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Visual-based Reading Strategies across Languages and Disciplines: The Tunisian EAP Context as a Case Study

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ABSTRACT

Scientific knowledge is not communicated through the verbal mode only but through the integrated use of tabular, graphical and verbal forms, a fact that has positioned visual understanding as a major element of literacy demands to acquire advanced knowledge. In spite of this, empirical studies on how scientists develop meaning out of visual data are scarce. Grounded in the Tunisian EAP (English for Academic Purposes), the present study aims to explores the relative contributions of background knowledge and language effect to the Tunisian specialists' strategy use; the purposeful actions they use to understand visuals. Based on their answer in a questionnaire probing their visual skills and strategies, eight specialists from the field of management belonging to two areas of specialization and displaying different layers of visual proficiency are recruited in this study. They were invited to verbalize their thoughts about visuals from research articles within and outside their area of specialization written in French and English. At a first stage of analysis, the participants' idea units were classified into six categories. At a second stage, the clustering of idea units for each visual is analysed and divided into three categories. The participants strategies were analyzed in number and quality and were associated with the study variables. The results showed that background knowledge is a more predictive factor of participants' performance than language effect. They also indicated weaknesses in participants' use of strategies for meaning-building. Their strategy use is most often confined to low-level idea units (for example, restatement and main idea). The present study argues for a systematic implementation of visual teaching in EAP classes.

INTRODUCTION

The present study is rooted in the Tunisian academic context. The linguistic situation in Tunisia is complex. Arabic is maintained as an official language (Daoud, 1991a), but it is scarcely associated with academic literacy at graduate and postgraduate levels. This linguistic situation also witnesses "an intensified functional competition between French and English" (Daoud, 2011, p. 9). In the last two decades, French has been relegated to a second position in the teaching of science-related subjects in primary and secondary education. Yet, the status of French has not totally regressed since it resumes its position as the language of academic literacy at university. Due to the spread of English as the global language of science, business and technology, Tunisian education policy makers have shown a genuine interest in the teaching of English. It has become an obligatory subject from the sixth grade of primary education up to

graduate education. Thus, it has spread very rapidly to the point that it is gradually replacing French in its function as a language to have access to advanced knowledge. The spread and importance of English are particularly accentuated in graduate and postgraduate education. EAP researchers seeking academic recognition as members of the scientific community are confronted with the challenge of reading and writing different genres in the English language. Therefore, they are struggling not only with content but also with linguistic structures and generic features. Despite the emerging awareness among Tunisian EAP specialists of the importance of English in the acquisition of advanced knowledge, their linguistic competence remains generally poor (Labassi, 2009). This linguistic handicap prevents them from understanding publications in their area of specialization. Many specialists from the field of management with whom the researcher undertook discussions claim that they resort to many strategies to overcome this linguistic failure. Since French is widely established as the language of academic literacy in this academic context, many academics assert they resort to publications in French to have access to advanced knowledge. They also claim that background knowledge can reduce the effect of linguistic weaknesses. They also confirm they rely on non-verbal data, due to their limited linguistic output, to have access to advanced knowledge in their discipline. This claim raises, however, two major issues. First, the literature revealed that science is not communicated in one mode but through the combined use of the verbal and visual modes. Their integration and alternation of modes contribute to the expansion of meaning (Jewitt, 2008; Lemke, 1998; Rowley-Jolivet, 2002). Thus, the focus on one mode prevents the reader from developing a comprehensive understanding of scientific genres (see Archer, 2006). The second issue is that there has so far been little exploratory research probing the Tunisian visual reading skill and strategies when dealing with scientific genres, such as the research article (RA). Very little has, to date, been said about the real impact of reader-related variables, such as background knowledge as well as text related features, namely the language effect on the reading of visuals in scientific discourse.

When looking at the issue from a broader global perspective, we are confronted with the scarcity of research on the dynamics of visual literacy development. Most studies on science-related visual literacy remain descriptive and focus on the norms of acceptable visual design in scientific genres (Ackerman et al., 2012, Bailey, 2003; Burnett, 2005). In counterpart, research adhering to the social semiotic tradition argues that the reader is an active sign-maker engaging in the construction of meaning out of the visual sign (Kress & van Leeuwen, 2006; Kress, 2010). In an attempt to explore the applicability of this claim to scientific discourse, the present study aims to explore empirically the impact of reader and text features on meaning-making out of multimodal scientific discourse.

The present study proposes to determine the relative contributions of readers' background knowledge and the rhetorical features of RAs in French and English to the understanding of visuals among Tunisian EAP specialists who belong to the fields of strategy and marketing. The hypothesis underlying the present study is that the difference in the disciplinary background as well as the variation in the rhetorical features of texts across the languages may affect the participants' processing of visuals.

To tackle the above mentioned issues, the present study addresses the following research questions:

1/ How does disciplinary background knowledge affect the Tunisian researchers' strategies in processing visuals in RAs?

2/ How do languages affect the Tunisian researchers' strategies in processing visuals in RAs?

A brief description of the study variables drawing upon the literature and emphasizing their relevance in the present study is undertaken in the following section.

KEY COMCEPTS

Background Knowledge

In English for Specific Purposes (ESP) research, the term background knowledge is associated with the participants' familiarity with the broad discipline of the text and its topic in particular (Alderson & Urquhart, 1988; Clapham, 1998; Mohammed & Swales, 1984; Peretz & Shoham, 1990; Pogner, 2003; Zaidha, 2003). These studies demonstrate that the participants' performance in texts within their area of specialization exceeds their performance in non-specific texts or texts outside their discipline areas. Highly specialized texts, as opposed to neutral ones, can activate the participants' schemata.

This study proposes to test the impact of discipline-specific background knowledge on the processing of visual discourse by engaging the study participants in the processing of visuals from their disciplinary area and outside it.

Rhetorical Features of the Text

In several studies, the term rhetorical background has been used to refer to the syntactic, lexical, rhetorical, and pragmatic features of the first language or any language to which the participants are exposed (Carrell, 1984; Daoud, 1991b) that may affect the readers' processing of texts in the target language. In the present study, the concept of rhetorical background is expanded to visual discourse. The present study argues that visuals are not purely visual data but a combination of visual and verbal information manifested in titles, captions and cross-references. Therefore, it is hypothesized that while a few aspects of visual discourse may be standardized across languages, other aspects can vary from one language to another affecting the comprehension of readers. The present study aims to investigate whether there is a discrepancy in the understanding of visuals between RAs written in French and English.

In the present study, the rhetorical hypothesis is tested in connection with French versus English though the former is not the native language of the study participants. Although Arabic is the mother language in Tunisia, this language is scarcely associated with academic literacy, a function assumed by the French language due to historical and social considerations (cf. Daoud, 2011).

LITERATURE REVIEW

This section outlines the main directions of reading strategy research and sums up their major findings and limitations.

Overview of Reading Strategy Research

. Urquhart & Weir (1998) define strategies as the conscious actions taken by the reader to develop an understanding of a given text. In the field of education, the term is used to refer to the "specific actions taken by the learner to make learning easier, faster, more enjoyable, more self-directed, more effective and more transferable to new situations" (Oxford, 1990, p. 8). Studies on reading strategies fall into two major directions. Studies subscribing to the first direction are essentially concerned with establishing taxonomies for reading strategies. Studies adhering to the second direction associate strategy use with learners' features.

The literature is replete with models for classifying reading strategies (Cohen, 1998; Grabe, 2000; O'Malley & Chamot, 1990). A major problem arising from this is that different criteria are used to classify these strategies leading to inconsistencies across the different taxonomies. The variation in the taxonomies of strategies can be attributed to the subjective choices of the different researchers (Urquhart & Weir, 1998). It can also be attributed to the variation in task requirements (O'Malley & Chamot, 1990). The fact that different tasks require reliance on different reading strategies is relevant to the present study. This study posits that the processing of visuals requires the reliance on a set of strategies which do not necessarily coincide with the strategies associated with verbal discourse.

A second direction of research is centred upon the association of strategy use with variables related to the readers. A survey of a few studies has revealed that they have failed to provide conclusive evidence. This inability to draw final conclusions stems from the impossibility to compare the results of studies having distinct experimental conditions. These conditions pertain to data collection procedure, the readers' features (age, gender, cultural background and grade level), the materials used, task requirements and methods of data analysis… etc (cf. Block, 1986; Cohen, 1998; O'Malley & Chamot, 1990; Oxford, 1990; Kletzien, 1991). The next section provides a brief review of the literature related to the effect of the study variables on reading strategies.

Effect of Background Knowledge on Strategy Use

It is widely established in the literature that reliance on background knowledge-related strategies, such as using personal and general knowledge and knowledge of content material is facilitative of comprehension (Li & Munby, 1996; Ulijn & Salager-Meyer, 1998; Wijgh, 1996). It remains, however, to be seen how this matter is highlighted empirically: how reading materials in familiar and unfamiliar content affects strategy use. In ESP, focus is particularly laid on the impact of domain-specific background knowledge on the use of strategies (Afflerbach, 1990; Peacock, 2001; Zaidha, 2003). Results within this register remain inconsistent.

Effect of the Contrastive Rhetoric Hypothesis on L2 Reading Strategies

Alderson (1984) posits the hypothesis that failure in second language reading performance can be attributed to the use of incorrect strategies in reading texts in the second language. This failure is due to the difference in processing strategies employed in the first language and those used in the second language. This hypothesis starts from the premise that different languages have culture-specific rhetorical preferences. This speculation, however, has not gained much popularity in second language strategy research for several reasons. The validity of the CR Hypothesis is more strongly associated with writing rather than with the reading skill. In reading research, it is very difficult to isolate its effect from the effect of other variables, such as the constraints of the genre and language proficiency.

Empirical evidence has not helped validate this hypothesis in connection with strategy use. Block (1986) finds no culture-specific pattern of strategy use among her participants. She concludes that the language background of the participants does not account for the variation in their reading strategies suggesting that strategy use is a stable behaviour which is not affected by the structural features of a specific language. Within the same vein, Cohen (1986) finds a unique noticeable area where reading strategies vary across the languages. This variation relates to clarification and simplification moves because they are language-specific.

The studies adhering to both directions of research are centred upon strategy use for verbal discourse. The research on the processing of visual discourse, despite the importance of this mode in contemporary literacy situations, are scarce.

Effect of Multimodal Discourse on Reading Strategies

The study of the impact of multimodal genres on reading strategy is grounded in the premise that the strategies employed to process verbal discourse fail to account for the distinctiveness in processing multimodal discourse. Guthrie, Britten and Barker (1991) state that, though there is a possible overlap between the skills required for processing reading comprehension texts and the cognitive demands for the comprehension of multimodal genres, reading visuals requires "relatively independent abilities" (Guthrie et al., 1991, p. 323). To elaborate on the distinctive cognitive requirements for processing different document structures containing the same data, namely a table, a text and a directory, Guthrie et al (1991) report a variation in strategy use across the documents. Despite its contribution in connection with the cognitive demands for information search in different document structures, this study fails to acknowledge that most document structures in literacy contexts include multimodal resources conjointly used. A study elaborating on the cognitive strategies for processing multimodal genres is therefore required.

A study conducted by Scevak and Moore (1997) deals with this particular issue. It investigated the strategy use of 5, 7 and 9 grades in Australian schools as they process text and visual aids. The analysis of think-aloud protocols yields a grade and content area effects manifested in the reliance on reading strategies and more awareness of the link between the text and visuals. The present study shares a similar concern, namely to capture the strategies used for the processing of multimodal genres. Yet, it is different from the study above mentioned at different levels. While Scevak and Moore (1997) conducted their study within a General English context, the present study is situated within an ESP context. It offers to explore strategy use in connection with the RA genre. The present study posits that register can condition strategy use. Within this literacy context, visual-based strategy use cannot be dissociated from reader-related features, particularly, discipline-specific background knowledge as well as genre-related features.

The present study aims to explore the processing of visual discourse among EAP researchers in conjunction with other variables related to the reader and text. More concretely, it examines the applicability of the Contrastive Rhetoric Hypothesis to visual discourse- i.e. whether readers employ different sets of strategies when they read visuals in French and English. In parallel it tries to probe the connection between strategy and reader features (background knowledge). The present study postulates that a preliminary exploration of visual strategy use among researchers in a specific academic context is prior to developing a framework for the comprehension strategy instruction in multimodal texts that previous studies have devised (see Alvermann and Wilson, 2011; Danielsson & Selander, 2016; Liu, 2013). In order to fulfil these objectives, the present study has adopted the methodology described in the following section.

METHODOLOGY

Corpus

Four articles divided equally between the disciplines of the study (marketing and strategic management) were used in the think-aloud protocols. The articles were selected from two areas of specialization in order to seek the contribution of field-related knowledge to

shaping the participants' processing of visuals. In each phase, the participants were requested to process visuals in the RAs from their area of specialization and outside it.

The first pair of articles from marketing subject area comprises the two following RAs:

The first article (Jarvis, Mackenzie, & Podsakoff, 2003) is in English published in *Journal of Consumer Research*. It deals with marketing research tools. It is a meta-analysis that discusses the measurement models used in the data analysis stage of various articles from the top journals of marketing literature. It includes nine visuals divided into five figures and four tables. This RA is annotated as (RAME).

- The second RA (Jarvis, Mackenzie, & Podsakoff, 2004) is a French translation of the first RA. It was published in *Recherche et Applications en Marketing* in the section « sélection internationale ». This RA is annotated as (RAMF).

The second pair of articles from strategic management subject area contains two articles written in English and French by the same authors. The two articles deal with risk exposure due to outsourcing and evaluate risk exposure and associated undesirable outcomes. The two articles are described below:

- The first article (Aubert, Patry, & Rivard, S, 2005) was published in *Database for Advances in Information Systems*. It contains seven visuals divided into six figures and one table. It is annotated as (RASE)
- The second article in French (Aubert, Patry, & Rivard, 2004) was published in *Revue Internationale de Gestion.* It contains five visuals divided into three tables and two figures. It is annotated as (RASF).

In an e-mail with Benoit Aubert, the first author of the two articles, he asserts that the article in English was empirically-oriented in which the deductions were built on case studies. The article in French was a synthesis of many studies in which a framework for risk alleviation was proposed. Aubert argues that the authors have applied several strategies to adapt the French version to the requirements of the target audience (the audience is more diverse including managers, MBA students and specialists).

These Parallel articles were selected for the think-aloud protocols for the following reasons:

A detailed analysis of the articles across the languages revealed a large degree of similarity in the research problem, rhetorical organization, degree of specialization, and especially in visual data. A scale of parallelism was submitted to two Subject Specialist Informants (SSIs) from each area of specialization to evaluate the degree of parallelism of RAME versus RAMF and RASE versus RASF. This evaluation yielded a large degree of parallelism. This similarly allows for a reliable comparison of strategy use across languages. Discussions with specialists from the two areas of specialization revealed that the two pairs of RAs are representative of their reading sources. Therefore, the present aims to compare the participants' strategy use when dealing with visuals in RAs in French and English.

Participants

Eight participants participated in the present study divided equally into two subject areas (marketing and strategic management). The participants from the two sub-disciplines were partially matched in expertise, and proficiency levels (verbal and visual-related proficiency). The participants were selected from two areas of specialization to measure the impact of background knowledge on strategy use. The participants from marketing were annotated from M1 to M4 and those from strategic management from S1 to S4.

The participants selected formed a homogenous at several levels. They were native speakers of Arabic. All the participants were enrolled in a PhD Program They had similar educational background. They were holders of a Tunisian Baccalaureate from a science

background. The courses they followed in undergraduate education were conducted in French, except for ESP classes. In graduate programs, the reading sources were in their majority in English. The effect of other variables, such as the level of expertise and cultural background were controlled.

Questionnaire Design

In the present study, a semi-structured questionnaire was used to fulfill two basic objectives. The questionnaire was used to probe different aspects of the respondents' background knowledge (discipline area, reading sources, reading habits, attitudes to verbal and visual discourse in their discipline as well as strategies in the reading of visuals). The respondents were also requested to self-assess their reading abilities relative to different types of visuals (tables, graphs…etc). The questionnaire served to recruit the study participants. The researcher selected participants with different attitudes to the two modes (verbal and visual) and different knowledge backgrounds.

In the data analysis section, the results of the questionnaire were not reported in a separate section, but they were used to describe the features of the participants who were selected for an in-depth analysis.

Think-Aloud Protocols

In reading research, there has arisen a growing interest in analyzing learners' report of their learning strategies as means to understand second language reading processes (Block, 1986; Cavalcanti, 1987; Cohen, 1987; Grotjahn, 1987; Güvendir, 2014) In the present study, the think-aloud protocols were employed to highlight the readers' conscious processing of visual discourse in order to unveil the facilitative actions employed by the reader to understand visual information. Therefore, the think-aloud protocols were used in the present study to probe the effect of the study variables on strategy use. Accordingly, the respondents were requested to verbalize their thoughts as they were tackling visuals from RAs.

Prior to identifying the think-aloud procedure per se, different conditions relative to the preservation of the reading activity were taken into account (Calvacanti, 1987, p. 230):

- Reading is an authentic activity: this condition was guaranteed through the reliance on authentic unaltered texts as well as through restricting the use of electronic apparatus to the minimum. The reliance on videotaping did not reduce the authenticity of reading because such technical apparatus has become part of daily life (Flick, 2002).
- The participants were trained at the think-aloud procedure through trial texts. Once they were familiarized with the think-aloud procedure, they were left to speak at their ease with as little interference from the researcher as possible. The feeling of easiness was strengthened as the participants were allowed to speak in any language they felt more comfortable with or to code switch.

The think-aloud procedure is composed of two major steps:

(a)The candidates were allocated some time to examine the RA.

(b) The participants were then required to concentrate on each visual of the article separately. After examining it, they were requested to verbalize their thoughts about it.

The same procedure was reiterated with the four research articles. A time interval of one month minimum separated the introspection of parallel articles to reduce memory effect.

Methods of Data Analysis

The think-aloud units for the immediate introspection for each visual were transcribed. Units were separated by the pauses the participants made in the protocols. Each unit was allocated a general code subscribing to the one of the following six categories, namely the cognitive, metacognitive, utility, interaction, evaluation and top-down. A few categories were inspired from Scevak and Moore's (1997, p. 212) and (O'Malley & Chamot, 1990. p. 119). Other categories were developed by the researcher because of their relevance to the features of the present study.

As shown in Appendix A, the strategies used in coding are subsumed into six categories. The first category includes the cognitive strategies referring to the actions undertaken by the participants as they operate directly on visual information trying to manipulate it in order to foster their understanding of it. The second category contains metacognitive strategies, which include "the activities undertaken by the participants to control or monitor and evaluate their own comprehension in the process of L2 academic reading" (Li and Munby, 1996. p. 200). The third category of reading strategies pertains to interactive strategies. They refer to the attempts made by the participants to make sense of visual input through interacting with other sources of information, such as the visual, caption and text. The fourth category relative to evaluation strategies consists in the participants' attitudes towards visual input (positive, negative and criticizing). The fifth category labeled utility refers to the statement of visual data utility either compared to the text or other visual types or through stating its utility for research. Top-down strategies pertain to the participants' reliance on background knowledge for the understanding of a detail, the main idea or to predict the meaning of a concept.

The different categories are divided into subcategories (see Appendix A). A few cognitive strategies like main idea, reading path, deductions were annotated as positive or negative or partial building on information in the text and the SSIs' feedback. Metacognitive categories, utility categories, and evaluation strategies were annotated as positive or negative depending on the nature of feedback described by the participant (for instance, whether the participant provides a positive or negative checking of her understanding). Interaction categories were allocated as positive when the text/caption/ other visuals provided the participant with clarification, and as negative when the clarification was not achieved and X when the interaction was evoked without being actually undertaken.

The clustering of idea units was also analyzed and the strategies were divided into four categories to describe the sequencing of meaning negotiation. The strategies were divided into meaning-preparation, meaning-building, meaning-consolidation, assessment and meaning-failure categories as shown in Appendix B. A specialist in reading strategies was consulted on the categories

Two independent raters with experience in reading research code checked the different units devised by the researcher. The average inter-rater agreement was 87 %. Instances where strategies were classified differently were noted and highlighted and negotiations with the raters were undertaken to reach an agreement. The SSIs were consulted to check the accuracy of the interpretations advanced by the participants.

RESULTS

The analysis of the think-aloud procedure is undertaken according to the study variables to seek the relative contribution of each variables to the think-aloud performance both in terms of the amount of think-aloud units and their nature. An in-depth analysis of the performance of participants with disparate features was undertaken.

Effect of Background Knowledge on Reading Strategies

The effect of disciplinary background knowledge was relatively more significant than language effect. The strong impact of the variable was in conformity with the participants' declaration in the questionnaire that reading texts within their area of specialization constituted the most decisive factor for a successful reading. The effect of background knowledge was tied to visual proficiency and topic familiarity leading to variations in its strength and manifestations (see Table 1).

Among the participants with poor visual skills like M2 and S3, the variable effect was more clearly manifested at the cognitive level than at the other levels. Yet, the effect of the variable diminished among the participants with relatively fair visual skills like S1 and S2 at the cognitive level. It had an opposite effect at the other levels (see Table 1). Among the participants with higher visual skills like M3, the effect of the variable was clearly manifested at the cognitive and other levels. The variable effect was also more consistently associated with topic familiarity.

Table 1. Frequency of Idea Units for the Different RAs

Features	**Participants**	**Cognitive**		**Metacognitive and Others**	
		RAME/F	RASE/F	RAME/F	RASE/F
Low visual skills	M2	62	33	17	16
	S3	56	55*	75	40
	M1	34	27	55	18
Fair visual skills	S1	16	18	58	33
	S2	36	48	42	8
High visual skills	M3	32	14	100	60
Topic familiarity	M4	115	34	47	26
	S4	46	38*	32	53

* Though the participant produced slightly more idea units outside the discipline, the effect of the discipline was quite clear due to the difference in the number of visuals.

After giving a general overview of the impact of background knowledge on participants' performance, an in-depth analysis of strategy use for individual participants was undertaken.

Effect of Background Knowledge on M4's Reading Strategies

M4 was a Ph. D student from the sub-field of marketing. She was selected to participate in this study because of her familiarity with model misspecification, the topic of RAME/F. During the questionnaire, she asserted she was more comfortable with publications in English because they displayed more rigorous methodology. Her visual reading skills were evaluated as very good. As to reading strategies, she asserted that she relied on the interaction between text and visual to develop an understanding of visual data.

During the protocols, background knowledge exerted a strong impact on M4's performance. The effect of the variable was manifested in number, variety of idea units at all levels. At the cognitive level, the participant produced more idea units in the RAs inside the discipline making a total of 115 idea units versus 34 for the RAs outside the discipline (see Table 2). The participant relied heavily on reading paths (pointing out and following the flow of information in a visual). In the RAs inside the discipline, she performed 27 reading paths

versus two reading paths in the RAs outside the discipline. In transactional models, she followed the direction of the arrows to explain the relationship between the variables.

Table 2. Distribution of the Strategies Used by M4

Category	RAME	RAMF	RASE	RASF
Cognitive	61	54	20	14
Interaction	11	15	6	5
Evaluation	1	0	6	4
Top-down	5	4	0	0
Utility	4	2	2	0
Metacognitive	2	3	2	1

The participant relied more heavily on deductions in the RAs inside the discipline than outside it (29 versus 4). Building on previous knowledge of theory, and data analysis, she was able to draw insightful and thoughtful deductions echoing her familiarity with the topic. In light of her knowledge of the transactions between construct and items displayed in formative and reflective models in the first figure of the RAs inside the discipline, she deduced that dropping one item from the reflective model does not alter the constructs because the measurement of one construct like satisfaction can be limited to one item. She deduced that in formative models changes in the item caused changes in the construct because the sum of the items generated the constructs. She was also able to predict the answers to questions in the first table about the decision rules to identify formative and reflective constructs. She deduced that the answer to the question "are the items expected to have the same antecedents and consequences?" was "yes" for reflective constructs and "no" for formative constructs- an answer that she confirmed when she read the answers in the two columns.

The participant relied on a few examples to consolidate meaning-building in the articles within her discipline area. In RAME, the participant used exemplification to explain reflective models suggesting that constructs like satisfaction were not quantifiable and items were needed to detect the variable. She asserted that satisfaction could be measured with items like motivation towards the employer, colleagues and conditions at work.

The effect of background knowledge was also manifested at the participant's mastery of utility strategies. M4 was more sensitive to the utility of the visual in the RAs inside the discipline performing a total of seven versus a single idea unit outside the discipline. In RAME and RAMF, the participant contended that the third table was very interesting especially for the constructs like sales performance and sales organization effectiveness, which were relevant to her study. Accordingly, she asserted she could refer to the references in the table to evaluate the constructs' accuracy.

The effect of background knowledge was also clearly manifested in the clustering of idea units. In the visuals inside the discipline, the participant moved from meaning-building to consolidation strategies. In the visuals outside the discipline, she relied more often on meaning-building strategies (see Figure 1). Inside the discipline, the participant tried to operate and concentrate directly on the visual information in order to develop meaning. In the first figure (RAME), the participant worked heavily on the data to build meaning. She primarily relied on the description of details on the visual, such as the direction of arrows, the position of errors, the use of different shapes to designate construct and measure and consolidated her

understanding through the cognitive categories of deduction, exemplification and reading path. She very often fostered this consolidation stage by reliance on background knowledge and interactions with the caption and other visuals for further details.

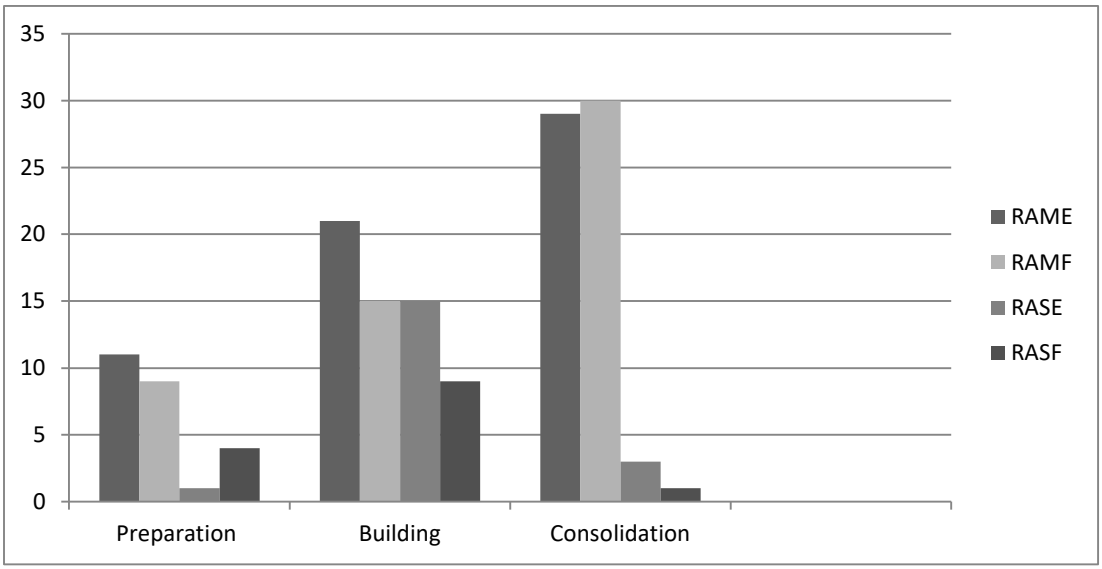


*Figure 1***.** Distribution of M4's strategies according to meaning-building stages.

This emphasis on meaning-building cognitive categories characterized most of the clusters of meaning for the visuals in the RAs outside the discipline. She often started with the description of the visual organization and then moved to the statement of the main idea. The few instances where the participant exploited interaction with other sources of information were only partially successful and sometimes unnecessary highlighting the participant's failure to depict information already present in the visual.

Effect of Background Knowledge on S4's Reading Strategies

S4 was a PhD student from strategic management. She was selected in this research due to her familiarity with outsourcing, the topic of the RAs from the strategy subject area. In the questionnaire, she asserted that she did not rely very often on visual data and she preferred to concentrate on the text as a primary source of information and she referred to the visuals when the text referred to them. She indicated that she was more comfortable with visuals displaying qualitative data especially those belonging to her area of specialization. She also asserted that she relied heavily on the descriptions of the visuals in the text to develop a better understanding of them.

The participant's performance in the protocols indicated that she relied on approximately similar numbers of cognitive strategies across the disciplines. Her performance was also marked by a heavy reliance on interaction strategies independently of the disciplinary area. The effect of topic familiarity was only detected at the nature of interaction strategies and more particularly

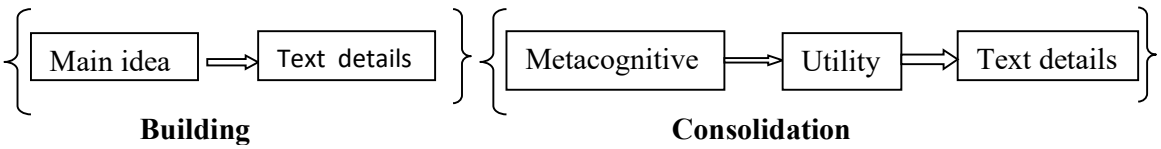
at the reasons fuelling the use of these categories. Outside the discipline, the reliance on this category often signalled a meaning-building failure. The participant relied on the text as a means to solve this problem. The reference to the text for clarification equalled 19 instances outside the discipline and was restricted to six inside it. In most of the cases, this reference was fruitful and led to the clarification of visual information.

Inside the discipline, this category was mainly used as a meaning-consolidation strategy. The participant referred to the text to obtain further details. She relied more heavily on the interaction with the text for further details at a total of 21 versus 13 instances in the RAs from the opposite subject area. In the RAs inside the discipline and more particularly in RASF, the participant also relied on previous visuals to foster her understanding.

As to the clustering of idea units, the reading strategies outside the discipline did not follow a pattern and varied according to the level of understanding. In well-understood visuals, the participant relied on meaning-building strategies followed by meaning consolidation ones. In less understood visuals, she started with meaning failure categories, such as metacognitive strategies to indicate a negative checking of understanding levels. She also resorted to the text for clarification.

In the RAs inside the discipline, the sequencing of idea units was characterized by a transition from meaning-building to consolidation strategies, namely reading paths and the interaction with the text for further details. Example 1 represents the typical cluster of idea units for visuals inside the discipline.

(1)



Effect of Background Knowledge on S3's Reading Strategies

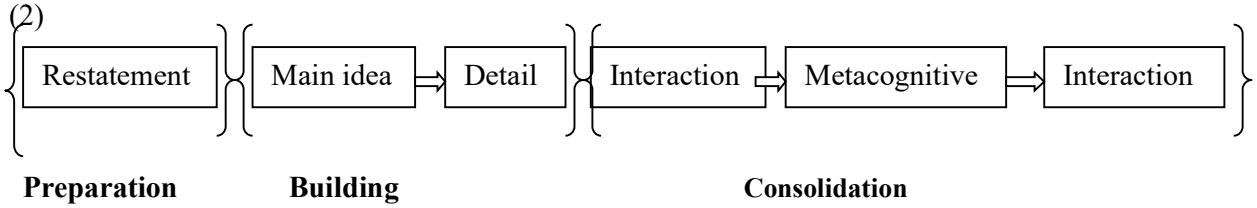
S3 was a PhD student in strategic management. She self-assessed her visual reading as fair. Her weakness related to the reading of tables, and graphs. Her skills with cross- references, captions, and titles were fair. During the protocols, S3 relied heavily on cognitive categories and other categories. Little background knowledge effect was noticed in her performance (see Table 1). She opted for operating directly on the visual information to develop an understanding of it. She relied on cognitive idea units ranging from lower level categories, such as the rehearsal of visual components like titles, subtitles and axes to higher level idea units, such as main idea formulation.

S3's concern with developing meaning out of visual information was very often unsuccessful. Actually, S3 made 15 unsuccessful endeavours to develop the main idea of visual across the four RAs. In RASF, S3 made six unsuccessful attempts to formulate the main idea for three visuals.

As to the clustering of main idea units, S3 divided her meaning-negotiation into three stages: a preparation stage where she used strategies like description and restatement as initial stages to handle the data. The rehearsal idea units constituted a major feature of the preparation stage of the meaning-negotiation process especially for the RAs outside her area of specialization. In RAME and RAMF, the participant resorted to restatement as the initial idea unit for six visuals and the reliance on this category diminished to three and two in RASE and RASF respectively. She moved to a meaning building stage where she normally tried to develop the main idea. She ended up with a final consolidation stage to strengthen her understanding

through the reliance on interaction with other sources of information. This is illustrated in Example 2:

(2)



Effect of Languages on Reading Strategies

The effect of languages on reading strategies was slightly and inconsistently displayed. It was also tied to levels of language proficiency as well as the rhetorical features of the RAs. The rhetorical hypothesis effect was more manifested among the participants with low levels of language proficiency in English and more particularly between RAs with more distinct rhetorical features (RASE versus RASF).

Among the participants with good proficiency in French like M2, the rhetorical effect was scarcely apparent. Though M2 asserted in the questionnaire that reading RAs in French facilitated her understanding, no such effect was detected in the think-aloud sessions. Among the participants with low proficiency in English like S3 and M1, French exerted a stronger effect on the participants' frequency of idea units. For M1, the effect of French was clearer in the RAs with distinct rhetorical features (5 idea units in RASE versus 22 in RASF). As to S3, the effect of French was only manifested at the metacognitive level.

The performances of S1, M4 and M1 across the languages are more deeply explored in the following parts of this section. This investigation aims to associate the effect of the rhetorical hypothesis with layers of language proficiency.

Effect of Language on S1's Reading Strategies

S1 was a PhD student in strategic management. She self-assessed her proficiency in English as good. She also declared that she understood visuals displaying qualitative data better than those with quantitative data. In her reading process, she was text-bound. Yet, she could monitor her reading strategies to the requirements of the task and could shift to the visuals if they were crucial to her understanding. Even though S1 was quite fluent in English and published in this language, she declared she prefers to read RAs in French. In RAMF, the participant recognized the article as a translation of the English version and asserted that she understood the French version better and found it more accessible apart from a few technical terms. In RASF, the participant acknowledged that the article displayed different rhetorical features and organization from the RA in English and was written for different objectives. She declared that while RASE used the IMRD division (Introduction, Methods, Results, Discussion) and included an extensive review of the literature and clear descriptions of methodology, RASF included neither an abstract nor key words. She argued that RASF included little focus on theory or methodology. In counterpart, RASE was purely academic, theory-based and included an extensive description of methodology. Despite its relatively

inferior academic nature, the participant asserted that she was quite familiar with the journal and authors in RASF and was inclined to read the whole RA because it was in French and within her area of specialization. Therefore, she could reduce reading time. In RASE, due to its linguistic complexity, she needed more time to read it because she needed to refer to a dictionary. She may be compelled to reread several sections.

This enthusiasm for publications in French was not paralleled with reliance on more idea units in the RAs in French. On the contrary, the participant relied on more idea units in the RAs in English. At the cognitive level, the participant relied on 22 idea units in the RAs in English versus twelve in the RAs in French..

The positive effect of French on the participant's performance was clearer in the clustering of idea units than in the number and variety of strategies. In RASF, she relied exclusively on assessment categories coupled with meaning-building and consolidation categories while in RASE, she resorted very often to assessment categories and meaning-failure strategies.

Effect of Language on M1's Reading Strategies

M1 was a PhD student in marketing. In the questionnaire, she indicated that she often used tables, graphs and diagrams in her writings. Her reading skills of all visual types were assessed as good. She also declared that she was a visual-oriented reader who primarily relied on visual data to understand information in her field of study. In the questionnaire as well as in the discussions with the researcher, M1 asserted that her skills in French were better than in English and she resorted to translation to overcome her deficiencies in English. In the think-aloud session, she reiterated her problems in reading RAs in English. In RASF, she asserted that, though the RA was not very academic, she preferred to read it to have a grasp at the research problem thanks to its linguistic accessibility. The effect of the rhetorical hypothesis in the think-aloud session was more manifested between RASE and RASF. This effect was manifested at the cognitive level (main idea, the description of organization, statement of details and description of interactional devices). On the contrary, the participant relied more heavily on evaluation and top-down categories in RASE to denote a negative evaluation or a lack of background knowledge.

The clustering of idea units across the RAs indicated that in RASE the participant started with negative assessment categories to signal meaning building failure whereas in RASF, she moved from meaning-building to consolidation categories. In the first table in RASE, the participant made a negative assessment pertaining to its lack of interest for her to move to meaning-failure categories relative to her lack of background knowledge. She finally declared she needed to refer to the text for clarification. She stated that the difficulty of the visual obliged her to change her reading habits through relying on the text to understand the visual. In RASF with the parallel visual, the participant relied on restatement as a meaning-preparation strategy then built the main idea and ended up with a meaning consolidation strategy through indicating its utility.

Effect of Language on M4's Reading Strategies

In her discussions with the researcher, M4 was more favorable to RAs in English because she relied exclusively on RAs in English in her readings. She self-assessed her proficiency in English as very good. During the think-aloud sessions, the participant reiterated her faith in publications in English. She maintained that, though RASF was easier to read than RASE, the latter was more reliable because it included more references, an abstract with key words and an extensive description of methodology. Numerically, the participant performed better in the RAs

in English (see Table 1). However, the differences between languages were not very strong and were not consistently displayed in individual strategies. Inside the discipline, the effect of English was slightly detected at preparation and building categories (see Figure 1). No such effect was detected in parallel visuals outside the discipline.

The effect of languages on reading strategies was slightly and inconsistently displayed. The rhetorical hypothesis effect was more manifested among the participants with low levels of language proficiency more particularly in the RA with simplified result-oriented rhetorical features (RASF).

IMPLICATIONS FOR ESP TEACHING

The present paper has demonstrated, through an exploratory research study, that apart from the participants with topic familiarity, Tunisian specialists from the field of management generally failed to employ high-level cognitive strategies, such as the utility, reading path and interaction idea units (associating information in the visual with other information in the text and caption) failing, thus, to exploit the full meaning potential of the visual data. Their meaning-making processes were generally restricted to the meaning-building/failure level and did not reach the consolidation stage. Therefore, due to the proliferation of modes of communication in scientific discourse, the evolving nature of literacy demands in the Tunisian EAP context, ESP classes are required to integrate the teaching of multimodal discourse at different levels of ESP teaching in Tunisian universities. This integration of visual literacy in ESP classes can be undertaken in different phases following a six-levelled process involving a movement from LOTS (low-level thinking skills) to HOTS (high-level thinking skills) (cf. Ackerman et al., 2012; Moalla, 2016). It aims to promote visual-based cognitive abilities. This objective is adopted from the revised version of Bloom's taxonomy. These objectives include promoting the abilities of remembering, understanding, applying, analyzing, evaluating and creating visual data.

CONCLUSION

This paper has explored the effect of disciplinary background knowledge, and language effect upon the participants' strategy use. In line with research on learning strategies and more particularly reading strategies (Alderson, 2000; Urquhart & Weir, 1998), the present study has defined reading strategies as the purposeful actions and plans exploited by the participants of the study to develop an understanding of the visual information and ultimately to use this information for more practical ends. Think-aloud protocols based on visuals from four RAs were used as methods to capture the endeavours used by the participants to facilitate their understanding. The participants were requested to verbalize their thoughts about the different visuals in the RAs. The think-aloud idea units were transcribed then classified into six categories as shown in Appendix A. The participants' strategy use was analyzed in connection with the study variables in terms of idea unit quantity and quality. The cluster of idea units or their sequencing was also associated with the features of the participants in order to explore their effect on the participants' meaning-negotiation processes.

The quantitative and qualitative analyses of participants' strategy use indicated that disciplinary background knowledge was a stronger predictor of the variation between participants than was language effect. The effect of languages on reading strategies was slightly and inconsistently displayed. It was also tied to levels of language proficiency in English. Among the participants with high levels of language proficiency, the rhetorical effect was scarcely apparent and even reversed. Among the participants with lower levels of language

proficiency, French exerted a stronger effect on the participants' strategy use in RAs with distinct rhetorical features, namely RASE versus RASF.

The present study has argued that, though the literature is replete with studies suggesting that visuals are central carriers of meaning in academic discourse, very little has, to date, been said about the cognitive processes involved in the processing of visual data in this register. By means of conducting an empirical study, the present study aimed to capture the cognitive processes involved in the processing of visuals. By focusing on the interface between these processes and reader and text features, the present study has tried to shed light on the boundedness of visual literacy development to the contextual factors in which this literacy is developed. The present study argues that the findings of the present study can inspire teachers and practitioners in similar educational and linguistic backgrounds. The taxonomy of visual-related strategies provided in this study is applicable to broader academic contexts.

The present article has focused on the conscious actions employed by the readers to understand visuals. It is, however, difficult, building on the findings of this study, to determine whether these actions have reached the automaticity level to become skills that enable the reader to understand the RA through the coordination between verbal and visual data (text, caption and visuals). Administering reading tasks to EAP readers that require the combined use of modes can provide insight into this particular issue.

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APPENDIX A

Table A1. Division of Reading Strategies

Category		

Cognitive	Rehearsal or restatement	Restating/ rehearsing of a visual verbatim (title, subtitle, caption, axes)
	Content	Describing a visual content
	Theme	Stating a visual theme
	Main idea	Stating a visual main idea (+/ - / partial)*
	Details	Stating a detail/details in a visual
	Rhetorical section	Relating the visual to the rhetorical section
	Organization	Describing the organization of a visual
	Interactional devices	Describing the interactional devices in a visual (colors, arrows, bold…etc.)
	Objective	Stating a visual objective
	Deductions	Drawing deductions about the visual
	Exemplification	Using examples to demonstrate understanding
	Interpretation	Interpreting a visual results
	Reading path	Following/ pointing out the flow of information in a visual
	imagery	Using imagery to understand a visual
	Translation	Translating a visual detail into French
	Tools	Using tools to understand a visual (highlighters, pens…etc)
Metacognitive	Reading strategies/ habits	Reflecting upon one's reading habits / strategies
	Monitoring details	Checking one's comprehension of a given detail (+/-)
	Monitoring main idea	Checking one's comprehension of the main idea (+/-)
	Monitoring RA	Checking one's comprehension of the RA (+/-)
	Monitoring organization	Checking one's comprehension of the organization of the visual (+/-)
	Monitoring interactional devices	Checking one's comprehension of interactional devices (+/-)
	Monitoring language	Checking one's comprehension compared to language
	Evaluation	Checking the outcome of the reading task
Interactive	Text primary	Referring to the text as a primary source of information
	Text clarification	Interacting with the text for clarification (+/ X)**
	Text interpretation	Interacting with the text for the interpretation of results
	Text further details	Interacting with the text for further details
	Caption further details	Interacting with the caption for further details
	Another visual	Referring to another visual (+/X) **
	Parallel article (French)	Referring to the parallel RA

	Theoretical course	Referring to the theoretical course
	Reluctance (text/ caption)	Reluctance to refer to the text or caption
Evaluation	Positive evaluation	Stating a positive evaluation of a visual (clarity, importance…)
	Negative evaluation	Stating a negative evaluation of a visual (ambiguity lack of importance…)
	Criticizing	Criticizing a visual
	Attitudes to visual types	Stating attitudes to different visual types
	Attitude Text / caption	Stating attitudes to text and caption
Utility	Visual utility in general	Stating the utility of the visual in general
	Visual utility in thesis	Stating the utility of the visual for the thesis
	Ignorance of utility	Failing to state the utility of the visual
Top-down	Meaning of a concept	Predicting the meaning of a concept (+/-) ***
	Prior knowledge	Relating the visual to prior knowledge
	Lack of prior knowledge (main idea)	Acknowledging a lack of prior knowledge to state the main idea
	Lack of prior knowledge (details)	Acknowledging a lack of prior knowledge for a specific detail

* The cognitive strategy relating to the statement of the main idea was annotated as partial if the participants provides a partial main idea, - if the main idea is incorrect and + where the main idea is correct.

** The interactive strategy relative to the interaction with text and visual was annotated X if the participant did not actually refer to the text/visual and + if the participant refers to the text or visual.

*** The top-down strategy 'predicting the meaning of a concept' was annotated – if the prediction in incorrect and + if the prediction is correct.

APPENDIX B

Table B1. Division *of* Strategies according to

Meaning Negotiation Categories.

Classification of Strategies	**Description**
Meaning preparation categories	- Description of content - Restatement
Meaning-building categories	- Main idea + - Detail +
Meaning Consolidation categories	- Reading path + - Deductions or interpretations - Exemplification - Interaction for further details - Utility + - Metacognitive + - Top-down +
Meaning failure categories	- main idea – or partial - Details - - Metacognitive – - Interaction for clarification - Top down – - Utility -
Assessment	- Evaluation + or – - Metacognitive at the end of the cluster (evaluation)

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