

Cross-Disciplinary Study of Marked Themes in Research Article Introductions

Seyed Foad Ebrahimi¹, Maryam Farnia^{2,*}

¹ Department of English, Shad. C., Islamic Azad University, Shadegan, Iran

² Department of English Language and Literature, Payame Noor University, Tehran, Iran

Corresponding Author's Email: mfarnia@pnu.ac.ir

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ABSTRACT

The introduction of a research article is an important area of study, as writers need to cohesively state the significance and current status of research, identify and define the gap, and clearly show how this gap is addressed. To write cohesive research article introductions, writers need to keep track of several linguistic features, among which is the theme. Thus, this study aims to investigate the types, frequencies, and communicative purposes of the marked theme in research article introductions across four disciplines. To this end, this study adopted an exploratory descriptive design, and analyzed a corpus of 40 research article introduction sections from four disciplines, namely applied linguistics, psychology, chemistry, and environmental engineering, randomly selected to meet the aims of this study. The research article introductions were extracted from articles published in the 2020–2023 issues of international high-impact journals. The corpus was analyzed based on Ebrahimi's (2014) taxonomy of marked themes. The findings suggested that most of the marked theme types were realized frequently in different manners, indicating disciplinary differences. The findings reported that the communicative purposes of marked themes were influenced and guided by the rhetorical functions of research article introductions and the disciplinary conventions of writing. The findings of this study could be included in EAP writing courses, highlighting the relationship between the rhetorical functions of research article introductions and the disciplinary conventions of writing on one end and the conscious use of marked theme types on the other end.

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Introduction

As a point of departure in any message, themes (Halliday, 2004) present known, context-dependent information, and is discussed under unmarked theme (a theme which is the subject), and marked theme (a theme which is not the subject). Analysing a text for the use of themes, its textual features or texture can provide knowledge on what thematization strategies a writer opt for as theme of a clause and attempt to create a more cohesive text. A number of studies have been carried out to determine the possible types of theme across different genres such as translated texts (Ghadessy & Geo 2001; Khedri & Jalilifar 2011), newspaper editorials (Mardani, 2016), or academic writing and research articles (e.g., Arús-Hita, 2022; Borsinger 2003; Ebrahimi 2008; Ghadessy 1999; Gosden 1992; Gunawan & Aziza, 2017; He, 2020; Jalilifar 2010; Lores 2004; Martinez 2003; North 2005; Zein et. al., 2023). The results of these studies proved that the use of theme structures varies across different texts and genres. The present study aims to explore themes structures in the introduction sections of research articles published in four disciplines (i.e., applied linguistics,

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psychology, chemistry and environmental engineering). Research on disciplinary discourse is significant in that variation in disciplinary culture is echoed in academic writing, representing the linguistic and rhetorical features of disciplinary texts (Dressen-Hammouda, 2014; North, 2005). According to Bazerman (1988), disciplinary variation can be observed in the subject matter, literature, audience and authors themselves, to the extent that ‘each text seems to be making a different kind of move in a different kind of game’ (p. 46).

Thus, the present research is intended to investigate the realizations and communicative purposes and functions of marked themes (hence, MT) in RAIs. The selected corpora represent the classification of science by Becher (1989) into hard (pure and applied) and soft (hard and pure) disciplines.

Research Article Introduction Section

Writing research article introductions (henceforth, RAIs) is commonly agreed to be tricky and problematic, and writing a well-organized introduction “seems like a battle won hard” (Swales & Feak, 1994, p. 173). What makes writing RAIs more challenging is that writers are expected to present objectives as well as the justifications for the significance of the study in a manner that attracts readers’ attention (Swales & Feak, 1994), and journal editors and reviewers carefully and critically review the introduction (and discussion) of manuscript submitted for publications to the journal (Martin et al., 2014). In other words, writing an effective RAI can probably determine the chances an article may be accepted for publications.

RAIs include opening paragraphs after the title that are written to provide readers with information concerning the research background, rationale, gap, objectives, delimitations and assumptions (Jalilifar, 2009). Writing a RAI is quite challenging since writers in this section “project themselves for the first time and they prepare the ground for the research to come by referring to previous research and emphasising possible existing gap in the literature” (Saz Rubio, 2011, p. 259). To Swales (1990, p. 142), the importance of the RAI is rooted in its attention to: “the need to re-establish in the eyes of the discourse community the significance of the research field itself; the need to ‘situate’ the actual research in terms of that significance, and the need to show how this niche in the wider ecosystem will be occupied and defended.” Lim (2012) also pointed that the importance of the RAI descended from the fact that writers need to present a convincing, valid and remarkable introduction to guarantee capturing the interest of the audience, especially those peer researchers and reviewers.

Research on RAIs fascinated several researchers and the literature is replete with studies analyzing how academic writers develop introductions from different perspectives such as rhetorical and generic structures (e.g., Nabilla, et al., 2021; Soodmand Afshar, et al., 2018), the use of metadiscourse markers (e.g., Estagi & Vafaeimehr 2015), collocations (e.g., Gledhill, 2000), or thematicity (e.g., Jalilifar et al., 2017; Zein et. al., 2023). However, not many studies have focused on themes structures in the RAIs in general and compared it cross-disciplinary in particular.

Marked Themes

A writer attempts to organize his text in a manner that is comprehensible and understandable to the reader. Thematic structure is then referred to this information structuring process, and theme and rheme are two main constituents in a clause which explain how information is structured in a message. These two concepts work simultaneously to develop an idea in a text and make it readable and interpretable to the reader. From the perspective of Halliday’s (2004) Systemic Functional

Linguistics, as important aspect of text analysis is how the language is structured and information is communicated in a text. This view posits three metafunctions (Halliday, 2004; Matthiessen & Halliday 1997), which links what is being said or spoken to other texts and contexts (Halliday & Matthiessen, 2014): The interpersonal meta-function enacts relationships; the ideational meta-function is about representation of experience and the world, and the textual meta-function is about organising text. While Theme is treated under the textual meta-function, it also embraces elements of the two other meta-functions (Kong, 2004, as it “mirrors the tri-partitesemantic structure of language, when we recognize textual, interpersonal and experiential (or topical) thematic elements” (Eggins, 1994, p. 271).

Theme, as noted in Halliday and Matthiessen (2014), is “the point of departure of the message or point of departure”, and rheme is “the rest of the message” (p. 89), following the theme. Theme is classified as marked and unmarked based on information occurrence in the sentence initial position. When a theme is the subject of the clause, as in nominalization, it is referred to as unmarked theme. For example,

- (1) ***EPXMA*** is capable of simultaneously detecting the elemental composition, morphology and size of micrometer-size individual particles.

On the other hand, marked theme is not the subject of the clause, as in adverbial or propositional group. For example,

- (2) ***If “the genre are living and the RA is continually evolving” as suggested by Swales (1990 p.110),*** medical genre will also undergo some changes dictated by the outer and wider contexts surrounding the discipline.

Thus, in this study, the initial position is considered as the theme of the clause. This position could be occupied by the subject (as in the example 1) or information proceeding the subject (as in the example 2).

Studies showed that different texts are characterized by the use of certain types of marked themes (for example, travel brochure and newspaper reports (Guijarro & Hernandez, 2001; Travel guide (Lavid, 2000). As North (2005) noted, “the initial constituent of the clause appears to have particular significance in the way it reflects the writer’s beliefs and values, and thus provides an indicator of disciplinary difference in professional academic writing.” (p. 5). Research on marked themes is significant in that besides their default textual roles, marked themes play different discourse roles across genre (Kong, 2004). This is also noted in Martin (2000, p. 285):

From the perspective of textual meanings, we interested in how texts naturalize power by weaving together meanings into an apparently seamless whole in order to position readers and listeners in particular ways. Essentially this has to do with the way in which the writers texture ideational and interpersonal meaning-the way they phase these strands together to form a coherent response.

As noted earlier above, research on thematicity fascinated several researchers’ attention (see introduction section). One of the earlier studies is Gosden’s (1992) research on the discourse functions of context frames (i.e., MT) in the research articles written by English native speakers. Gosden analysed a corpus of 12 international academic journals published in the U.K., U.S.A., and Canada from three hard science disciplines namely physics, chemistry, and biology. Gosden reported that context frames were used more frequently in the introduction, result and discussion

sections, suggesting higher topic shifting in these sections which are signalled through context frames. The result also showed that the greater the application of context frames the more cohesive the text would be. Also, lower manifestation of context frames in method section could be due to the “matter-of-fact” statements that writers’ use to figure out the scientific procedures taken while conducting the study.

Martinez (2003) investigated thematic structures in the method and discussion sections of biology research articles. Results showed that authors used significantly different types of marked themes in these two sections. The findings showed that purpose and time were the most frequently used MT in the method section. Moreover, the higher proportion of MT in the discussion section, as Martinez noted, can contribute to “the logical organization of the text” (p. 119). Also, it was found that unmarked theme was distributed interestingly in the method and discussion sections. In the method section, stating the objective of the research was the point of departure. More application of unmarked themes in discussion sections also showed that this section could be more argumentative and abstract. Martinez finally argued that thematic choices were different across different sections of research articles.

In another study, Jalilifar (2010) investigated the use of thematic types and thematic progression patterns in different rhetorical sections of Iranian local and English international research article in English language teaching journals. He reported that there two corpora showed similarities in the use of different types of themes and patterns of thematic progression which can be attributed to the share genre, and Halliday (2004) noted, text with similar genres present a similar contextual configuration; that is, they display common characteristics in linguistic element related to the field, mode and tenor of discourse. This also entails similarities in textual choices and is echoed in the preferred thematic choices. Jalilifar’s findings also confirmed that research into different types of themes show crucial characteristics of academic articles. Moreover, his study showed that local authors significantly used more marked/unmarked themes in the introduction section, suggesting that local writers opt for more description rather than argumentation in their text, whereas international writers used significantly more marked/unmarked themes in the results and discussion sections, indicating that they tend to argue the points in more details compared to local writers.

In another cross-disciplinary study, Ebrahimi and Chan (2013) investigated the realization of theme types in the research article result and discussion sections of four disciplines (i.e., English language teaching, economics, biology, and civil engineering) based on Halliday’s (2004) model. Their findings displayed almost all themes types were found in the corpus under study; however, there were variations in the use of theme types across the disciplines, suggesting disciplinary rules and conventions which affecting the choice of a particular themes types. Moreover, results showed that the frequency of unmarked theme were higher than marked then in the corpus, indicating the high frequency of thematic and subject positions in the result and discussion sections.

Zein et al.’ (2023) investigation of theme types and structure in the local Indonesian RAIs written by Indonesian writers showed that the RAIs were replete with simple themes with topical patterns as the most frequent, and Textual-Topical-Interpersonal patterns as the least frequent theme types in the corpus. North (2005) study of theme types in university students’ essay indicate that variation in the use of theme types based on students’ background. Results showed that students with art background used significantly more themes in their essay than students with science background, confirming the context-dependent nature of themes. As North noted, this variation “could be related to a greater tendency to present knowledge as constructed, using themes which framed the discussion as a matter of interpretation rather than fact” (p. 1). In other words, although the writing essays were on the same topics, the used themes in the corpus mirrored the views of

knowledge typical of the students' disciplinary background. In a comparative study, Kazemi (2015) examined theme marked themes in English and Persian Medical science research articles and reported that Persian language does not comply with Halliday's theory as many circumstantial adjuncts in the subject positions were found in Persian corpus which is unmarked to Persian native speakers. Her study confirmed that the use of theme marks is characterized with some factors such as genres, author's style difference, contrast and language differences.

The focus of this cross-disciplinary research is on the textual metafunction, analysing the organization of a text for the use of marked theme in RAIs of disciplines from hard and soft sciences disciplines. It aims to investigate the realizations and communicative purposes and functions of marked themes in RAIs. Thus, the study addresses three research questions:

1. What MT types occur in RAIs across applied linguistics, psychology, chemistry, and environmental engineering?
2. What frequency patterns characterize MT usage in these disciplinary RAIs?
3. What communicative purposes do MTs serve within the studied corpus?

Method

Design

Corpus based approach was employed to effectively address the research questions. In this design, corpus, a set of structured texts, was analyzed for language use and linguistic patterns. This design is widely used in fields like linguistics and language teaching as it enables researchers to identify frequency and functional usage of linguistic patterns or features.

Corpus

This study utilized a corpus of 40 research article introductions (RAIs) compiled through a systematic four-stage process. First, four disciplines were selected following Becher's (1994) taxonomy of academic fields, which categorizes sciences into soft/hard and pure/applied dimensions. Psychology (soft-pure) and Applied Linguistics (soft-applied) represented the soft sciences spectrum, while Chemistry (hard-pure) and Environmental Engineering (hard-applied) constituted the hard sciences counterpart. This strategic selection ensured disciplinary diversity across Becher's framework, enhancing the potential generalizability of findings across scientific domains.

Second, three Thomson Reuters-indexed journals from each discipline were identified, all published by Elsevier to maintain consistency in editorial standards. Third, ten empirical research articles adhering to the IMRD structure (Introduction, Method, Results, Discussion) were selected from each journal cluster, with publication dates restricted to 2020–2023 to control for temporal variations in academic writing conventions. Finally, the RAI sections – defined as textual segments between abstracts and method sections without subheadings – were extracted to form the analytical corpus. Table 1 provides detailed specifications regarding journal titles, article distribution, and disciplinary representation.

Table 1
Details of the corpus

Discipline	No. of articles	Journals	Size
Applied Linguistics	10	Journal of English for Academic Purposes English for Specific Purposes Journal of Pragmatics	10762
Psychology	10	Journal of Behavior Therapy and Experimental Psychiatry Journal of Anxiety Disorders Behaviour Research and Therapy	11249
Chemistry	10	Journal of Molecular Structure Microchemical Journal European Polymer Journal	6837
Environmental Engineering	10	Building and Environment Journal of Hazardous Materials Water Research	7887

Corpus Analysis

The analysis employed Ebrahimi's (2014) framework for categorizing marked theme (MT) types and their communicative purposes, a refined adaptation of Gosden's (1992) original model. Ebrahimi's modifications emerged from systematic analysis of a large multidisciplinary corpus spanning research articles and related academic genres, enhancing the framework's applicability to diverse disciplinary discourses. To ensure analytical rigor, the research team conducted two iterative coding passes separated by a one-month interval, mitigating temporal bias through this staggered approach.

Inter-rater reliability was strengthened through triangulation with three applied linguistics experts possessing publication records in related domains. These raters independently evaluated a stratified sample of eight RAIs, focusing on contested classifications of MT types and functional purposes. Discrepancies – predominantly concerning functional interpretations and never exceeding 3% of coded instances – were resolved through structured dialogic validation sessions where raters substantiated their rationales. All divergent cases underwent consensual reclassification, with emergent interpretive nuances incorporated into the final typology. The resultant dataset underwent systematic tabulation to facilitate comparative analysis across disciplinary categories, with particular attention to patterns in functional realizations of MT structures.

Table 2
Types and communicative purposes of MT (Ebrahimi, 2014)

MT type	Communicative Purpose
Location in Discourse (Data)	To show and describe the world-related or discourse-related context of the research or its findings and claims. <i>In the present study, we aim at establishing a detailed procedure to treat Al powder</i>

Validation	To provide supportive evidences to validate the research hypothesis, findings, and conclusions. These supportive evidences could be sourced from the same study by reference to the tables, figures or from other studies in the disciplinary discourse community.	<i>In accordance with Alden et al., and consistent with overall research in the area, we hypothesized that clinical self-evaluation,</i>
Condition	To systematically reports empirical events and findings derived from experimental processes and procedures, emphasizing causal relationships. It further examines provisional hypotheses that require additional validation, which originate from observed phenomena, unresolved patterns, or incomplete datasets warranting future investigation.	<i>If BED is an associated feature of effective or anxiety disorders, it should be more likely to co-occur with these conditions than to present without them.</i>
Cause	To help writers present the cause or the rationale for the research actions and hypothesis.	<i>Since slightly elevated levels of heavy metals in the environment are more common than severe contamination, the effect of elevated CO2 on growth</i>
Purpose	To present the purpose for which a research action was used.	<i>To improve treatment efficacy, it is essential to gain more insight in causal....</i>
Contrast	To sharply juxtaposed with the positive additive aims of addition CF, since these CFs are mainly used for negative expansion.	<i>Although several researchers have reported structural and/or linguistic changes in certain sections of medical RAs (Atkinson, 1992; Ayers, 2008; Huangfu, 2005; Liang, 2005), no report, to our knowledge, has specially dealt with the structural ...</i>
Addition	To exemplify and elaborate by using opposition and expanding on the preceding statements through positive emphasis.	<i>In addition to the analyses of treatment outcomes, we also wanted to investigate the predictors of treatment adherence. (Psy 9)</i>
Means	To introduce common processes and techniques of scientific investigation.	<i>By comparing the locations of the IREDs over time, it is possible to track movement ...</i>
Viewpoint	To show overt viewpoint temporarily help writers to gain a high discourse profile, "similar to the participant role of We as subject."	<i>From the semantic and pragmatic point of view, she also detected a strong tendency towards self-promotion....</i>
Time	To show time-related context of the research, research actions, findings and claims.	<i>In the last three decades the field of genre analysis has seen a great number of studies on written academic genres.....</i>

Results

To answer the first and second research questions, the corpus was analysed for the types and frequencies of MT and the results are presented in Table 3. In this Table, overall frequencies of unmarked theme types are presented as well to ease the comparison or realizations of MT across four disciplines.

Table 3
Frequencies of MT types in RAIs across four disciplines

MT Types	AL		Psy		Che		EE	
	f	%	f	%	f	%	f	%
Location in Discourse (Data)	33	28	21	28	17	28	14	28

Condition	35	29	11	14	9	14	5	10
Validation	17	14	12	16	8	13	4	8
Cause	3	2	8	1	4	6	6	12
Contrast	16	14	12	16	3	5	1	2
Time	3	2	5	7	4	6	6	12
Purpose	3	2	4	5	8	13	4	8
Viewpoint	4	3	1	1	2	3	3	6
Addition	-	-	1	1	3	5	-	-
Total MT	114	100	75	100	58	100	43	100
Total Unmarked Theme	473	100	396	100	286	100	295	100

Note: AL: Applied Linguistics, Psy: Psychology, Che: Chemistry, EE: Environmental Engineering

Table 3 indicates that the realization of the location in discourse (Data) was similar across the four disciplines, while the realizations of other MT types in RAI varied across the corpus. This consistent tendency toward the inclusion of location in discourse (data) MT may be attributed to its role as a signpost that guides readers toward a preferred interpretation and encourages them to engage with the discourse. Regarding the frequencies of the condition MT, the results suggest that AL writers prefer to present a comprehensive picture of the findings from earlier studies by outlining the conditions under which these findings emerged.

Table 3 reports a significant disciplinary difference among the four sets of RAIs concerning the use of the validation MT, indicating that writers in Psycholinguistics tend to situate their studies in relation to the existing literature. In the case of the cause MT, the evident disciplinary difference suggests that EE writers appear to favor establishing reason-result connections between the ideas presented in RAIs. The notable disciplinary difference in the employment of the contrast MT indicates that utilizing this MT may contribute to text development. The disciplinary differences regarding the frequencies of time and purpose MT types reflect the writers' inclinations to frame a text from a temporal perspective or chronologically, as well as to explicitly justify how purposes are articulated and achieved. The last two MT types on the list are viewpoint and addition.

To address the third question of this study, the corpus was analyzed for the communicative purposes of the MT types, and the results are presented in Table 4.

Table 4

Communicative Purposes of MT used in RAIs across four disciplines

MT types	Communicative purpose	AL	Psy	Che	EE
Location in Discourse (Data)	State the discourse-related context for the specific characteristics of a study	✓	✓	✓	✓
	State the discourse-related context for the findings and arguments reported	✓	✓	✓	✓
	Present the context to facilitate interpreting the information presented	✓	✓	✓	✓
Condition	Highlight the real world conditions of earlier findings	✓	✓	✓	✓
	Highlight hypothesized conditions which need more clarification	✓	✓	✓	✓
	Highlight the area of study	✓	*	✓	*

Validation	Highlight the aim(s) of a study	*	✓	*	✓
	Validate earlier findings and arguments	✓	✓	✓	✓
	Validate a gap in the literature	✓	✓	✓	✓
	Validate key term definitions	✓	✓	*	*
	Validate study hypotheses	*	✓	*	*
	Validate the topic of study	*	*	✓	*
Cause	Validate the aim(s) of a study	✓	*	*	*
	Rationalize the significance of a study	✓	✓	*	✓
	Rationalize the method of study	✓	✓	*	*
	Rationalize earlier findings	*	*	✓	✓
	Rationalize the aim(s) of a study	*	✓	*	*
	Rationalize the gap filled by a study	✓	*	*	*
Contrast	Indicate a gap in the existing literature	✓	✓	✓	✓
	Contrast with earlier studies' findings	✓	✓	✓	*
	Contrast the current study with earlier ones	✓	✓	*	*
	Justify a study's opinions and actions	*	✓	*	*
	Indicate the significance of a study	✓	*	*	*
Time	State the significance of a study	✓	✓	✓	✓
	Organize research events and procedures chronologically	✓	✓	✓	✓
	Present the external real world time orientation of events and procedures	*	*	✓	✓
Purpose	Justify the significance of a study	*	✓	✓	✓
	Justify a study's techniques, procedures and actions	✓	✓	✓	*
	Justify earlier studies' techniques, procedures and actions	*	✓	*	✓
	Justify the significance of earlier studies	*	✓	*	*
Viewpoint	State a viewpoint which interprets earlier findings	✓	✓	*	✓
	Present the author's viewpoint	✓	*	*	*
	Present the author's viewpoint concerning earlier findings	*	*	✓	*
Addition	Adding information and elaborating on preceding statements	*	✓	✓	*

Note.*means that the communicative purpose was absent in the RAI.

The location in discourse (data) MT was used to perform three communicative purposes; a) to state the discourse-related context for specific characteristics of the study (Example 1), b) to state the discourse-related context for the findings and arguments reported (Example 2), and c) to present the context to facilitate interpretation of the information presented (Example 3).

Example 1: *In the present study*, we evaluated a series of factors, including baseline SAD symptoms... (Psy 9)

Example 2: *In a previous research*, several block copolymers based on an x-amino-terminated polyether, Jeffamine_ M1000 (JeffM1, Fig. 1) ... (Che 7)

Example 3: For example, *among speakers of American English positive VOTs* are typically longer for short-lag voiced plosives ... (AL)

The results of data analysis confirm four communicative purposes via application of the condition MT (see Table 4). All four groups of writers used the condition MT to highlight the real-world conditions from which earlier studies' findings emerged (Example 4) and to highlight hypothesized conditions needing more clarification (Example 5). AL and Che writers used this MT to highlight the area of study (Example 6) and Psy and EE writers used this MT to highlighting the aim of a study (Example 7).

Example 4: *In most cases*, the imagery was linked with unpleasant memories of earlier events. (Psy 3)

Example 5: *If faster degradation of semi-crystalline polyesteramides occurs in composite*, it can be assumed that..... (Che 7)

Example 6: *If "the genre are living and the RA is continually evolving" as suggested by Swales (1990 p.110)*, medical genre will also undergo some changes ... (AL 4)

Example 7: *Taking into account these facts*, in the present study it was decided to follow the inactivation (EE 10)

The validation MT was used to perform six communicative purposes in the four sets of RAIs (see Table 4). They are a) to attest to the validity of earlier findings and arguments (Example 8), b) to make the current study stand out more by signifying a gap in the literature through phrases such as *"to our knowledge/to the best of our knowledge"* (Example 9), c) to authorise the definitions of key terms (only in AL and Psy RAIs) (Example 10), d) to give scientific backing to their studies' hypotheses (only in Psy RAIs) (Example 11), e) to communicate the significance of the topic studied scientifically (only in Che RAIs) (Example 12), and f) to validate aims of a study (only in AL RAIs) (Example 13).

Example 8: *Based on findings derived from examining several hundred titles of academic publications*, Hartley concludes that titles differ across genres. (AL8)

Example 9: *To the best of our knowledge*, there is no information on purification (Che 6)

Example 10: *As defined by Frost, Heimberg, Holt, Mattia, and Neubauer (1993)*, the Maladaptive Evaluative Concerns (MEC) subscale draws from the FMPS's CM, DA, (Psy 4)

Example 11: Taken together, and *on the basis of the existing literature*, we hypothesized that higher baseline symptom levels of SAD, (Psy9)

Example 12: *According to the National Cancer Institute*, more than 37,680 American men and women will suffer from pancreatic cancer. (Che 6).

Example 13: *In the view of the above*, the present study aims to answer the following questions. (AL8)

The cause MT was used by the four groups of writers to serve five communicative purposes in the RAIs analysed. First and second communicative purposes are to prove the reader with the underlying significance of a study (Example 14) and to state explicitly the reasons for the selection of methods (procedures, techniques, actions) (Example 15). These communicative purposes were found in four sets of RAIs. Next communicative purpose was to present the reasoning of earlier findings that was enacted in the Che and EE RAIs (Example 16). The last two communicative purposes in the list state the cause in relation to a) the aim(s) of a study (Psy RAIs) and b) the gap filled by a study (AL RAIs). These two communicative purposes are exemplified below (Examples 17-18), respectively.

Example 14: *As English is predominantly a tense language* (Norman, 1988), many researchers (Heslot, 1982; Liang, 2005; Malcolm, 1987; Selager-Meyer, 1992; Zhang, 2004) have employed the ESP genre analysis..... (AL 4)

Example 15: *As it has been noted that it might be useful to include a behavioural index of disgust sensitivity in this type of research* (Rozin, Haidt, McCauley, Dunlop, & Ashmore, 1999), part of the children were presented(Psy 2)

Example 16: *Due to its simplicity*, polymer blending is an attractive technique for the design of new materials (EE 3)

Example 17: In addition, *because the trauma memories of PTSD patients include mainly visual and/or bodily sensations* (Ehlers et al., 2002; Hackmann et al., 2004), and since memories of panic attacks are likely to contain bodily sensations as well, we decided to examine these two sensory qualities more closely in a separate analysis. (Psy 3)

Example 18: In addition, *and because titleology in scientific discourse has focused almost exclusively on titles written in English*, another issue, also left unaddressed, concerns the analysis of titles (AL 8)

It can be inferred from Table 4 that the contrast MT was used to perform different communicative purposes in the four sets of RAIs. Common to all disciplines, the contrast MT was used to indicate a gap in the existing literature (Example 19). With the exception of EE RAIs, the contrast MT was used to contrast with findings from earlier studies (Example 20). Contrasting the current study with earlier ones (Example 21) was found among AL and Psy RAIs, and justifying a study's opinions and actions (Example 22) occurred only in the Psy RAIs.

The results illustrate that the contrast MT served the communicative purpose of demonstrating the significance of a study in the AL RAIs (Example 23).

Example 19: Although mindfulness practice should, theoretically, improve these four areas of attention, few studies have investigated this issue. (Psy 10)

Example 20: *In contrast to the Allen et al.*, these authors concluded that male–female differences in VOT were independent of speech tempo. (AL 1)

Example 21: *In contrast to its move structure*, the language of the RA abstract has received little attention. (AL 6)

Example 22: *Although in the present study participants were asked to rate their memory of the event without making a distinction between this memory being voluntary or involuntary*, we assume these concern voluntary memories, because they had to deliberately retrieve the memory in order to describe it. (Psy 3)

Example 23: *While lexical bundles of this sort are important, and have the great benefit of being easily identifiable with simple corpus search methods*, they are also likely to leave out much that is of collocational interest. (AL 3)

As is evident in Table 4, the time MT serves three communicative purposes; a) to illustrate the significance of a study (Example 24), b) to organize research events and procedures chronologically (Example 25), and c) to present the time orientation of research events and procedures in the external real world (Example 26).

Example 24: *In the last three decades* the field of genre analysis has seen a great number of studies on written academic genres, especially the research article (e.g., Hyland, 2000; Swales, 1990, 2004). (AL 2)

Example 25: *Prior to the attempt of metal-ion removal*, the membranes were characterized by different techniques. (EE 3)

Example 26: *In summer*, daytime cooling by the tree canopy due to reduction in sky view factor (shading component) is relatively small compared to cooling due to low transmissivity. (EE 1)

Variations in the communicative purposes accomplished by the use of the purpose MT are demonstrated by the data analysis (see Table 4). Justifying the significance of a study is achieved by application of the purpose MT in the Psy, Che and EE RAIs (Example 27). Justification of selected techniques, procedures and actions in a study was found in the AL, Psy and Che RAIs (Example 28). In Psy and EE RAIs (Example 29), the purpose MT was applied to justify earlier studies' techniques, procedures and actions. Data analysis indicates that justifying the significance of the earlier studies is unique to Psy RAIs (Example 30).

Example 27: *To improve treatment efficacy*, it is essential to gain more insight in causal and maintaining factors of anxiety disorders. (Psy 1)

Example 28: *To this end*, a corpus containing 1140 title was constructed for their analysis. (AL 3)

Example 29: *To investigate the effect of the indoor environment on the prevalence of allergy and asthma symptoms among children*, the ALLHOME study started in 2004 in Sofia and Burgas, Bulgaria. (EE 2)

Example 30: *To overcome these shortcomings*, tasks have been developed that measure the construct of interest without asking the participant directly. (EE 1)

The viewpoint MT is used to carry out different communicative purposes in the four sets of RAIs (see Table 4). The most common communicative purpose is presenting a viewpoint from which the reader can interpret the reported results (Example 31). The second communicative purpose, which was unique to the AL RAIs, was presenting the author's viewpoint (Example 32). The last communicative purpose enacted by the viewpoint MT was presenting the author's viewpoint concerning earlier findings (Example 33).

Example 31: *From the semantic and pragmatic point of view*, she also detected a strong tendency towards self-promotion and "interestingness" (AL 8)

Example 32: *In our view*, the data collected from one external variable... (AL 8)

Example 33: *Interestingly*, the enzymatic degradation of these diblock and triblock copolymers have been recently studied(Che 7)

Concerning the communicative purposes served by the addition MT, the four groups of writers used it to add information and elaborate on preceding statements. The salient point is that even though both groups of writers used it for the same communicative purpose, they used it positively, to add information and elaborate on different parts of an RAI. Psy writers used it to add information about the aim(s) of a study (Example 34) and Che writers applied it to provide more information concerning the significance of the current study as well as the findings of earlier studies (Example 35).

Example 34: *In addition to the analyses of treatment outcomes*, we also wanted to investigate the predictors of treatment adherence. (Psy 9)

Example 35: *In addition to the experimental studies*, the Ru (II) polypyridyl complexes have also attracted many theoretical chemists. (Che 2)

Discussion

The first and second research questions can be addressed and elaborated from three perspectives. The first perspective focuses on the MT type(s) that received similar attention from all four groups of writers. The location in discourse (data) is the only MT that garnered comparable attention from the writers in the four sets of RAIs. This suggests an orientation toward explicitly providing readers with the discourse-related circumstances of the presented material.

The second perspective considers MT types that received different disciplinary attention from the four groups of writers while developing the RAIs. The differing orientations regarding the condition and validation MT types suggest that increased use of these MT could enhance the writing of RAIs with cause-and-effect structures and facilitate the validation and confirmation of studies. Disciplinary differences were also observed concerning the cause and contrast MT types. These differences may indicate the importance of explicitly demonstrating the validity, reliability, and objectivity of the RAIs, as well as communicating the "creation of the polarizing tension necessary to set up and achieve certain rhetorical aims" (Gosden, 1992, p. 212).

Lastly, the time and purpose MT types also exhibited different inclinations among writers while developing their RAIs, suggesting that greater use of these types could imply a chronological framing of RAIs and a clear demonstration of how purposes are articulated and achieved.

The third perspective includes MT types that received little attention compared to others, specifically the viewpoint and addition MT types. Their limited use may indicate the writers' intention to provide readers with a perspective that facilitates interpretation and comprehension, while also reflecting a reluctance to expand on preceding statements through positive emphasis.

The results related to the third research question (Table 3) are discussed as follows. The first group encompasses MT types used to serve communicative purposes imposed solely by the rhetorical conventions of the RAI section. Communicative purposes enacted through the use of the location in discourse (data) MT fall into this category. For instance, in the four sets of RAIs, this MT was employed to articulate the discourse-related context for specific characteristics of the study. Through this communicative purpose, writers aimed to explicitly direct the reader's attention to particular aspects of a study, such as its aims or significance. This application is expected, as writers of RAIs must communicate the significance of their study to reviewers and readers in order to have their manuscripts published and read by members of the discipline.

Another communicative purpose identified in the four sets of RAIs was stating the discourse-related context for the findings and arguments presented. Presenting such information in the thematic position conveys the worthiness of a study, which, in turn, contributes to its validity. This approach also helps to communicate the continuation of the current study from earlier research in the literature and may highlight the novelty of the study. Such presentations are required by the rhetorical functions of RAIs.

The second class includes MTs that serve communicative purposes dictated by the nature of the disciplines. This class encompasses cause, purpose, viewpoint, and addition. For example, the purpose MT type was utilized to serve four communicative purposes. The first communicative

purpose involved justifying the significance of a study, as observed in the Psycholinguistics, Chemistry, and Environmental Engineering RAIs. Considering Swales' (1990) CARS model, this usage could facilitate the realization of an optional step in the RAIs, confirming the importance of the area of study. This also justifies the rationale for conducting the study and underscores the significance of the findings and contributions to the disciplinary discourse community. A plausible reason for the lack of emphasis on this communicative purpose in the AL RAIs may be that AL writers prefer to indicate the significance of their study using other MTs.

The second communicative purpose was the justification of selected techniques, procedures, and actions in a study, which was found in the AL, Psycholinguistics, and Chemistry RAIs. This communicative purpose appears to assist writers in drawing the reader's attention to their rationale for the selection of techniques, procedures, and actions. This rationalization also contributes to the validity and reliability of the findings and claims, as well as the study in general.

The third communicative purpose was to justify the techniques, procedures, and actions of earlier studies, which was found only in the Psycholinguistics and Environmental Engineering RAIs. It appears that both Psycholinguistics and Environmental Engineering writers aimed to ensure that readers are not only informed about the rational selection of techniques, procedures, or actions in their own studies but also in those of prior research. This approach helps convince readers that current studies are built on valid and rational foundations. The final communicative purpose unique to the Psycholinguistics RAIs was justifying the significance of earlier studies. This purpose highlights the contributions of previous research to the disciplinary discourse community literature, providing a comprehensive view of the research landscape related to the study under investigation.

The third class includes condition, validation, contrast, and time MT types, which were used to serve communicative purposes imposed by disciplinary conventions and the rhetorical functions of RAIs. For instance, the contrast MT was utilized to fulfill five communicative purposes. Two of these purposes—indicating a gap in the existing literature and contrasting findings from earlier studies—are rooted in the rhetorical functions of RAIs. In this context, writers are expected to clearly highlight their contributions to the existing disciplinary literature by identifying gaps and creating a research space through contrasting findings reported in previous studies. Contrasting the current study with earlier ones was observed in both the Applied Linguistics and Psycholinguistics RAIs. Justifying a study's opinions and actions occurred solely in the Psycholinguistics RAIs, while demonstrating the significance of a study was noted in the Applied Linguistics RAIs. These communicative purposes are dictated by disciplinary conventions to emphasize a study's contribution, show that opinions and actions are rationalized, and justify the study by contrasting it with other studies more effectively.

The findings reported in this study may have several implications for teaching RAI writing in English for Academic Purposes (EAP) courses. The findings can assist textbook developers in including information about how MT is used and how it serves different communicative purposes in RAIs. The results underscore that writing is constrained by disciplinary conventions. EAP instructors should inform learners about how the communicative purposes enacted through the use of different MTs are restricted by these conventions. By understanding the relationship between MT and communicative purposes, learners can make more informed and conscious selections of MT to effectively serve the discourse functions required in their writing. Incorporating these insights into EAP courses can enhance students' abilities to write RAIs that meet disciplinary expectations and effectively communicate their research contributions.

Conclusion

This study aimed to shed light on the types, frequencies, and communicative purposes of MT in RAIs across four disciplines: Chemistry (Che) and Environmental Engineering (EE) representing the hard sciences, and Applied Linguistics (AL) and Psychology (Psy) representing the soft sciences. The results demonstrated that the location in discourse (data) was the most dominant type of MT in the three sets of RAI sections (Che, Psy, and EE). This usage serves to guide readers toward the preferred interpretation of the discourse while simultaneously persuading them to engage with the text. It can be inferred that the location or context of the study is of primary importance to both the writer and the reader.

Regarding the communicative purposes enacted through the use of MT types in the RAI sections, the communicative purposes associated with the location in discourse data were common across all four sets of RAIs. Such purposes may be dictated by the rhetorical functions inherent to the RAI sections. Other types of MT, however, performed different communicative purposes across the four disciplines. Therefore, it can be concluded that many communicative purposes related to MT usage are influenced by the nature of the disciplines.

In discussing the limitations of the study, it is important to note that the sample size was limited. The analysis included only ten RAIs from each discipline, which may not be sufficient for generalizing the reported findings. Future research could benefit from increasing the sample size of RAIs. Additionally, the focus on only four disciplines could be seen as a limitation. Expanding the study to include more than four disciplines could yield more representative and generalizable findings, thereby enhancing the cross-disciplinary nature of the research.

The findings of this study have implications for teaching RAI writing in English for Academic Purposes (EAP) courses and for EAP textbook developers. A review of available textbooks on RAI writing reveals that most focus primarily on the move structures and rhetorical sections of RAIs. In contrast, linguistic features such as MT, which are crucial for realizing these move structures, have received little attention. The findings of this study could assist textbook developers in incorporating information about how MT is used and how it serves various communicative purposes in the RAI sections. Furthermore, the results emphasize that writing is constrained by disciplinary conventions. Therefore, EAP instructors running RAI writing courses need to make learners aware of how communicative purposes enacted through different MT types are influenced by these conventions. This awareness could enable learners to make more conscious selections of MT to effectively serve their communicative purposes.

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Conflict of interests

The authors declare that they have no conflict of interest.

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Seyed Foad Ebrahimi is an assistant professor of applied linguistics at the Department of English, Shad. C., Islamic Azad University, Shadegan, Iran. His main areas of research are Text Analysis and Discourse Studies. He has presented and published papers in international conferences.

Maryam Farnia is an associate professor of applied linguistics at the Department of English Language and Literature, Payame Noor University, Iran. Her areas of research are Pragmatics, Sociolinguistics, and ESP/EAP.