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A Functional Analysis of the Thematic Organization in Electrical Engineering Research Article Introductions Written in English By Native and Saudi Scholars: A Comparative Study

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Abstract
The study of the Research Article (RA) genre has been dominated by genre analysis and corpus linguistics focusing on rhetorical moves and, or lexicogrammar, with little attention to the level of the message and the realization of different types of Theme and progression patterns. To the best of our knowledge, there is a lack of comparative studies investigating similarities/differences in the use of theme in electrical engineering RA Introductions written by native English-speaking (NES) scholars and non-native English-speaking (NNES) Saudi scholars. We address this gap using Systemic Functional Linguistics (SFL) approach to analyze the texture of electrical engineering RA Introduction sections written by NES scholars and NNES Saudi scholars from a message perspective. The research questions aimed to quantitatively and qualitatively investigate (1) Theme types, (2) thematic markedness, and (3) thematic progression patterns in the two data sets. After reviewing comparative research on message structure, we analyzed 117 RA Introductions written by experienced NES/NNES authors. The results accord with research comparing thematic organization in native English scholars' writings and those from cultural background other than Arabic. The findings showed that NESs' and Saudi NNESs' introductions overlap at a clause level, but they start to diverge beyond the clause. This study provides a good starting point for understanding NNES Saudi scholars' use of underexplored linguistic items. The results of the current study offer insights for academic writing instruction and material developers.

Keywords: comparative study, engineering research articles, functional analysis, native and Saudi scholars, thematic organization.
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Introduction

The study of the Research Article (RA) genre has been dominated by the theoretical and methodological approaches of genre analysis (Kanoksilapatham, 2015; Kuteeva & McGrath, 2013; Loi & Evans, 2010; Ozturk, 2007; Ruiying & Allison, 2004; Stoller & Robinson, 2013; Tessuto, 2015) and corpus linguistics (Esfandiari & Barbary, 2017; Gilmore & Millar, 2018; Le & Harrington, 2015; Pan, Reppen, & Biber, 2016), with little work employing Halliday's (2014) Systemic Functional Linguistics (SFL) approach in the analysis of thematic choices in RAs.

One major resource for maintaining cohesiveness in a long stretch of discourse is thematic progression (TP) patterns, where sentences build on one another to create global unity in the text (Daneš, 1974). TP patterns are identified by the sequencing of Theme/Rheme in a text (Fries, 1995). The Theme/Rheme contrast offers a great analytical tool to investigate the local/international message in RAs as reflected in empirical research on thematization in RAs (Ebrahimi, 2016; Jalilifar, 2010; Leong, 2015, 2016; Leong, Toh, & Chin, 2018; Lorés, 2004). However, these studies have examined thematization in the context of cross-disciplinary differences (Ebrahimi, 2016; Leong, 2016), generic structure analysis (Leong, 2015; Lorés, 2004; Mozaheb, Saeidi, & Ahangari, 2014), and similarities/ differences between local and international journals (Jalilifar, 2010; Shokri, 2016). What remains unexplored are the similarities/differences between Native English Speaking (NES) scholars' and Non-Native English Speaking (NNES) Saudi scholars' use of Theme in electrical engineering RA introductions. The present study could provide invaluable insights for novice NNES authors. Annual publication output in Saudi Arabia has outpaced many other Middle East countries, as it has been immensely influenced by the support of the Saudi Ministry of Education to scientific research productivity and the government investment in research development (Al-Ohali and Shin, 2013). The analysis of this output by Al-Ohali and Shin (2013) revealed that the most significant amount of international publications in Saudi Arabia is in scientific fields, such as medical sciences, engineering, chemistry, biological sciences, physics, and mathematics. With the increase in the number of English RAs written by Saudi scholars, an increasing need for scrutinizing their writing quality in this particular genre has developed. It is pertinent to examine and compare the use of Theme in electrical engineering RA introductions written by Saudi scholars with their native counterparts since the study may offer pedagogical insights for NNES Saudi scholars in particular or for English for Academic Purposes (EAP) teaching in the Arab world in general. This study aimed to investigate quantitative/qualitative significant similarities/differences in electrical engineering RA introductions written by NES scholars and NNES Saudi scholars in the following aspects: 1) topical Themes; 2) textual Themes; 3) interpersonal Themes; 4) Theme markedness; and 5) TP patterns.

This study intends to answer the following research questions:

1- Are there any similarities/differences in the use of types of theme in the published electrical engineering RA introductions that were written by NES scholars and NNES Saudi scholars?
2- Are there any similarities/differences in the use of TP patterns in the published electrical engineering RA introductions that were written by NES scholars and NNES Saudi scholars?
3- Are there any similarities/differences in the use of thematic markedness in the published electrical engineering RA introductions that were written by NES scholars and NNES Saudi scholars?

4- Are there any statistically significant differences in the use of theme types, thematic markedness, and TP patterns in the published electrical engineering RA introductions that were written by NES scholars and NNES Saudi scholars?

Literature Review

As this paper aims to investigate the use of Theme in NES/NNES scholars' engineering RAs, we first provide an overview of Theme and Information Structure systems.

Systemic Functional Linguistics

Systematic Functional Linguistics (SFL) is based on a functional approach to language, adopting the view that linguistic choices are inseparable from the communicative and cultural contexts of their use (Halliday, 2014). This approach maintains that language serves three functions: experiential meanings represented by our talk about our experience of the world, interpersonal meanings represented by the interactive features of discourse, and textual meanings that create contextualized messages, thereby enabling and organizing such representations and interpersonal relations through language. An analysis of the textual metafunction of a text, therefore, can reveal its organization. One of the main structural systems within the textual metafunction is Theme, discussed next.

Theme and Rheme choices maintain cohesion within a clause. Theme is "the element that serves as the point of departure of the message; it is that which locates and orients the clause within its context" (Halliday, 2014, p. 89). Thus, while Theme is the initial element(s) of a clause, Rheme is "the part in which the theme is developed" (Halliday, 2014, p. 89). Whereas Theme in English is always clause-initial, Rheme occurs later in a clause: Clause-final position makes Rheme/New information more prominent, while a logical sequencing of information is guaranteed by starting the clause with Theme/Given information. This suggests that Theme overlaps with Given information, Rheme with New information. Since the two information structure elements Given/New are marked off by tonic prominence (or pitch contour), Theme/Given and Rheme/ New do not necessarily conflate with each other (Halliday, 2014). Theme is defined and identified structurally, through position, in English (plus functionally, by thematic prominence).

Theme is divided into three types: topical (i.e., experiential), interpersonal, and textual. The topical Theme is obligatory and is realized by three experiential elements. Unlike the topical Theme, both the interpersonal and textual Themes are optional. It is also important to note that interpersonal Themes convey a writer's stance, while textual Themes develop grammatical and logico-semantic links within and beyond a clause (Halliday, 2014).

A further classification of thematic choices is the unmarked/marked contrast. The unmarked Theme is the typical way of starting the message of a clause, while the marked Theme is the atypical choice rarely employed by writers. At a clause level, the unmarked theme in declaratives is grammatically realized by Subject and in marked cases by fronted Complements and Circumstantial Adjuncts (Halliday, 2014). While complements are realized by a nominal/adjectival group and have the potential to be Subjects but they are not, Circumstantial Adjuncts are realized by an adverbial and prepositional group/phrase (Halliday, 2014). One function of marked Themes is announcing a change of topic, guiding readers through the text and

showing them how to interpret the ideas being presented (Mauranen, 1996). Marked Themes then have a facilitative effect as they render the message unambiguous by setting the scene for the clause carrying that message.

Besides establishing cohesion within the clause, Theme-Rheme can develop cohesion beyond the clause. Theme-Rheme patterns contribute to maintaining a naturally flowing text in three possible ways. One is through linear (or zig-zag/sequential) development in which the Rheme of one clause is introduced as the Theme of the following clause. Developing ideas in a linearly sequenced manner is preferred in the RA genre to construct an argument (Banks, 2008). Scholars choose to present ideas in this way to create a text that seems to flow logically. A second TP pattern is the reiteration of the same Theme in following themes, while the Rhemes change. Maintaining the same element as the Theme of more than one clause develops a topic-focused text. A strong topical focus characterizes persuasive discourse, building on the same topic to convince the reader about the point being raised (Hawes, 2015). A third TP pattern is the split Rheme (or multiple-Theme/fan pattern). It is when the Rheme, mostly of a paragraph-initial clause, carries more than one idea which is then developed one by one in subsequent Themes.

Previous Theme studies

A number of studies compared the use of thematic choices and TP patterns by native English learners with those found in non-native writers' texts (Aronsson, 2005; Hasselgård, 2009; Hawes, 2015; Hawes & Thomas, 2012; Leong, 2007; Park & Nam, 2015; Wei, 2013). A common finding of these learner-focused studies is the under-, over-, or misuse of Theme choices and TP patterns. Unlike these student writer-focused studies, the present study deals with NNES scholars' use of thematic structure in RAs compared to NES scholars.

Several studies have analyzed NNES expert authors' use of thematic choices and TP patterns. SFL researchers have examined NNES authors' use of Theme in media texts (Lu, 2002; Potter, 2016) and textbooks (Jalilifar & Montazeri, 2017; McCabe, 1999). Another genre that has received attention, though with diverse focus, in SFL-based research is RAs. While early research on thematic structure in RAs examined cross-linguistic influences by comparing NES/NNES scholars' thematic choices in published RAs (Mauranen, 1996; Mirahayuni, 2002; Ventola & Mauranen, 1991), the attention has gradually turned to topics such as variation within RA sections (Leong, Toh, & Chin, 2018; Martínez, 2003), RA generic thematic structure (Leong, 2015; Leong, Toh, & Chin, 2018; Lorés, 2004), similarities/differences in local/international journals (Jalilifar, 2010; Shokri, 2016), and RA cross-disciplinary differences (Ebrahimi, 2016; Heng & Ebrahimi, 2012; Leong, 2016; Shokri, 2016). In investigating cross-disciplinary differences, Ebrahimi's (2016) study of the textual organization of Theme in RA abstracts from four disciplines (Applied Linguistics, Economics, Agriculture and Applied Physics) revealed disciplinary differences in the use of theme types and patterns. This indicates that a discipline's requirements influence the choice of a particular Theme type or pattern. Mirahayuni (2002) investigated 652 independent and complex clauses from 10 RA Introductions on education written by NES scholars and NNES Indonesian scholars and found that 16 % of the total clause-Themes comprised marked Themes in native and non-native English. Constant and linear TP patterns were the most frequently occurring patterns in the two data sets. Whereas constant TP pattern was the most dominant in NES scholars' introduction (38.6%), linear TP was the most dominant in NNES Indonesian scholars' (44%) texts.

Nevertheless, it is hard to uncover the reasons underlying the discrepancy since the number of texts is limited. However, these findings were contradicted by a recent study by Jalilifar (2010) that compared Theme choices and TP in 16 applied linguistics RAs written by Iranians in a local journal with a comparable number of RAs published in an international journal. It was found that the writers in the two journals in the same field used similar Theme types and progression patterns. The discrepancy between these studies is due to Jalilifar's (2010) comparison of NNES writers to a group identified by their writing contribution (i.e., international journal authors) rather than NES authors, suggesting that information on first language (L1) background should be reported in comparative studies to eliminate such discrepancies. To the best of our knowledge, there is a lack of comparative studies investigating similarities/differences in the use of theme in electrical engineering RA Introductions written by NES scholars and non-native English-speaking NNES Saudi scholars.

It is pertinent to investigate if there are any variations in the use of types of Themes and TP patterns in electrical engineering RA introductions written by NES and NNES scholars. The motivation for the present investigation arose from a number of methodological concerns in RA research and from works on thematic structure in NNES writing. First, as stated in the introduction, research on RAs is dominated by genre/corpus linguistics methodologies, with little work applying SFL. Second, most reviewed SFL studies of Theme have concentrated on NNES student/novice writings, neglecting texts written by experienced writers. The need for more research on Theme in a variety of writers/texts has been raised by Forey and Sampson (2017), suggesting the present study. Third, previous comparative studies of Theme did not control or explicitly state contextual factors that might confound the results, such as matched level of writing expertise (Mirahayuni, 2002; Ventola & Mauranen, 1991), information on the L1 background of the compared groups (Jalilifar, 2010), publication context, i.e. local/international journals (Jalilifar, 2010; Mirahayuni, 2002), and topic similarity (Jalilifar, 2010; Mirahayuni, 2002; Ventola & Mauranen, 1991). A comparative study controlling these factors is expected to reveal more accurately any similarities/differences between NNES scholars' use of TP patterns and their NES counterparts. Fourth, few studies have examined thematic structure in texts produced by NNES authors from an Arabic L1 background, highlighting the need to examine the English writings of Arabic speakers. To address the gaps identified in mainstream RA research and related works on Theme, this study adopted an SFL-based approach to compare English RAs written by Arabic scholars in refereed journals in the field of electrical engineering with a matched set written by NES scholars.

Methodology

Unit of Analysis

The unit of analysis in this study is the T-unit (an independent clause plus one or more dependent clauses). A T-unit is defined as "a clause complex which contains one main independent clause together with all the hypotactic clauses which are dependent on it" (Fries, 1995, p. 318). Thus we will be having two T-units if a sentence includes two independent clauses. Following the recommendations of Forey and Sampson (2017) and McCabe (1999), the choice of the unit of analysis was determined by the aim of the study and the corpus type. As one major purpose of the study is to investigate TP patterns, given that it has been theoretically established that the T-unit is the optimal unit for capturing such patterns, the T-unit was chosen. The choice was also prompted by the fact that previous studies of thematic development in RAs selected the T-unit as

their unit of analysis (Ebrahimi, 2016; Jalilifar, 2010; Leong, 2015; Leong, Toh, & Chin, 2018; Williams, 2009).

Recognition of Theme and Delimitations

The recognition of Theme is not always straightforward as there are issues in the delimitation of theme, such as the cases of marked and multiple ideational elements (or topical Themes) in clause complexes: What counts as Theme? Where Theme stops and where Rheme begins? The position taken by several scholars (Davies, 1988a, 1988b; Hasan & Fries, 1995; McGregor, 1992) is adopted in the present study since the unit of analysis is the T-unit rather than the clause. Such analysis renders the method of development of the message clearer as the clause identifies **the point of departure** (Theme). These scholars agree that the point of departure does not necessarily conflate what is being talked about (topic/Given information) when recognizing a Theme. For example, the adverbial clause in table one is the Theme of the clause complex:

Table 1. *Example of Theme in a complex clause*

Since the existing statistical UWB CMs	do not incorporate the effect of the antenna,	the present study	considers the possibility of extending the existing wideband directional models to UWB systems. (IET Communications, 4/1, 2010)
Theme	Rheme	Theme	Rheme
Theme		Rheme	

According to Hasan and Fries (1995) "everything up to and *including* the element Subject is Theme so long as there is no marked Topical Theme" (p. xxxvi). Thus, the Subject is excluded in the case of marked Topical Theme since Theme has a MOOD function other than Subject. Also, the clause "*while many have used rule-of-thumb approximations*" in the following example has the textual functions of marked topical Theme, the interpersonal function of Adjunct and the ideational function of temporal Circumstance.

> *"While many have used rule-of-thumb approximations, [Theme] the present paper shows from the theory … [Rheme]."* (*International Journal of Microwave & Wireless Technologies*, 2016)

Theme is realized by the elements preceding the grammatical subject. The identification of Theme depends on the position of the dependent clause in the complex T-unit. If it occurs initially, the entire clause is considered the Theme; if the independent clause occurs initially, the grammatical subject is the Theme.

Following Thompson (2004), anticipatory *it* and the projecting clause are treated as interpersonal projections (or thematized comments) of a writer's claims. The dummy *it* and

the projecting clause in "it is necessary" are annotated as Theme in the following example since the method of development s will be obscured if only *it* is selected: "it is necessary to find alternative energy sources to overcome the continuous energy consumption increase in the last decade." Thompson (2004) states that thematized comment "serves to set up as the starting point of the message the speaker's own comment" (p. 157).

TP Criteria

Two conditions are necessary for establishing a TP link. First, a Theme of one clause must share propositional content with (a) preceding Themes/Rhemes or (b) subsequent Themes through any of the four semantic relations listed in table two These semantic relations aid in recognizing propositional similarity across Themes of neighboring clauses, facilitating the identification of a TP pattern. Second, the Theme of one clause should pick up information from a maximum distance of two clauses away. In other words, a TP pattern is set up if and only if information found in two clauses placed above or below a Theme is picked up by that Theme. Meeting these two conditions can ensure a more systematic approach to the analysis of TP patterns.

Table 2. *Reiteration forms*

Reiteration forms	Example
Repetition	There's a boy climbing along *the rafters*. Those rafters
(Near-)synonymy	Those beams
Superordinate	Those timbers
General word	Those things

Note 1. Adapted from Halliday & Hasan (1976, pp. 279-281)

The Corpus

The corpus comprises 117 Introduction sections (84,752 words) of scientific papers published by NES/NNES scholars (Table 3) in the field of electrical engineering (Appendix 1). T-units were calculated using Ai and Lu's (2010) Web-based L2 Syntactic Complexity Analyzer (Single Mode). The following keywords were used to search for the RAs: *cellular networks, communication systems, MIMO communication, mobile communication, radio communication, wireless and mobile communications, wireless digital communication, wireless sensor Network.*

Table 3. *Key statistics of the corpus*

	Articles	Words	T-units
NES authors	56	42,390	2442
NNES authors	61	42,362	2550
Total	117	84,752	4992

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The field of electrical engineering was chosen because it is the second highest field in Saudi Arabia in terms of the number of international publications (Al-Ohali & Shin, 2013). The focus on one field is necessary to control discipline-based Theme differences, as studies have shown consistently that each discipline has a preference for certain linguistic choices (Hyland, 2000). The Introduction section was analyzed in the present study because most studies have investigated the RA abstracts. Moreover, this section seemed most suitable for thematic analysis as the communicative purposes of an Introduction lend themselves readily to long cohesive chains, allowing a broad range of TP patterns. Another factor minimized in the design of the corpus is individual idiosyncrasies. Multi- or co-authored RAs were chosen where possible rather than single-authored ones to avoid idiosyncrasies that may confound the results. The English RAs in the corpus were grouped into two sets, one written by NES scholars and the other by NNES Saudi scholars. The following criteria were used to be sure that the writers included where native speakers of English/Saudi scholars: (1) institutional affiliations of the authors; authors' undergraduate/secondary education background; and authors' first and last names.

Data Analysis

The steps in analyzing the data were as follows. Each independent clause in the RAs was identified and recorded and the Theme of each independent clause was classified (textual, interpersonal, topical). Each topical Theme was coded as marked or unmarked. Next, the TP patterns were identified.

All features identified in the corpus were reported both qualitatively and quantitatively. Basic descriptive statistics in the form of frequencies and percentages were used to precisely compare between the two data sets. Raw frequencies rather than normed counts are reported since the two data sets are comparable. To compare the frequencies, a chi-square test was also run employing Stangroom's (2019) online Chi-Square Test Calculator was run to examine if the difference in the frequency of occurrence of each of the three thematic aspects (Theme choices/markedness and TP patterns) in the two data sets is significant. Finally, AntConc 3.5.8 software was employed to code instances of first-person pronouns in topical Theme position. This tool calculates the frequency of all words in the corpus and presents them in an ordered list. The frequency of each pronoun was identified using the search only feature. The instances were then manually checked in the software's concordance page to eliminate incorrect annotations.

Results and Discussion

Table four presents the findings of the frequencies and percentages and the Chi-square distribution of three thematic aspects across the two data sets at both local and global levels, represented respectively through Theme choices/markedness and TP patterns. Overall, the RAs written by NNES Saudi scholars contained slightly more of the examined features than those by NES scholars except for the interpersonal Theme and the two TP patterns "linear" and "split-Rheme."

Table 4**.** *Chi-square test and the frequency and percentage of three thematic aspects in the two data sets*

		NES		NNES				
		Freq	%	Freq	%	*P* - Value	df	Asymp. Sig.
Theme Types	Topical	2442	74.36	2550	74.19			
	Textual	768	23.39	821	23.89			
	Interpersonal	74	2.25	66	1.92			
		3284	100%	3437	100%	.583024	1.0791	.05
Markedness	Unmarked	2005	82.10	2132	83.61			
	Marked	437	17.90	418	16.39			
		2442	100%	2550	100%	.15883	1.9853	.05
TP	Linear	600	54.64	480	48.93			
	Reiteration	416	37.89	442	45.06			
	Split Rheme	82	7.47	59	6.01			
		1098	100%	981	100%	.003475	11.3244	.05

The Chi-square test for theme types and thematic markedness indicates no substantial differences between NES scholars and NNES scholars at $p < .05$, whereas the Chi-square values for TP patterns (11.3244) indicate significant differences at $p < .05$ (p-value=.003475). In other words, there were significant differences between the NES scholars and NNES Saudi scholars in terms of the different TP patterns. This is in line with Ventola and Mauranen's (1991) finding that NNES scholars' TP patterns/Theme choices lack variety. The discrepancy in the use of interpersonal themes is insufficient to argue that NES scholars' data included more such instances. The low rate of occurrence of the interpersonal Theme type in the two data sets is in line with what would be expected of objective, non-evaluative RA discourse (Gray & Biber, 2012; Hyland, 2005). Rather than using interpersonal Themes to take a specific stance, the researchers opted for a subtler way of conveying interpersonal meanings, as will be discussed next. At the global level, however, NES scholars used more linear and split-Rheme patterns than did their NNES counterparts, as discussed in Section 4.2.

Local Organization

Topical Theme

The use of topical themes in NES scholars' and NNES Saudi scholars' electrical engineering RA Introductions was similar. This finding is in line with Leong's (2016) study of 200 abstracts from science and humanities disciplines, which indicated that topical themes were used more in scientific abstracts. A closer look at the elements selected as the topical Theme in RA introductions might reveal more about the difference between NES scholars' and NNES Saudi scholars' RAs. One of the topical Theme choices that occurred in both NES scholars' and NNES scholars' Introductions is clause-initial deictic *this/these*. The examples cited here are

representative of the feature under discussion. The NNES Saudi scholars' texts revealed a significant difference in the frequency of occurrence of these forms (189 instances) compared to their NES counterparts (97 instances). This construction is frequent in RAs as it contributes to the development of cohesion in texts (double slashed lines indicate the end of a T-unit).

(1) *NES authors:*

These systems *[Theme] can identify previously unobservable patterns thanks to their large spatial extent. [Rheme] (IEEE Sensors Journal*, 10/6, 2010)

WSNs [Theme] have several common aspects with wireless ad hoc network [11] [Rheme] // and in many cases they [Theme] are simply considered as a special case of them. // ***This*** *could lead to erroneous conclusions… [Rheme] (Sensors*, 9, 2009)

Each RFID tag [Theme] has a unique identifier or signature [Rheme] which [Theme] is encoded onto the backscatter of the interrogation signal from a RFID reader. [Rheme] // ***Utilizing this passive backscatter-based encoding technique****, [Theme] a single powered reader can retrieve individualized data from large quantities of densely packed mobile tags from a centralized location. [Rheme] // (Sensors*, 14/8, 2014)

Significant growth of the asset base [Theme] occurred in some technologies…[Rheme]// ***This changing mix*** *[Theme] was distorting the apparent reliability. [Rheme] (IEEE INTLEC*, 2017)

(2) *NNES authors:*

It is natural for the two operations of channel and data recovery [Theme] to be considered jointly, [Rheme] especially since one operation [Theme] can be used to enhance the performance of the other. [Rheme]// ***This intuitive idea*** *[Theme]… (IEEE Transactions on Signal Processing Journal*, 55/7, 2007)

In [6], the author [Theme] has taken the stator resistance variation into consideration, [Rheme]// but the same observer gains of [4] [Theme] have been used. [Rheme] // ***This*** *[Theme] causes that the speed-adaptive full order observers integrated with stator resistance estimation scheme have unstable regions [12]. [Rheme]// (Electrical Engineering*, 99/3, 2017)

In [4,5], a Direct Torque Control (DTC) [Theme] is proposed. [Rheme] // ***This technique*** *[Theme] has a good transient response [Rheme] // but it [Theme] necessitates a high switching frequency to reduce the torque/current ripples. [Rheme] // (Electrical Power & Energy Systems*, 103, 2018)

Although the NNES authors' RA introductions seem to overuse clause-initial *this/these + noun*, the examples indicate that this form realized similar functions in NES authors' introductions. This finding contrasts with Mirahayuni's (2002) study, which reported the minimal use of normalized

forms as Themes in NNES scholars' RAs published in local journals. This was not the case in the refereed journals examined in the present study, suggesting that the status of NNES scholars' academic authorship might play a role in the skillful use of Theme choices.

Another interesting finding is that the NES scholars (288 instances) used more first-person pronouns *'we'* and *'our'* in topical Theme position than did the Saudi NNES scholars (105 instances), suggesting greater visibility of the former group than the latter. The use of this form indicates authorial stance towards a proposition and increased author visibility (Ebrahimi & Chan, 2015; Ebrahimi, Chan, & Ain, 2014; Leong, Toh, & Chin, 2018). It seems that the Saudi NNES scholars' reluctance to over-use this form may be attributed to their awareness of academic writing norms which discourage its use.

(3) *NES authors:*
***We** propose an approximate MMSE ABD method for MIMO active sensing systems.* // (*IEEE Transactions on Signal Processing*, *66*/18, 2018)

***We** show in this paper that R-RANSAC is also more computationally efficient.* // (*IEEE Transactions on Automatic Control*, *61*/2, 2016)

We** compare six routing protocols designed for WSANs in terms of route discovery and maintenance, delay-bound and energy consumption.* // **(Journal of Parallel & Distributed Computing*, *72*/7, 2012)

(4) *NNES authors:*
*In this paper, **we** derive a new union bound on the bit error probability of coded FHSS systems with MAI.* // ***We** consider FHSS systems with perfect channel estimation and pilot-aided channel estimation over Rician and Nakagami fading channels.* // *(EURASIP Journal on Wireless Communications & Networking*, 2008)

***We** rely on a precoded cooperative transmission technique to extract the underlying rich multipath-Doppler-spatial diversity.* // *(Wireless Communications & Mobile Computing*, 2018)

The under-use of first-person pronouns by NNES scholars was also observed in biology RAs written by Spanish-speaking scholars and was explained in light of cross-linguistic influence (Martínez, 2005). The NNES Saudi scholars' reluctance to over-use this form, however, may be attributed to their awareness of academic writing norms which discourage its use.

Interpersonal Theme

The realization of the interpersonal Theme was extended to include grammatical metaphors in *it-clauses* with extraposed subjects. Both NES scholars and NNES scholars minimally employed this structure (25 and 21 instances, respectively) to construe their stance towards propositions in a neutral way, as illustrated in their use of the modalized adjectives *desirable*, *necessary*, *pertinent*, *well documented*, and *evident* in table five. This is expected since this type of construction tends to cluster in more opinionative, less-formal genres than RAs (Gómez-González, 2001; Mirahayuni, 2002).

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Table 5. *Examples of it-clauses in the two data sets*

Text Group	Textual Theme	Topical Theme	Rheme
NES authors 2	And	it is usually desirable	to minimize this metric, which decreases with increasing amplifier linearity.
5	and on occasion	it is necessary	to define a single (ith) element of a sum/ set as (:)
47	therefore,	it is expected	to show similar characteristics.
NNES authors 10	Consequently,	it is necessary	to find alternative energy sources to overcome the continuous energy consumption increase in the last decade.
25		It is also possible	to change the defect hole radius and spacing to modify the sensitivity and quality factor.

The thematized comment in the first example in Table includes the modal adjunct 'usually' to convey to the readers the degree of certainty.

Textual Theme

NNES scolars' RAs contained slightly more clauses with a textual Theme (N = 821) than did NES scholars' (N = 768). However, further analysis of textual Theme types showed that both groups used textual devices to achieve similar functions of setting grammatical and, or semantic relations.

Table 6. *Textual theme instances in the two data sets*

Group (Text)	Textual Theme	Topical Theme	Rheme
NES author 11	However,	neither paper	addresses the analytical performance of R-RANSAC.
	Therefore,	the main contribution of this paper	is to analyze the convergence properties of R-RANSAC.
NNES author 10	Additionally,	integrating different energy resources	improves system reliability and efficiency and decreases system cost.

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However,	in comparison with single-energy systems,	HES appear to be more complicated because of the use of two different energy resources joined together.
Consequently,	an optimum sizing methodology	is essential to utilize the renewable energy resources efficiently and cost-effectively.

Grammatical and semantic relations within a clause were constructed using conjunctions (e.g. so, but, or). In contrast, logico-semantic relationships between a clause and the preceding text were established using conjunctive adjuncts (e.g. however, while, on the other hand). The use of conjunctive adjuncts makes the logico-semantic relationships in a text explicit, as adjuncts relate the clause with what precedes through addition, apposition, and other semantic relations (Halliday, 2014). Both groups employed conjunctive adjuncts in Introductions to explicitly advance arguments highlighting the importance of their work. Table six shows instances of NES scholars' and NNES scholars' ways of realizing causal (therefore, consequently), additive (additionally, moreover), and adversative (however) meanings through conjunctive adjuncts. Similar conclusions were drawn in previous research showing that retrospective cohesive devices tend to occur in argumentative RA sections such as the Introduction to persuade readers of the validity of claims (Gosden, 1992; Jalilifar, 2010).

Unmarked and Marked Themes

The use of unmarked and marked Themes was almost equal in both data sets (Table 4). A similar distribution in engineering report writings was found by Mirahayuni (2002), indicating a preference for maintaining the same topic rather than shifting focus through the frequent use of marked Themes.

The function of contextual frames (CFs) or marked themes in Examples 5 and 6 is to draw contrast by comparing the research with previous studies, allowing the authors to present their work as a solution to the identified problem and establish the significance of their study as a result. Gosden (1992) argues that writers employ CFs in RA introductions "contrast and addition to fulfill the need for finding a gap through contrasting their study with the current state of knowledge, as well as raising [a] problem and showing disagreement with existing research" (p. 8). This finding is in line with Gosden's (1992) study of 36 Physics, Chemistry, and Biology RAs written by native speakers of English. The findings revealed that CFs were more employed in introduction, result and discussion sections, indicating higher topic shifting through the use of CFs.

(5) *NES author 1: While many have used rule-of-thumb approximations [Theme], the present paper shows from the theory that the Pareto trade-off need not be approximated, [Rheme]// but [Theme] can be directly obtained from the S-parameters and noise parameters [Rheme]. (International Journal of Microwave & Wireless Technologies*, 2016)

(6) *NNES author 12: Since the existing statistical UWB CMs do not incorporate the effect of the antenna [Theme], the present study considers the possibility of extending the existing wideband directional models to UWB systems [Rheme]. //* (*IET*

Communications, 4/1, 2010)

Marked Themes were also employed by the two groups to justify the research and emphasize its novelty. Fronting the hypotactic clause (*Since many*…) or circumstantial element (*In light of*) enabled the authors to place the study within a broader context and thereby motivate the study.

(7) *NES author 9:* ***Since many*** *designs must focus on minimizing the spectral spreading from wideband excitations [Theme], the intention of our work is to present a fast measurement-based load impedance optimization to obtain the highest PAE possible while achieving an acceptable ACPR [Rheme].* // (*IEEE Transactions on Microwave Theory & Techniques*, *62*/8, 2014)

(8) *NNES author 12:* ***In light of*** *the future of the very promising UWB technology [Theme], the objective of this study is directional UWB channel characterization [Rheme].* // (*IET Communications*, *4*/1, 2010)

Similarly, the circumstances of place in Examples 5 and 6 helped the writers to orient the attention of their readers to the proposed work and its contribution to the field. Perhaps the NNES Saudi scholars' group selected more atypical message starting points for such purposes because they may have received more EAP writing training due to their NNES status. In other words, they had formally learned the importance of situating their research and establishing or occupying a niche (Swales, 2004) to gain acceptance in the global research community. The difference then does not likely stem from the Arabic L1 background of the NNES group, but rather from the NNES authors' recognition of the increased promotional elements in academic discourse (Hyland, 2000, 2005).

(9) *NES author 5:* ***In this paper*** *[Theme], we provide an approximate method for MMSE ABD // that is less computationally expensive than the exact solution [Rheme].* (*IEEE Transactions on Signal Processing*, *66*/18, 2018)

(10) *NNES author 13:* ***In this paper*** *[Theme], we derive a new union bound on the bit error probability of coded FHSS systems with MAI [Rheme].* // (*EURASIP Journal on Wireless Communications & Networking*, *1*, 2008)

The first part of this section examined within-clause Theme choices. What follows is the global thematic analysis of the two data sets to reveal the authors' preferred ways of sequencing information across the clause.

Global Organization

A combination of linear and constant theme patterns constituted over 90% of the TP patterns in the NES and NNES authors' texts (Table 4). This result is in line with Lorés' (2004) study, which examined RA abstracts in linguistics and reported the tendency to include linear and constant patterns.

Linear

Consistent with previous studies on thematic development in the Introduction section of biology RAs (Leong, 2015; Leong, Toh, & Chin, 2018) and abstracts in applied linguistics (Ebrahimi, 2016; Lorés, 2004), linear (zig-zag) TP was the most dominant in both NES scholars' (54.11%) and NNES Saudi scholars' (48.19%) texts (Table 4). This finding is in contrast with Rahmawati and Kurniawan's (2015) study of TP in five undergraduate students' thesis abstracts written in English by students at an Indonesian university, which indicated that constant theme pattern was the most dominant pattern followed by the linear pattern. The high frequency of this pattern in the present study can be explained by the tendency of scientific texts to develop a linear "chain of reasoning (ultimately based on experiments) in which each step led on to the next" (Halliday, 1993, p. 131). Carrying information over from the Rheme of one clause to the subsequent Theme helped to create a clear and coherent line of argument in the introductions as the authors built each idea on what was said before, resulting in a hierarchically structured text.

Table seven shows how NES and NNES authors developed their main topic in the first part of the Introduction through the systematic use of linear patterns.

Table 7. *Linear development in the two data sets*

Text Group	Theme	Rheme
NES author 7 : (*IEEE Communications Magazine*, *52*/12, 2014)	Lack of reliable power infrastructure, a chronic problem in developing rural areas,	can paralyze cellular infrastructure in even the most well-developed areas after a disaster.
	Following Hurricane Sandy,	the FCC reported approximately 25 percent of cell sites in the affected 10-state area were non-operational [7].
	Commercial cellular base stations	require access to network operator services such as a mobile switching center and home location register.
	Damage to central switching stations, power outages, or loss of backhaul connections	can eliminate cellular service across large areas.
	Community cellular base stations	do not require any remote infrastructure to operate, and are therefore better suited to emergency and disaster use.
	In this work,	we leverage a rural community cellular network, VillageCell (also called Kwiizya), as a starting point for a rapidly deployable cellular system for emergency and disaster networks [6, 8].

Text Group	Theme	Rheme
NNES author 9: (*EURASIP Journal on Wireless Communications and Networking*, 2010)	At high data rates and large bandwidth,	communication channels become frequency selective.
	Single carrier modulation schemes	do not perform well under this condition, which has necessitated a shift to multicarrier modulation schemes.
	Multicarrier schemes such as orthogonal frequency division multiplexing (OFDM)	transform a frequency selective fading channel into a flat fading channel, simplifying or even eliminating equalization.
	This parallel data transfer method	offers immunity to multipath fading and impulsive noise and can be efficiently implemented in digital hardware through the use of fast Fourier transform (FFT) [1, 2].
	Despite these advantages,	one major drawback is that OFDM signal exhibits high peak-to-average power ratio (PAPR).
	Such large dynamic range of these signals, when amplified,	drive the high-power amplifier to operate in the nonlinear region.
	This	results in two types of distortions:

Both extracts demonstrate the potentials of this type of pattern for producing a coherent argument in the Introduction, a requirement that must be fulfilled as this characteristically argumentative section is where writers have to convince readers of the relevance of the proposed work (Swales, 2004). This is illustrated in the NES scholar's example, where the use of linear development helped the author argue for the need to "leverage[e] a rural community cellular network" and hence build a case for conducting the study. Another skillful employment of the linear method is illustrated in the NNES scholars' example, where the author introduced "multicarrier modulation schemes" as the Rheme of the second clause and moved it to successive Theme by considering one such scheme, "OFDM," which was maintained in the following Theme using reiteration. The remaining Themes in the example derived from the Rhemes preceding them, giving a strong sense of topic continuity and in turn sustaining the argument being made. Theme five in NES scholar's text 7 ("Community cellular base stations") is reiterated from Theme 3, "Commercial cellular base stations."

Reiteration

The second most common TP pattern in the two groups is reiteration, comprising 37.51% of NES scholars' and 44.38% of NNES scholars' use of information development methods. While both recognized the usefulness of linking clauses by thematic repetition, they used it for slightly different purposes. In NES scholars' Introductions (Table 8), successive thematic elements were

reiterated across several clauses to explain the organization of the paper or elaborate on the observed similarities of two systems/networks (EDNs). Although the chain of reiterated elements (Section I, II, IV, etc.) in the Theme of a sequence of sentences in Text 8 is not an identity chain but a similarity chain and it contributes to the organization of the text.

Table 8. *Reiteration in NES scholars' introductions*

Text Group	Theme	Rheme
NES author 8	In Section II ↓	we investigate the development and origins of the existing RMa path loss models in 3GPP [1], [11], [23], and reveal important inconsistencies with the line-of-sight (LOS) model equation when used at frequencies above 9.1 GHz and at mm Wave bands.
	This work ↓	also illuminates numerous questionable empirical correction factors used by ITU-R and 3GPP which make no physical sense for rural environments.
	Section III ↓	describes 73 GHz propagation measurements conducted in rural Riner and Christiansburg, Virginia for LOS and non-LOS (NLOS) environments.
	Section IV ↓	introduces a clear weather RMa multi-frequency close-in reference distance (CI) path loss model and a new RMa path loss model that consists of a close-in free space reference distance and incorporates the base station transmitter height (CIH).
	Section V	discusses empirical model results and uses the measured data and existing 3GPP RMa path loss models to develop the CI and CIH RMa path loss models that are accurate, simple to understand and implement, and may be used for frequencies from 0.5 GHz to over 100 GHz.
NES author 7	Both types of networks ↓	operate under challenging power and network backhaul conditions.
	Both ↓	must be easy to deploy, operate, and maintain.
	EDNs ↓	have the additional requirements of serving large numbers of users, dealing with attempted usage in excess of network capacity, and operating in rapidly changing networking environments.

Text Group	Theme	Rheme
	EDNs ↓	are used to provide local communication inside a disaster area and enable contact with the rest of the world.
	These networks	may use pre-existing wireless infrastructure,

Identity chains are realized through pronominal cohesion, instantial equivalence, the definite article and demonstratives. In contrast, the NNES Saudi scholars' Introductions (Table 9) kept the Theme constant to indicate the significance of the topic discussed (CRAHNs) and provide further details about the design of an antenna (PIFA structure). Although the identified purposes of the TP pattern of reiteration in the two data sets may overlap, as it offers the authors a strategy to give additional information about a topic closely related to their work, it may be noted that the NES authors mainly drew on this TP pattern to describe the remaining sections of the paper at the end of the Introduction. Unlike the NES group, the NNES authors not only used reiteration to present an overview of the paper sections, but also to further discuss a point relevant to the present investigation and ultimately signal its importance to the study. Again, the examined NNES group seems to be highly aware of the linguistic choices available to them and hence the effective use of the reiteration progression pattern.

Table 9. *Reiteration in NNES Saudi scholars' introductions*

Text Group	Theme	Rheme
NNES author 7	The routing of CRAHNs ↓	is a very important issue
	because it ↓	affects the performance in terms of delay and throughput of the entire network.
	The routing of a CRAHN ↓	is different from the routing in conventional ad hoc networks
	because it	faces a number of challenges.
NNES author 11	Several PIFA configurations ↓	have been suggested for GSM/DCS/WLAN, 900/1800/2450 MHz bands in recent publications.
	A PIFA ↓	that consists of three separate short-circuited patches with a triple feed integrated in a compact structure is presented in [12].
	Another PIFA structure ↓	has been designed in order to reduce the number of feeders used in the above case, and hence simplifies the structure and reduces the cost [13].

Text Group	Theme	Rheme
	A meander patch PIFA structure	has been suggested to use only single feed instead of triple or dual feeds as in the above two cases.
	Moreover, the structure	uses two shorting pins.
	Branch line strip PIFA	has also been proposed for triple band operation [14].
	In that multilayer structure,	two short-circuited branch strips are used.

Split Rheme

While linear and reiteration methods of development occurred with similar frequencies in the two data sets, a difference emerged in the occurrence of split Rheme pattern. Whereas the data of the NES authors included 82 (7.47%) instances of split Rheme pattern, the NNES Saudi scholars included 59 (6.01%). This pattern works over somewhat extended stretches of text, unlike the linear and reiteration patterns, which operate between adjacent clauses. Split pattern unfolds across many clauses because it carries several pieces of information revolving around one major topic, with each piece taking thematic position in a separate clause, forming a cluster of topically related clauses. Although there was a quantitative difference in the use of this pattern in the two data sets, the qualitative analysis found a similarity in terms of function of use (Table 10).

Table 10. *Split Rheme pattern in the two data sets*

Text Group	Theme	Rheme
NES author 2 (*IEEE Transactions on Aerospace and Electronic Systems*, 52/6, 2016)	The reconfigurable amplifier	must satisfy performance criteria in several key areas.
	Linearity	allows spectrally confined transmission,
	power efficiency	allows expeditious use of available energy,
	and output power	is critical for target detection.
NES author 9 (*IEEE Transactions on Microwave Theory and*	The literature	does contain examples of using intelligent algorithms to perform faster impedance tuning.
	Sun [9] and Sun and Lau [10]	have demonstrated use of a genetic algorithm to perform

Techniques, 62/8, 2014)		antenna impedance matching based on the voltage standing-wave ratio (VSWR).
	Qiao et al.	demonstrated the use of genetic algorithms for real-time tuning of a transmitter amplifier with reconfigurable matching networks [11].
	du Plessis and Abrie	examined the use of genetic algorithms and found them to be much slower that other algorithms for some impedance-matching optimization scenarios [12].
NNES author 1 (*IET Generation, Transmission & Distribution*, 12/10, 2018)	Although SC is considered attractive in many fields of study,	it suffers from three main disadvantages when applied to power systems:
	many external parameters	must be set for optimization,
	global optimality	is not guaranteed,
	and extensive computational times for simple problems	may be required.
NNES author 4 (*IET Communications*, 4/3, 2010)	Following this methodology,	several contributions have been reported recently.
	For example, a set of switch-based multiuser access schemes	were proposed in [9] in order to reduce the feedback load.
	In addition, the authors in [10]	designed a scheduling algorithm that exploits MUDiv using multiple feedback thresholds.
	Furthermore, an investigation of the performance of multiuser selection diversity with absolute SNR-based scheduling and normalized SNR-based scheduling	was conducted by [11].

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Table ten shows that NES and NNES scholars used a split Rheme pattern for two purposes. One is to link clauses containing a list of points such as performance criteria (NES author 2) and system disadvantages (NNES author 1), the other to discuss previous work with the aim of supporting the adopted methodological approach (NES author 9 and NNES author 4). The use of this pattern allowed the authors to fill the Rheme with a statement indicating the existence of previous research and then pick studies from this body of research in the subsequent Themes. For example, the Rheme "*does contain examples of using …*" (NES author 9) introduced the idea that there are examples of this type of algorithm being used in previous work, and such studies were then separately discussed in the following Themes, forming a split Rheme pattern. This skillful use of the split pattern establishes cohesion in the text as the elements in the Rheme signal connections with the successive Themes by highlighting the propositional content to be provided subsequently.

Interpretation

This study aimed to answer four research questions to investigate several thematic choices in NNES Saudi scholars' writings compared to that of NES authors. To answer these questions, this study analyzed the message structure at local and global levels in 117 electrical engineering RA Introduction sections written by NES scholars and NNES Saudi scholars. The analysis highlighted the quantitative and qualitative similarities/differences between the two groups. Quantitatively, the Chi-square tests revealed that there were significant differences in the use of TP patterns across the two data sets but not for Theme types and thematic markedness. On the other hand, the functional analysis showed that the rhetorical purposes for the examined Theme choices were identical to a large extent but comparatively less identical for TP patterns.

The present findings support earlier research in some respects and contradict it at others. The quantitative analysis revealed that NES and NNES scholars differ in their use of TP patterns. This is in line with Ventola and Mauranen's (1991) finding that NNES scholars' TP patterns/Theme choices lack variety, leading them to use a limited set of patterns. The current study showed that NES scholars' introductions had more instances of linear and split-Rheme patterns compared to those written by NNES scholars. This variation in the number of TP patterns across the data indicates that NES scholars linked their clauses using an extensive range of TP chains, unlike their NNES counterparts. However, unlike previous works (Mauranen, 1996; Mirahayuni, 2002; Ventola, 1994; Ventola & Mauranen, 1991), there was a limited divergence in Theme types and thematic markedness in the analyzed NNES authors' and NES authors' introductions. The fact that the present study observed few quantitative and qualitative differences of clause-level Theme choices might indicate that advanced NNES Saudi scholars might be as skillful as their NES counterparts in manipulating the thematic development of a text.

There are several factors that might account for the lack of any major differences in Theme types and thematic markedness in the examined data sets. Unlike some of the previous works (Mauranen, 1996; Mirahayuni, 2002; Ventola, 1994; Ventola & Mauranen, 1991), the design of the current study may have controlled the contextual factors that typically introduce linguistic/rhetorical differences in the analysis of NES and NNES scholars' RAs. Specifically, the present corpus was designed to ensure the comparability of the compiled NES/NESS scholars' texts in terms of (1) academic authorship (i.e., authors' writing expertise measured by the number of publications in leading journals), (2) publication context (i.e., fairly high-ranked journals) and

(3) field and topic similarity (i.e., electrical engineering, wireless digital communication) to control any extraneous effects. Another possible factor for the observed similarity in Theme choices can be attributed to the relatively fixed nature of the examined field, which expects the topics being discussed in the Introduction to be "formulated in a highly standardized code" (Hyland, 2008, p. 20), and this specific formulation of information seemed to require the use of certain TP patterns, resulting in similar patterns of use across the two groups. Further, the high metalinguistic awareness of the examined NNES group might explain the overlap between the Theme choices in the two data sets. The NNES scholars' status of the examined authors coupled with the push by the Saudi Ministry of Higher Education to publish in English in their home country (Al-Ohali & Shin, 2013) may have led them to consider taking EAP classes to better grasp the conventions of English academic writing, which made them more aware of the thematic choices available to them. It may also simply be that the NNES Saudi scholars' publishing experience, including negotiating with peer-reviewers' comments, drew their awareness to the importance of the level of the message in constructing a publishable RA and hence the observed effective use.

Little attention has been paid to the local and global message structures in English RAs written by Saudi scholars. The current study sought to examine this underexplored linguistic aspect in a sample of Saudi NNES scholars' introductions and a comparable set written by NES scholars as the baseline for comparison. Analyzing the quantity and quality of NNES Saudi scholars' use of Theme types, thematic markdeness and TP chains in their published works can help material designers, academic instructors and novice researchers to gain valuable insights on these linguistic features. The findings of the present study thus can raise designers', instructors,' and researchers' awareness of the importance of the message structure in the RA genre and in academic writing in general.

Conclusion

This study was set out to compare electrical engineering RA introductions written by NES scholars and Saudi NNES scholars in terms of Theme choices and thematic markedness within a clause and TP patterns across clauses. The analysis of a) Theme types b) thematic markedness and c) TP patterns in electrical engineering RA introductions revealed two major findings. One is that the NES scholars and the NNES Saudi scholars used quantitatively and qualitatively similar topical, interpersonal, textual, and (un)marked Theme choices in writing the introduction section. The second main finding is that the two groups diverged in their inclusion of TP patterns, with significantly more linear and split-Rheme patterns in NES scholars' data as the Chi-square test has shown ($p < .05$). Although there was a considerable quantitative variation in TP patterns across the data sets, the examined scholars seemed to have drawn on linear and split-Rheme patterns for similar rhetorical functions. In other words, while the two groups statistically differed in employing TP patterns, they generally used the patterns for the same functions. Taken together, the main results of the present study showed that the NNES Saudi scholars' Theme choices within a clause quantitatively and qualitative match that of NES scholars', with only qualitative but not quantitative similarities for the TP patterns. It is possible to say then that the NES scholars' and the NNES Saudi scholars' introductions overlap at a clause level but start to diverge beyond the clause.

Future research could develop the present findings by examining further TP patterns in RAs written by NES scholars and NNES scholars. For instance, TP patterns can be examined within one RA section or across sections to understand the actual differences between the two writer groups. Future studies could also investigate the use of Theme in RA introductions written by NNES scholars from other L1 backgrounds or in different disciplines. Another suggestion is conducting a contrastive study comparing RAs in Arabic to RAs in English in terms of Theme choices and TP chains.

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Appendix: Journals used in the corpus

Advances in Materials Science & Engineering
Ain Shams Engineering Journal
Arabian Journal for Science & Engineering
BioScience
Computer Networks
Digital Communications and Networks
Electrical Engineering
Electrical Power & Energy Systems
IEEE Antennas and Propagation Magazine
IEEE Communications Magazine
IEEE Communications Surveys & Tutorials
IEEE INTLEC
IEEE Journal of Solid-State Circuits
IEEE Journal on Selected Areas in Communications
IEEE Sensors Journal
IEEE Systems Journal
IEEE Transactions on Aerospace & Electronic Systems
IEEE Transactions on Automatic Control
IEEE Transactions on Communications
IEEE Transactions on Information Forensics & Security
IEEE Transactions on Instrumentation and Measurement
IEEE Transactions on Signal Processing
IEEE Transactions on Wireless Communications
IEEE Transactions on Microwave Theory & Techniques
IET Communications
IET Electric Power Applications

IET Generation, Transmission & Distribution
Intelligent Automation & Soft Computing
International Journal of Digital Multimedia Broadcasting
International Journal of Electrical Power & Energy Systems
International Journal of Electronics Letters
International Journal of Energy Research
International Journal of Interdisciplinary Telecommunications and Networking (IJITN)
International Journal of Microwave & Wireless Technologies
International Journal of Wireless Information Networks
Journal of Electromagnetic Waves and Applications
Journal of Lightwave Technology
Journal of Network and Computer Applications
Journal of Parallel & Distributed Computing
Mechanical Systems and Signal Processing
Microelectronics Journal
Open Journal of Antennas and Propagation
Proceedings of the IEEE
Progress in Electromagnetics Research
Sensors
Sensors & Transducers
EURASIP Journal on Wireless Communications & Networking
Wireless Communications & Mobile Computing
Wireless Personal Communications