Punctuation as readability and textuality factor in technical discourse

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Abstract

This paper studies the incidence of punctuation on the reading comprehension of technical discourse and its role as a factor of textuality. Starting out from the notions of textuality and punctuation functions formulated by different linguistic approaches, an analysis has been made to quantify the decoding skills and punctuating competence of 60 Aeronautical Engineering students, as well as to determine the nature and effects of their punctuation errors. The survey has been focused on the Full Stop, the comma and the hyphen due to their highly conflicting uses as regards the identification of immediate sentence constituents and semantic relationships. The results obtained suggest that most students have a poor knowledge of punctuation rules and little awareness of punctuation as a textual element affecting readability. Errors are in the main related to comma use and produced by transference, either of Spanish punctuating habits into English, or of individual prosodic patterns into writing, while meaning appears to be the prevailing punctuating criterion over sound and syntax. Punctuation proves an effective tool for the anticipation of implicit meanings and an untapped resource in the teaching of the diverse communicative and stylistic possibilities offered by technical texts.

Key Words: Readability, Textuality, Technical discourse, Punctuation criteria, Prosodic punctuation

Resumen

El presente trabajo estudia la incidencia de la puntuación en la comprensión lectora del discurso técnico en lengua inglesa y su papel como factor de textualidad. Partiendo de este concepto y de las funciones propias de la puntuación formuladas por diversos enfoques lingüísticos, se ha llevado a cabo un análisis para cuantificar la habilidad descodificadora y los conocimientos sobre puntuación de 60 estudiantes de Ingeniería Aeronáutica, así como para determinar la tipología y las consecuencias de sus errores. El estudio se centra en el punto, la coma y el guión dada la conflictividad de su uso al identificar los constituyentes oracionales inmediatos y las relaciones semánticas. Los resultados obtenidos indican que la mayoría de

los alumnos poseen un exiguo conocimiento de las normas de puntuación y que apenas si son conscientes de la influencia de ésta en la inteligibilidad del texto. Los errores están por lo general relacionados con la utilización de la coma y se deben a un fenómeno de transferencia lingüística, ya sea de las reglas de puntuación en español, o de los hábitos prosódicos individuales al mensaje escrito, mientras que el criterio semántico predomina sobre sonido y sintaxis a la hora de puntuar. Si bien su presencia ha sido tradicionalmente escasa en los planes de estudio de las lenguas de especialidad, la puntuación se nos brinda como una herramienta eficaz en la anticipación de significados no explícitos y como un recurso poco explorado en la enseñanza de las múltiples posibilidades comunicativas y estilísticas que ofrecen los textos técnicos.

Palabras Clave: Legibilidad, textualidad, discurso técnico, criterios de puntuación, puntuación prosódica

Introduction

Most technical manuals pose considerable problems for reading comprehension in the ESP class: aimed at native or highly competent speakers, they are content-based and usually lack a linguistic orientation disclosing the cohesive workings within the text. What often impels students to qualify some technical readings as "dense" or "tangled" is the existence of structural deficiencies that go beyond the profusion of specific vocabulary. One such deficiency is punctuation, which has so far received little attention from ESP authors.

Defective or non-optimum punctuation may lead to a misinterpretation of contents by hindering awareness of significant grammatical structures and relationships (e.g. immediate sentence constituents, coordination and subordination, etc.), the functions of textual markers (adjuncts, disjuncts, conjuncts) and, in sum, by adding difficulties to the grasp of the gist and topic sentences.

Objectives

The purpose of this paper is twofold: firstly, to determine the actual knowledge technical students have about punctuation rules and to what extent punctuation interferes with reading comprehension skills. Secondly, to highlight its role as a readability and textuality factor and tool for the prediction of meaning. I have confined my study to the use of full stops, commas and hyphens because they prove to be the most conflictive signs in text decodification and production: in fact they generate most punctuation errors arising in the ESP class, both in the compositions

of university students and in the authentic technical texts used with didactic aims. Another reason for this focus is that the teaching of English in secondary education hardly provides learners with punctuation rules, so it is more than probable that they reach college with the limited repertoire and the habits of *natural punctuators* (Shaughnessy, 1977), which largely involve full stop and comma use.

Theoretical Framework

The theoretical background employed in the present study comprises two major concepts: the notions of textuality and punctuation functions.

Textuality

According to De Beaugrande and Dressler (1981) *textuality* consists of seven features which must occur simultaneously to identify any oral or written extract as text. These seven criteria are: cohesion, coherence, intentionality, acceptability (by the targeted audience/readership), informativity (including progressiveness and closure), situationality (pertinence) and intertextuality (formal or semantic connections with texts of the same type). Halliday and Hasan´s *texture* (1976), however, suggests that cohesion seems to be the only obligatory requisite since it entails semantic and intertextual factors; they describe it as a semantic phenomenon implemented through grammatical devices like reference, ellipsis, substitution, and lexical connectedness. In contrast, other researchers restrict textuality to coherence: the definitions set forth by Givón (1995), Vilarnovo (1990) and Grabe & Kaplan (1996) illustrate this view. For Givón (1995), coherence is a complex by-product of discourse comprehension and production, Vilarnovo (1990) differentiates between an internal and an external coherence (being subject and message-bound respectively), and Grabe and Kaplan (1996) divide the elements of textual structure into four potentially independent components (semantics, coherence, syntax, cohesion) sustained by lexis and operating at sentence and suprasentence levels while reflecting on both the deep and surface structures.

All five theories point at some kind of continuum regardless of the salient feature enhanced; there appears to be no clear-cut boundary between cohesion and coherence, and therefore textuality remains a fuzzy issue to delimit. A common approach has been to equate it with *readability* (the idea underpinning such equation is that readability depends on linguistic variables and can be objectively measured). In fact, much of the research

upon which certain manuals on writing base their *readability scales* dates back to the statistical analyses conducted in the USA during the 1920s and 1930s. This quantitative trend finds its exponents in the work of Flesch (1949) for English and, in Europe, in those of Richaudeau (1984) and Henry (1987) for French, and, more recently, Cassany (1998) for Spanish. On the whole they are coincident in pinpointing short sentences, concretion, and accuracy in the lexical choice as key factors to high readability, which obviously has to do with the proportion and distribution of punctuation throughout the text.

Nevertheless, it is debatable whether textuality and readability can be treated as synonyms. Textuality includes a series of inherent features contributing to the readability or communicative effectiveness of texts, but the immanency of readability parameters is definitely uncertain (must any text be by definition *readable*?). Kintsch and Van Dijk (1978) concluded that readability is not to be considered an inherent and exclusive trait of texts, but a property of the interaction between text and reader occasionally dependent on individual short-term memory and the amount of informative input. Kirkman (1992) would follow this subjectivizing current emanating from Cognitive Psychology and enumerate some additional factors which conform to a broader concept of readability termed *effectiveness of communication*, such as the reader´s degree of familiarity with the subject and his/her motivation, attitudes (to the topic, writer and channel), and stylistic expectations concerning organization and layout.

Punctuation functions

Whereas Bernárdez (1982) does not mention punctuation among the factors of cohesion and coherence, Kirkman (1992) comments extensively on it as a source of ambiguity and dwells on the consequences of omission or faulty collocation of hyphens and commas. Like Quirk et al. (1985), he distinguishes two main functions: the marking of lexical, grammatical and rhetorical items, and the mitigation of sentence or paragraph length (and hence complexity). That is, punctuation basically acts as a beacon and a rhythm regulator. Quirk et al. expand the notion of punctuation as a beaconing element to linguistic functions (contractions, genitives, etc.) and detail the nature of the items (units) to be marked out: *successive units* (those bearing an internal relationship with the text, no matter whether parenthetical or not), and *included units* (usually quotations, unrelated parenthetical information, and references to a reality outside the text). It is worth noting that this latter classification runs parallel to Vilarnovo´s (1990) previously-mentioned distinction between internal and external coherence.

Of special interest are the works of Crystal and Davy (1983), Chafe (1985, 1986), and Ivanič (1988). All of them set out from Quirk et al.´s idea of punctuation as a creative process influenced by prosody. Crystal and Davy (1983) present punctuation as a genre convention and stylistic factor and link it to the condition of social acceptability (which is, in turn, one of De Beaugrande and Dressler´s premises of textuality). Chafe and Danielewicz (1985) proved that inexperienced punctuators produce a prose form that is a kind of interlanguage (neither spoken nor having the typical characteristics of writing) since their own habits as speakers are transferred to it. One year later, Chafe (1986) established that there are constraints at work in oral language that do not show in writing; namely, the impossibility to introduce more than one concept into the same intonation unit, and the fact that writing uses more punctuation units dependent on other punctuation units than speech does (which explains why writers build more elaborate sentences than speakers). From Chafe´s findings it can be inferred that intertextuality, the last of De Beaugrande and Dressler´s conditions of textuality, also operates at a microstructural level affecting punctuation. Punctuation influences or is affected by coherence (see Quirk et al., 1985), cohesion, and intentionality, acceptability and situationality (see Crystal & Davy, 1983). In addition, Chafe debunked the traditional fallacy that intonation units and ideas coincide with clauses.

In line with Chafe´s research, Ivanič (1988) studied the punctuation of ten academically unqualified adult learners and deduced that non-standard punctuation has a logic just as Labov´s (1977) natural narrators proved to employ *competent* or standard structures, and non-standard varieties of English logically materialize ideas into discourse. Another chief point of Ivanič´s is precisely that every materialization of thought into words is apparently of a semantic (and not syntactic) nature: this justifies the natural punctuators´ tendency to omit their first strong punctuation sign in the opening paragraph, because they are holding in mind a complex *thought unit* and write fluently until it is exhausted.

Analytical Framework

The object of study was initially limited to a group of 60 3rd and 4th-year Aeronautical Engineering students, from whom a high intermediate *threshold* level of general English, equivalent to that of First Certificate, would be required for passing the subject at the end of a four-month full stop. The survey was divided into two stages, corresponding to the testing of their decoding and codifying competences as regards punctuation.

Analysis of decoding competence

The informants were provided with three printed technical texts (Burton, 1991: 66-67, 69) with an originally faulty punctuation. By *faulty* we should understand a defective or insufficient punctuation of the printed source, not having been manipulated or adapted for pedagogical purposes. The tasks demanded were these:

Task 1: Textual evaluation

Students were requested to evaluate the readability of the sample texts. The parameters listed below were submitted as guidance only in case of confusion about the causes of low readability:

a) *Length* (of the text, paragraphs, sentences, phrases, and words)→ it was measured according to the students´ subjective assessment; to an *impression* that the text fragments and/or their constituent units (e.g. strings of premodifiers) were *extensive* and made reading "tedious" or interrupted the logical flow of the ideas conveyed, thus hindering skimming and the spotting of focal referents.

b) *Density* (amount of information per paragraph and per sentence)→ students reported a *sense* of *informative overload* at paragraph and sentence level, which hampered decodification.

c) *Complexity* (of vocabulary, sentences, punctuation, sentence relationships—e.g. lack of substitutional items or visual aids—, lack of text progression, and insufficient or non-existent contextualization)

Task 2: Text-Skimming

It basically consisted in the detection of specific intratextual or intrasentential relationships/functions or the accomplishment of tasks conditional on punctuation, like:

Text A
- appositive synonymy (i.e. nominal or pronominal co-reference or explanatory comment between commas, e.g. …*the low pressure pump, usually called the Booster Pump*…)
- composition and structure through enumeration
- narrative sequence through enumeration
- gist through syntactic structure

Text B
- appositive synonymy (e.g….*the filler element, that part of the assembly which removes dirt from the fuel*…)

- erroneous restrictive relative clauses
- narrative sequence through diverse punctuating signs

Text C
- paraphrase of sentences with different meanings dependent on comma placement
- comprehension questions on badly-punctuated relative clauses

Task 3: Text-scanning
Subsequently, students were asked to complete a test on reading comprehension by means of multiple-choice and true/false questions and rephrasing exercises. Non-technical examples were deliberately chosen here so as not to distract the informants' attention from punctuation to meaning.

Task 4: Testing of the students´ codifying competence
Textual codification was not considered from the sole viewpoint of repunctuation, restructuration or rephrasing, but also from that of genuine creation. The three sample texts, this time unpunctuated, were given out again to students, who had to punctuate them and explain the criteria used. Next they were requested to fill in a questionnaire on punctuation rules (of the Full Stop, comma, and hyphen). In their scrutiny, special emphasis was laid on the traces of prosodic punctuation (i.e. that based on pauses determined by individual speech rhythm) as well as on the misapplication of rules.

Findings

Task 1: Textual evaluation
For the majority of students, the index of minimum readability soared in text C (see Table 1) but punctuation tended to go unnoticed as its direct cause (Figure 1). On the contrary, reading difficulties were in general attributed to vocabulary and insufficient contextualization. Length ranked as another outstanding factor in all texts: within its global percentage of 35%, text, paragraph, and sentence length reached the respective average percentages of 28.5%, 43% and 57%, whereas word length and punctuation as implicit component were not mentioned.

TEXT	MINIMUM READABILITY (percentage of informants' assessments)
A	3 %
B	12 %
C	85 %
TOTAL:	100 %

Table 1. Reader's response to sample texts

Structural complexity proved to be influential on readability in the students´ evaluation, which once more excluded punctuation as underlying constituent and instead revolved around text progression, paragraph structure (especially the lack of substitutional items) and sentence structure and relations. Each of these factors roughly represented 35% of the total 20%.
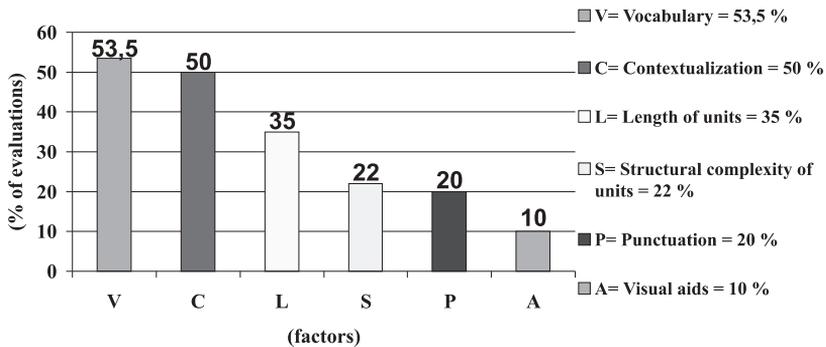

Figure 1. Awareness of punctuation as readability factor
(Causes of low readability in all texts)

Tasks 2 and 3: Text-skimming and scanning

Although students displayed heterogeneous skimming and scanning abilities, all of them made the mistake of confusing gist with text overview. However, almost all were successful in the identification of appositive synonymy (questions 1 and 2 on Texts A and B), in the rephrasing exercise on Text C, and in the recognition of fake defining relative clauses all throughout:

> *The servo pressure in the pump which dictates the piston stroke and therefore the delivery of the pump is supplied by the Altitude Sensing Unit which is a part of the Fuel Control Unit.*
> (Example of *originally mispunctuated* non-defining relative clause in Text C)

Conversely, they did not differentiate coordinate modifiers from non-coordinate ones by comma use (Appendix V, Recognition Test (a): *Expensive, chrome furniture* was a common mistake), and those sentences with a double punctuation option (Appendix V, Recognition Test (b)) were interpreted in a single way:

> *She bought two magazines, a quart of milk and honey* was the only version (versus *…magazines, a quart of milk, and honey*).

Hyphenation was cautious: they used it only in the compounds that were familiar to them, thus avoiding imitative and creative punctuation. Other failures were the identification of non-defining relative clauses when the subject was too distant from the deictic:

> *Adjacent to the Booster Pump selector switch is an indicator light which, when the pump is switched on the light illuminates until pressure has built up in the system to a specific value and then the light extinguishes.* (Text A)

or the discrimination of need for punctuation with commas in subordinate clauses with the same subject as the main clause and with different subjects (Appendix V, Recognition Test (b)) :

> *We have both studied, although he has more chances to pass.* (Different subjects require commas)
> *I have studied much although I am not going to pass.* (The same subject does not impose the need for comma use)

By contrast, Silva and Hurst (2001) discovered an inverted punctuating behaviour from university students in the research they conducted at the Faculty of Arts of the University of Porto (Portugal). When punctuating in English, the native Portuguese-speaking students had difficulty in discerning limiting or defining appositives, which, owing to a negative interference with Portuguese punctuation conventions and despite their obvious co-referential function, they mistakenly tended to turn into non-restrictive comments isolated with commas. A case in point is the example mentioned by the authors: *My friend, John, has gone to the USA,* clearly restrictive but here mispunctuated.

Another troublesome finding which arouses interest is that these students hardly punctuate non-defining relative clauses in English, since the absence of commas in Portuguese does not change the sentence meaning. Although the punctuating conventions for relative clauses are similar in both languages, native speakers of Portuguese usually resort to the context to determine the degree of *reality* intrinsic to the sentence and thus decide on the need for comma use. Silva and Hurst provide the following examples:

a) *The manager who I saw yesterday is over there.* (Defining or restrictive according to English norms)

b) *The manager, who I saw yesterday, is over there.* (Non-defining or non-restrictive according to English norms)

Example a) may perfectly convey a non-restrictive meaning for a native Portuguese speaker, who would also view the existence of more than one manager as quite an unrealistic possibility (and hence discard the use of commas). This study corroborates the culturally-bound nature of punctuation rules, which, as is the case of Portuguese and Spanish, may differ even in closely-related languages belonging to the same family (Romance).

Task 4: Testing of the students´ codifying competence

The questionnaire on punctuation rules (see Table 2) revealed that students virtually reduce the uses of the hyphen to compounding (70% of assessments) and syllabic division (16%), almost ignoring all other uses or mistaking them for those of the dash (e.g. clarification). Commas were widely associated with enumerations, pauses, and to a lesser extent, with reporting, genre conventions (e.g. punctuation norms in letter salutations and farewell formulae), and parenthetical information (but surprisingly enough, without relating this latter to non-defining relative clauses, omnipresent in university syllabi). Equally striking is the lack of reference to coordinate premodifiers, which abound in the technical environment.

As to the Full Stop, it was in the main connected with the end of paragraphs and sentences (a basic rule taught in the elementary grades) and with more or less dramatic shifts in meaning (through personal deduction), but few students detected the semantic function of Full Stops and commas as topical links (indicators of topical continuity) in the absence of syntactic markers. This may be due to the application of traditional *rules of thumb* like *Place a Full Stop for a long pause and a comma for a short one* (Fennick, 1996: 5) or *Periods mark the end of complete ideas* (McArthur, 1985: 19).

APPLICATION	PERCENTAGE OF INFORMANTS
COMMA	
to separate listed terms in enumerations	70 %
to express emphasis/clarification	50 %
to mark pauses	42 %
to introduce reporting verbs in indirect speech	35 %
after greetings and salutations in letters	30 %
in non-defining relative clauses	20 %
to separate sequential actions in narrative	20 %
in long subordinate sentences	18 %
to join sentences with the same idea	12 %
in vocatives	10 %
after interjections	6 %
PERIOD	
to mark the end of sentences	60 %
to mark the end of paragraphs	40 %
to mark shift in topic/idea/nuance	10 %
to link two closely-related sentences	8 %
HYPHEN	
to separate compounds	70 %
to mark syllabic division	16 %
to clarify (mistake)	2 %
to outline	5 %
to mark dialogs in reported speech	11 %

Table 2: Informants' knowledge of punctuation rules / uses
(comma, full stop, hyphen)

Inaccurate rules like these make up the theoretical punctuating repertory of students, although some *ad hoc* resources are employed as well (Ivanič, 1988). For the most part, students admitted to transferring Spanish punctuation to English and to basing their punctuation strategies on former experience rather than on learned rules. Approximately half of them relied predominantly on meaning criteria when punctuating (see Figure 2), while prosody (sound) and syntax criteria (sentence length and structure) came to a similar and somewhat lower moderate proportion. Quantity criteria (the comparative ratio of the various punctuating signs in the text) and the application of rules amounted to insignificant percentages.
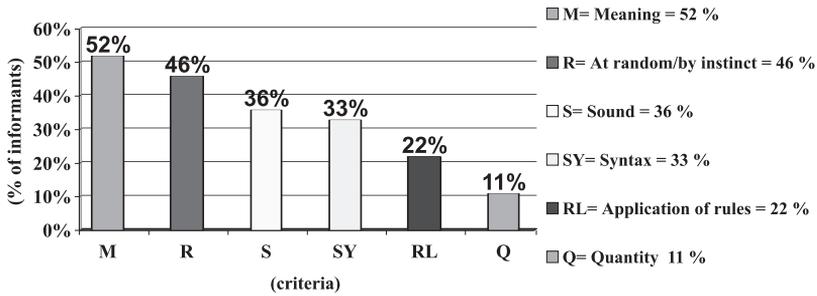
Figure 2:
Punctuation Criteria of Informants

Punctuation errors have been divided into two types (Figure 3). The most numerous one broadly corresponds to a violation (intended or not) of the punctuation rules most commonly gathered by grammars and textbooks. These strictly apply to the phrase and sentence levels but overlook the suprasentential scope, which chiefly involves the comma and concerns the inner structure of paragraphs and the stylistic effects triggered by interrupting elements (i.e. parenthetical information) and periodic and cumulative sentences. Students, nonetheless, would find it useful to know that enclosing inserted comments between commas may help them achieve a tone of informality or forcefulness (e.g. *His conclusions, if reliable, lack contrast with other sources.*), or that through periodic and cumulative sentences the main idea or thrust can be, respectively, suspended until the very end or appear first to draw the reader´s eye and mind along to an emphatic conclusion:

> *Although the Board would like to encourage every creative candidate to submit more than one project for consideration, it must select a maximum of ten according to the requisites published in the Company Bulletin, and therefore only a single project per person will be accepted.* (Sample of periodic sentence)

> *A single project per person will be accepted by the Board since, in order to democratise the selection process, it must only sort out a maximum of ten according to the requisites published in the Company Bulletin.* (Sample of cumulative sentence)

Turning back to the phrasal and sentential levels, some instances of the students´ mistakes are: the absence of hyphenation in compounds where the first term qualifies the second, the omission of commas in enumerations, in complex subordinate clauses and after conjuncts and disjuncts, or their use between independent clauses on the grounds that they

seem semantically related. Prosodic punctuation (i.e. the reproduction of speech pace in writing) accounts for more than half of the spotted errors and has been found to be a recurrent pattern in every kind of punctuating exercise provided (including blanked-out texts). Here are several examples of prosodic punctuation by the students:

The Booster Pump is also provided with a by-pass so that in the event of failure of the Booster Pump, fuel can still be drawn … (Text A)

…the light illuminates until pressure has built up in the system to a specific value, and then the light extinguishes (Text A)

To achieve this, the fuel is heated prior to the filter, therefore preventing the formation of ice in the fuel … (Text B, first comma)

Alternatively the fuel may be heated by a heat exchanger utilising the oil from the engine lubrication system as the heating medium, and in this system the oil will be cooled at the same time. (Text B)

In most modern gas turbine fuel systems, the principle of a FLOW CONTROL SYSTEM is used…(Text C)

As the throttle is slowly opened, the pressure in the pump servo piston supply increases… (Text C)
The result of this unbalanced fuel/air ratio will be an increase in engine gas temperature, and possibly compressor surge. (Text C)
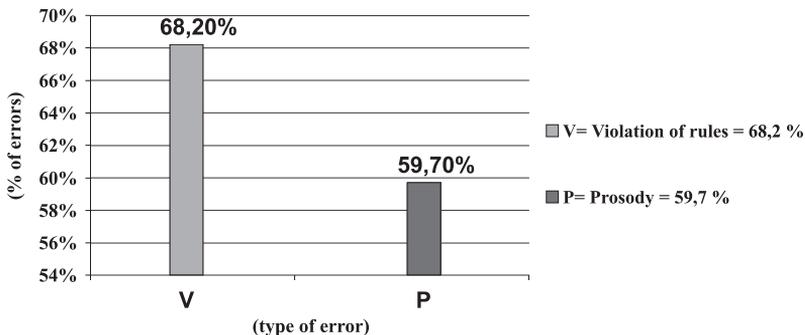

Figure 3: Punctuation errors

Of all errors, the most abundant were the confusions between comma, Full Stop, and colon uses (especially between Full Stop and comma, whose difference appears to be a matter of degree). The omission of commas embodied more than half of the errors related to the misapplication of rules. Interestingly (if not incomprehensibly), they accounted for 43% of the total 68,2 % in enumerations and after introductory adverbials (*Eventually, however,…* Text B), despite the prosodic pause implicit in both. The remaining percentage within the misapplication of rules corresponds to the omission of commas in subordinate clauses.

Conclusions

As an informativity device (i.e. as a marker of textual closure and semantic continuity), punctuation can be considered inherent to all texts, and thus a factor of textuality. Yet it tends to go unnoticed to readers, who frequently regard vocabulary and syntactic length as the main causes of low readability. It also proves a valid strategy for the prediction of meaning, since students, although not conversant with the topics presented, were able to identify relationships of synonymy, composition, or sequence through comma use. It remains to be seen, however, whether it truly facilitates the identification of gist and topic sentences, because students mistake those two concepts for the general outline of the text.

Most punctuation problems in both codification and decodification arise precisely from the use of commas. Prosodic transfers, on the other hand, account for 60% of production errors. Students´ knowledge of punctuation rules is exiguous and either limited to elemmentary rules concerning clause ending and enumerations, or to unsound associations of strong punctuation signs with intonation units and complete chains of thought. Meaning is the prevailing criteria for punctuating larger units and the application of learned rules is not as common as the punctuation according to speaking habits or individual preferences for organizing information (prosodic punctuation), which by themselves turn out to be inaccurate. The ideal punctuating strategy would be a combination of meaning, sound, and syntax. Perhaps this latter is the most reliable criterion, for it contemplates sentence length and structural complexity at the same time. The teaching implication of this study is that students should be provided with more models to foster imitative punctuation, and awareness of punctuating criteria should be increased at sentence and paragraph levels. It would be worthwhile to include contrastive punctuation exercises of conflictive readings in

the usual reading comprehension tasks so as to hone students´ perception of textual relationships and possible differences in communicative and stylistic effects.

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Appendix I

(Text A) "Low Pressure Fuel Pump"

The low pressure fuel pump, usually called the *Booster Pump*, is normally an electrically operated pump and is often connected to the underside of the fuel tank. It is controlled by an *On / Off* switch in the cockpit. Its primary purpose is to maintain a low pressure, normally at least atmospheric pressure, in the fuel system between the pump itself and the main or engine driven pump (High Pressure Pump) in order to prevent

or minimise vapour locks occurring in the components and pipelines. The Booster Pump is also provided with a by-pass so that in the event of failure of the the Booster Pump fuel can still be drawn through the Booster Pump by the engine driven pump to maintain a fuel supply to the engine. Adjacent to the Booster Pump selector switch is an indicator light which, when the pump is switched on the light illuminates until pressure has built up in the system to a specific value and then the light extinguishes.

Appendix II

(Text B) "Low Pressure Filter"

A filter is fitted in the low pressure fuel system to ensure a clean supply of fuel to the engine. The filter is normally fitted with a relief valve or by-pass valve so that in the event the filter element, that part of the assembly which removes dirt from the fuel, becomes blocked, or clogged, a supply of unfiltered fuel will continue to be pumped to the engine. Problems may arise in respect of filters in fuel systems due to ice particles forming in the fuel. Water can accumulate in suspension in the fuel and as the aircraft climbs to high altitude and the temperature reduces, the water in the fuel may form ice particles. Initially the filter element will prevent such ice particles passing further into the fuel system and fuel will continue to be supplied to the engine. Eventually, however, the ice will build up and block the element and also the relief or by-pass valve leading to fuel starvation of the engine. It should be noted that while the water content of the fuel is in liquid form it presents no serious danger to the engine, therefore if the water is prevented from forming into ice particles fuel starvation will be avoided. To achieve this the fuel is heated prior to the filter, therefore preventing the formation of ice in the fuel and therefore preventing the filter element becoming blocked by ice. The fuel may be heated by a number of methods, firstly it may be heated by bleed air from the high pressure zone of the compressor of the engine. Alternatively the fuel may be heated by a heat exchanger utilising the oil from the engine lubrication system as the heating medium and in this system the oil will be cooled at the same time. Temperature control is exercised in both systems to maintain a specific fuel temperature.

Appendix III

(Text C) "Fuel Flow Control System"

In most modern gas turbine fuel systems the principle of a FLOW CONTROL SYSTEM is used, earlier engines operated with a pressure controlled fuel system. In the flow control system the fuel pump delivery pressure is sensitive to engine speed, therefore at low engine rpm the fuel pump delivery pressure is quite low. The flow control system is very compact and with the exception of the engine speed governor, all other devices are contained within one combined fuel control unit.

The High Pressure Fuel Pump delivery pressure is controlled by the Fuel Control Unit and the rpm of the High Pressure Fuel Pump is controlled by the Engine Speed Governor. The servo pressure in the pump which dictates the piston stroke and therefore the delivery of the pump is supplied by the Altitude Sensing Unit which is part of the Fuel Control Unit.

At any steady running condition below governed speed, the fuel pump delivery is controlled to a fixed value by the Altitude Sensing Unit. As the throttle is slowly opened the pressure in the pump servo piston supply increases, in turn the pump output increases. Any variation in engine air intake pressure, due to a change in aircraft forward speed or altitude, is sensed by a capsule in the Altitude Sensing Unit, this causes the unit to respond reducing the pump delivery in the event the intake pressure reduces, and the opposite will occur should the intake pressure increase.

During a rapid acceleration, the rapid movement of the throttle will cause an increased supply of fuel to the combustion chambers which not be matched by an adequate supply of air from the compressor. The result of this unbalanced fuel/air ratio will be an increase in engine gas temperature and possibly compressor surge. It is essential therefore, to have an Acceleration Control Unit to give a corresponding lag in the rate of fuel flow increase.

The components in the fuel control system are very complex and the description is purely to give the reader a basic understanding of their purpose.

Appendix IV

CLASS RESEARCH TEST ON READING COMPREHENSION

1) Skim (read quickly and superficially) each of the three texts enclosed. What is each text about?

2) Read each text carefully. Can you extract the main idea of each text?

3) Evaluate each text according to its readability. Which one have you found most difficult to understand? Enumerate the possible causes.

4) With the corresponding text in front of you, answer the questions or complete the sentences below by selecting the best option:

Text A

The low pressure pump is the same as
a) the underside of the fuel tank
b) the booster pump
c) the high pressure pump
d) the main or engine driven pump

The low pressure fuel pump consists of
a) an on / off switch
b) a high pressure pump
c) a by-pass
d) components and pipelines
e) a booster pump selector
f) an indicator light
g) a booster pump selector, an indicator light, a by-pass, components, and pipelines

The main idea of the text is that...
a)   the booster pump is operated electrically and connected to the underside of fuel tanks
b)   its major purpose is to maintain a fuel supply to the engine
c)   its major purpose is to minimize vapor locks
d)   its major purpose is to maintain the pressure built up in the systemto a specific value

True or false?
a)   The booster pump and the low pressure fuel pump are the same device
b)   The booster pump and the high pressure pump are the same device
c)   The indicator light switch only functions in case of failure
d)   In case of failure the booster pump drives fuel to the engine
e)   Booster pumps and high pressure pumps function simultaneously

Text B

True or false?
a)   The relief valve and the by-pass valve are the same thing
b)   Blocked and clogged mean the same
c)   The filter element is the part to remove dirt from fuel
d)   Water accumulates in suspension in fuel when aircraft climb to high altitudes
e)   The heat exchanger utilizes the oil from the engine lubrication system to heat the fuel
f)   Fuel may be heated utilizing the oil from the engine lubrication system and also by using the heat exchanger

Text C

Rephrase in your own words:
In most modern gas turbine fuel systems the principle of a flow control system is used, earlier engines operated with a pressure controlled fuel system.

Choose the best option
The delivery of the pump is supplied (2nd paragraph)
a)   by the altitude sensing unit which is part of the fuel control unit
b)   by the altitude sensing unit. This is part of the control unit

Variations in engine air take pressure (3rd paragraph)
a)   are only normally caused by changes in aircraft forward speed or altitude
b)   are sensed by a capsule in the altitude sensing unit only if they have been caused by changes in aircraft forward speed or altitude

What causes the unit to respond reducing the pump delivery when intake pressure reduces? (3rd paragraph)
a)   The altitude sensing unit
b)   Any variation in engine intake pressure
c)   The sensing by the capsule of variations in engine intake pressure

An increased supply of fuel to the combustion chamber (4th paragraph)
a)   is sometimes not matched by an adequate supply of air from the compressor
b)   is never matched by an adequate supply of air from the compressor

Appendix V

QUESTIONNAIRE ON PUNCTUATION

Uses

Please answer these questions:
a) When do you use the period or full stop?
b) Mention at least five uses of the comma in English
c) When do you use the hyphen?

Criteria

You have been given three whited-out texts to be punctuated. What criterion or criteria have you followed to punctuate them? Tick your answers

a) Quantity (according to the proportion or balance between commas and periods / full stops)
b) Sound (by reading it mentally or aloud to yourself)
c) Meaning (separating dramatically different ideas with periods/full stops or equivalent signs, and aspects of the same idea with commas)
d) Syntax (depending on sentence length and structure)

RECOGNITION TEST

a) *Insert a comma where appropriate*
    corrupt local governments
    small white hats
    healthy intelligent children
    expensive chrome furniture
    hot humid summers
    All club members agreed they would need bicycles motorized bikes and scooter

b) *What do you notice in the following sentences?*
    She bought two magazines and a quart of milk and honey.
    My father who is a diplomat has traveled all around the world.
    Only the people at our party who enjoy classical music are having a good time.
    That tree that I have watered and fertilized carefully all spring shows signs of dying.
    My brother John spent two years in the Peace Corps.
    My older sister Mary will take her vacation early this year.
    Father always did the cooking for us while mother looked after marketing laundry and other chores.
    We have both studied although he has more chances to pass.
    I have studied much although I am not going to pass.

c) *Insert a hyphen where needed*

    semi abstract   great grandmother
    anti human   step sister
    anti imperialistic   self induced
    brother in law   forty nine

hall like	pre paleolithic
trash can	trans Siberian
clear minded	X rays
first rate	22 caliber rifles