the word order between the ST and

the TT. This is evident in Example 1, in which the ST sentence “A logical system for the scientific process was first put forward by the English philosopher Francis Bacon in the early 17th century” was translated as كان الفيلسوف الإنجليزي فرانسيس بيكون أول من طرح نظامًا منطقيًا للتجربة العلمية في أوائل القرن السابع عشر. So, the grammatical structure (O+V+S) in the SL sentence is shifted to (V+S+O) in the TL.

It was also found that, in some instances, structure shifts occurred between the two texts in relation to active and passive voices. This can be seen from example 2, in which the English sentence ‘it gave new public credibility to spaceflight’ was rendered into Arabic as مُنحت مصداقية جماهيرية جديدة لرحلات الفضاء. This technique involved changing the active voice in the original text to a passive voice in the TT. Moreover, structure shifts occurred in a number of instances as a result of the lack of tense-to-tense equivalence. This is evident in examples 3, in which “rockets needed air to push against” in the ST was translated as الصاروخ يحتاج إلى هواء كي يندفع للأمام; the past simple tense in the ST was shifted to the present simple tense in the TT. Appendix A contains many examples that demonstrate the use of structure shift in the TT.

As for class shift, the current investigation found that this type of shifts was used in many examples. The utilization of these shifts indicated that Arab translators made some efforts to achieve naturalness in the TL. A well-known example of this is the translation of the adjective ‘speculative’ in the ST, which was transposed as the noun تخمينات (speculations) in the TT (see Example 7). Another example is the adverb ‘mathematically’ in the ST that was shifted to the form of the adjective الرياضي in the TT (mathematical). Some shifts may be obligatory to adapt the word to the linguistic system of the TL. For example, the verb ‘discover’ in the ST is shifted to the form of the noun اكتشاف (discovering) in the TT (see Example 6).

Unit shifts was a commonly used type of category shifts. This translation technique involves representing a unit of language in the source text with a different one in the target text, such as a word being changed into a phrase, a phrase into a word, or a phrase into a clause. This is evident in Example 10, in which the ST word ‘simultaneously’ is rendered in the TT as a prepositional phrase, (at the same time).

Another interesting finding is that, in some cases, a phrase could also be shifted to a single word. By way of illustration, in Example 12, the phrases ‘space-based’ and ‘earth-bound’ in the ST were translated into the TL as the words الفضائية (space) and الأرضية (ground). In addition, unit shifts could also be adopted to convey the meaning and avoid ambiguity in the translated text. This is evident in Example 11, in which the ST word ‘vacuum’, which is a single noun, is shifted to an adjective phrase مفرغ من الهواء (devoid of air).

Another finding that stands out from the results reported earlier is the use of Intra-system shift. These shifts were used to sustain the TL style. This point can be illustrated clearly by examining Example 13, in which the singular noun ‘work’ in the ST is shifted to the plural form أعمال (works) in the TT. Additionally, intra-system shifts are also made from the indefinite noun ‘truths’ in the ST to the definite noun in the TT الحقائق (the truths). It is worth mentioning that these shifts are made due to the difference in the grammatical rules between the SL and the TL, and they can be obligatory or non-obligatory.

Bridging the gap between the SL and the TL

. The analysis of the data showed that Arabic translators encountered some linguistic difficulties when translating the ST into Arabic. These difficulties included differences in grammar, syntax, and semantics. To overcome these difficulties, Arab translators, as discussed in the previous section,

used category shifts, which involved changing the grammatical or syntactical structure of the text to make it more appropriate for the TL audience.

The Arab translator's effort to bridge the linguistic gap between English and Arabic is evident in the successful translation of some complicated linguistic aspects of the ST. This has been seen in the treatment of word order. In English the word order of a typical sentence is subject-verb-object (SVO). However, Arabic has a different word order, which is mainly verb-subject-object (VSO). This difference is illustrated in the translation of example 3, in which the English sentence 'Gene therapy has moved from a hope into reality' has the word order (SVO) and was translated into Arabic as انتقل العلاج الجيني من مجرد حلم إلى واقع ملموس with the word order (VSO).

The translation of tenses was also a serious challenge for Arab translators. Arabic has a greater range of verb tenses than English, which can make it difficult to accurately translate between the two languages. For example, there is no equivalent in Arabic for the English present perfect tense, so this tense has to be replaced by the past simple in Arabic. Moreover, in some cases, the past simple tense in the TT was used to express the past perfect tense in the ST. Appendix (A2.1) illustrates this point clearly, in which the past perfect tense 'had seen' was expressed by the past simple tense اطلع (saw) in the TT.

It was also found that there were differences in using voices in Arabic and English although they didn't affect the intended meaning. Arab translators were fully aware of the importance of maintaining the Arabic style which, in some cases, determined which voice was more appropriate. Generally, in many instances, shifts from passive voice to active voice occurred because Arabic structure favours the active over the passive, unless the agent isn't specified.

The analysis of the data showed that Arab translators made great effort to maintain the Arabic style and achieve naturalness. This is evident in the utilization of transposition (class shift) when dealing with the ST; pronouns were transposed into noun (see Example 5), verbs into nouns (see Example 6), adjectives into nouns (see Example 7), and adverbs into adjectives (see Example 8). It can be argued that, in all cases, the translators used class shifts to transfer the intended meaning rather than to adhere to the form and structure of the original text.

In general, the utilization of different interventional strategies (shifts) by Arab translators suggests that they were fully aware of the linguistic gap between the SL and TL, and that these techniques were very useful in bridging this gap.

5. Conclusion

The main aim of the current study was to examine the use of different category shifts by Arab translators to translate the scientific texts from English into Arabic. The study also discussed some linguistic factors that the translators encountered, and explored their efforts to bridge the linguistic gap between English and Arabic. The findings of the research revealed that Arab translators used four types of category shifts in their translations. These types included structure shifts, class shifts, unit shifts, and intra-system shifts. It was also found that the use of these techniques was affected by the differences between the linguistic systems in the two languages, and that the translators made great effort to get the message across and achieve naturalness in the TL.

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List of Appendices

Appendix (A): Structure Shift

1. Illustration of the grammatical structure in both languages

ST	TT
1.1. The idea of the black holes began to take root.	بدأت فكرة الثقوب السوداء تترسخ. Back translation The idea of the black holes began to take root.
1.2. In biology, chromosomes <u>were shown</u> to be the basis of inheritance and the chemical structure of DNA was decoded.	يُبين علم الأحياء أن الكروموسومات أساس الوراثة وأُخضع التركيب الكيميائي للحمض النووي للتحليل. Back translation Biology <u>shows</u> that chromosomes is the basis of inheritance and the chemical structure of DNA was decoded.

2. The difference of the tense structure between the ST and the TT

2.1. He meant primarily Galileo, but he <u>had</u> probably also <u>seen</u> a copy of Alhazen's Optics.	وقد قصد بذلك جاليليو في المقام الأول، لكنه ربما أطلع كذلك على نسخة من بصريات ابن الهيثم. Back translation He meant by that Galileo, in the first place, but he probably also <u>saw</u> a copy of Alhazen's Optics.
2.2. It also sent out a press release that included the lunar idea.	نشرت أيضًا بيانًا صحافيًا يضم فكرة القمر. Back Translation It also published a press release that includes the moon idea.

Appendix (B): Class Shift

1. The great English physicist Isaac Newton <u>famously said</u>	المقولة المشهورة للفيزيائي الإنجليزي العظيم إسحاق نيوتن Back translation <u>The famous saying</u> of the great English physicist Isaac Newton
2. One reason for building the vast apparatus known as the Large	وقد كان <u>البحث</u> عن جسيم هيغز، الذي تنبئ بوجوده قبل 40 عامًا في عام 1964م، أحد أسباب بناء الجهاز

Hadron Collider, or LHC, was <u>to search</u> for the Higgs particle, whose existence was predicted 40 years earlier, in 1964.	الضخم المعروف باسم مصادم الهدرونات الكبير (LHC) Back translation One of the reasons for building the vast apparatus known as the Large Hadron Collider, or LHC, was <u>searching</u> for the Higgs particle, whose existence was predicted 40 years earlier, in 1964.
3. It also sent out a press release that included the lunar idea.	نشرت أيضًا بيانًا صحافيًا يضم فكرة القمر. Back Translation It also published a press release with the moon idea.
4. It included more advanced ideas about spaceflight technology	تضمن الكتاب أفكارًا حول تكنولوجيا رحلات الفضاء اتسمت بأنها أكثر تقدمية Back Translation The book included more advanced ideas about spaceflight technology

Appendix (C): Unit Shift

1. The New Zealand-born physicist Ernest Rutherford watched <u>his</u> students fire alpha particles at gold leaf in a search for small deflections.	شاهد الفيزيائي النيوزيلندي الأصل إرنست رذرفورد طلابه وهم يُسلطون أشعة جسيمات ألفا على رقاقة ذهب بحثًا عن انحرافات بسيطة. Back translation The New Zealand-born physicist Ernest Rutherford watched <u>his</u> students fire alpha particles at gold leaf in a search for small deflections.
2. Making a <u>testable</u> hypothesis or a prediction is always useful.	لطالما كان التنبؤ أو تقديم فرضية قابلة للاختبار أمرًا مفيدًا. Back translation Making a <u>testable</u> hypothesis or a prediction has always been useful.

3. These in turn are only theories, and may yet be disproved, although in many cases this is unlikely given the evidence <u>in their support</u> .	إلا أنّها بدورها ما هي إلا مجرد نظريات قد تُدحض فيما بعد، مع أنّ هذا غير مرجح في كثير من الحالات؛ لأنّ ثمة أدلة <u>تدعمها</u>. Back translation These in turn are only theories, and may yet be disproved, although in many cases this is unlikely given that some evidence <u>support them</u>.
4. They made star maps— <u>partly</u> as navigational aids—and <u>named</u> stars and groups of stars.	صنعوا خرائط النجوم – لتكون مُعينات للملاحة إلى حدٍّ ما – كما أطلقوا أسماء على النجوم ومجموعات النجوم. Back translation They made star maps to be aids to navigation - <u>to some extent</u> - and <u>named</u> stars and groups of stars.
5. 41. He wanted to measure the Sun's radiative output absent the atmosphere.	أراد قياس الناتج الإشعاعي للشمس في ياب الغلاف الجوي. Back Translation He wanted to measure the Sun's radiative output absent the atmosphere

Appendix (D): Intra- System Shift

1. new theories on the <u>origins</u> and ecology of life	نظريات جديدة حول <u>أصل</u> الحياة والبيئة. Back translation new theories on the <u>origin</u> and ecology of life
2. <u>The idea</u> of <u>black holes</u> began to take root.	بدأت فكرة الثقوب السوداء تترسخ. Back translation <u>The idea</u> of <u>the black holes</u> began to take root.
3. ... revealing his grand dream of spaceflight.	... بالإفصاح عن أحلامه العريضة في مجال رحلات الفضاء. Back Translation ... revealing his grand dreams in the field of space flight.

4. A story that spread around the world.	وانتشرت القصة انتشار النار في الهشيم في العالم بأسره Back Translation The story spread like wildfire all over the world.
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