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WHAT IS THE INFLUENCE OF GENRE DURING THE PERCEPTION OF  
STRUCTURED TEXT FOR RETRIEVAL AND SEARCH?

MALCOLM JOHN CLARK

A thesis submitted in partial fulfilment  
of the requirements of  
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What is The Influence of Genre During the Perception of Structured Text for Retrieval and Search?

Doctor of Philosophy

Malcolm John Clark

### **Abstract**

This thesis presents an investigation into the high value of structured text (or form) in the context of genre within Information Retrieval. In particular, how are these structured texts perceived and why are they not more heavily used within Information Retrieval & Search communities?

The main motivation is to show the features in which people can exploit genre within Information Search & Retrieval, in particular, categorisation and search tasks. To do this, it was vital to record and analyse *how* and *why* this was done during typical tasks. The literature review highlighted two previous studies (Toms & Campbell 1999a; Watt 2009) which have reported pilot studies consisting of genre categorisation and information searching. Both studies and other findings within the literature review inspired the work contained within this thesis.

Genre is notoriously hard to define, but a very useful framework of 'Purpose and Form', developed by Yates & Orlikowski (1992), was utilised to design two user studies for the research reported within the thesis. The two studies consisted of, first, a categorisation task (e-mails), and second, a set of six 'simulated situations' in Wikipedia, both of which collected quantitative data from eye tracking experiments as well as qualitative user data.

The results of both studies showed the extent to which the participants utilised the form features of the stimuli presented, in particular, how these were used, which ocular behaviours (skimming or scanning) and actual features were used, and which were the most important. The main contributions to research made by this thesis were, first of all, that the task-based user evaluations employing simulated search scenarios revealed 'how' and 'why' users make decisions while interacting with the textual features of structure and layout within a discourse community, and, secondly, an extensive evaluation of the quantitative data revealed the features that were used by the participants in the user studies and the effects of the interpretation of genre in the search and categorisation process as well as the perceptual processes used in the various communities. This will be of benefit for the re-development of information systems. As far as is known, this is the first detailed and systematic investigation into the types of features, value of form, perception of features, and layout of genre using eye tracking in online communities, such as Wikipedia.

**Keywords:** Genre, Perception, Information, Seeking, Retrieval, Structure, Texts, E-mail, Wikipedia, Eyetracking

## Acknowledgements

During my exceedingly long part-time PhD journey, I have received invaluable support and advice from many people. Due to exciting new challenges arising for the members of my original supervisory team which resulted in their leaving RGU, I found myself needing to find new supervisors. This has resulted in my having a long list of people to whom I would like to express my gratitude, and it is therefore probably most appropriate to mention each of these individuals in chronological order.

Dr Stuart Watt offered me the wonderful opportunity of embarking on the PhD, by introducing me to the great discipline of genre. His encouragement, passion and drive was an inspiration and I will be forever thankful to him. Secondly, Dr Ayse Goker also agreed to be the second supervisor on my team and I count myself fortunate to have had experience of her enthusiasm and passion for research. Fortunately, she has now returned to RGU as a Professor, and I am able to benefit from her experience and knowledge. Professor David Harper, long since departed for Google, was the last original team member and is still a source of great inspiration during his occasional visits to RGU; he encouraged me greatly after reading my MSc thesis.

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At around the same time, during one of the many conferences that I attended in Glasgow, I met Professor Ian Ruthven. After seeing him deliver a lecture and introducing myself, it became apparent that I could benefit from his wisdom and guidance. Ian agreed to become my joint supervisor with Patrik, and soon, my PhD project was back on course, thanks to the vital support and assistance of this perfectly balanced team. Again, Ian's guidance, friendship and long conversations about research and life were something I enjoyed immensely. Ian has a wonderfully blunt way of expressing himself in face-to-face meetings and in e-mails which always helped to put me back on track when he thought I was digressing from the research reading topics. To quote the acknowledgements from a good friend's thesis regarding Prof. Ruthven: "I have to also admire your boldness: you agreed to supervise me after knowing me for about one hour (how silly was that?)"

---

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As some portions of this dissertation have been presented in various conferences, workshops and journals, each individual publication went through a review process which provided me with insightful comments from the reviewers. These were invaluable in improving the final thesis. So, thank you anonymous reviewers.

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*Being deeply loved by someone gives you strength, while loving someone deeply gives you courage.*

(Lao Tzu)

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## Published Papers

I declare that I am the sole author of this thesis and that all verbatim extracts contained in the thesis have been identified as such and sources of information specifically acknowledged in the bibliography. Parts of the work presented in this thesis have appeared in the following publications:

Clark, M., Watt, S. (2007). Classifying XML documents by using genre features, *Proceedings of the 18th International Conference on Database and Expert Systems Applications (DEXA)*, Regensburg, Germany, IEEE Computer Society, Washington DC, USA, pp. 242–248.

Clark, M. (2007). Structured text retrieval by means of affordances and genre, *Proceedings of the 1st BCS IRSG Conference on Future Directions in Information Access*, Glasgow, UK, British Computer Society, Swinton, UK, pp. 16.

Clark, M., Ruthven, I., Holt, P. (2008). Genre analysis of structured e-mails for corpus profiling, *Proceedings of the Workshop on Corpus Profiling for Information Retrieval & Natural Language Processing*, London, UK, British Computer Society, Swinton, UK.

Clark, M., Ruthven, I., Holt, P. (2009). How do people interact with structured e-mails in terms of genre and perception?, *Proceedings of the Conference on Information: Interaction and Impact (I3)*, Aberdeen, UK.

Clark, M., Ruthven, I., Holt, P. (2009). The evolution of genre in Wikipedia, *Journal for Language Technology and Computational Linguistics* **25**(1): 1–22.

Clark, M., Ruthven, I., Holt, P. (2010). Perceiving and using genre by form – an eye-tracking study, *Libri: International Journal of Libraries and Information Services* **60**(3): 268–280.

Clark, M., Ruthven, I., Holt, P. & Song, D. (2012). Looking for genre: the use of structural features during search tasks with Wikipedia, *Proceedings of the 4th Information Interaction in Context Symposium (IIIX 2012)*, Nijmegen, The Netherlands, ACM Press, New York, NY, USA, pp. 145–154.

Clark, M., Ruthven, I., Holt, P., Song, D., Watt, S. (2014). You have e-mail, what happens next? Tracking the eyes for genre, *Information Processing & Management* **50**(1), 175–198.

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## Chapter 1: Introduction

### 1.1 Background

The digital age has led to vast amounts of data being produced and stored on online servers. Much of this data has been created in communities of practice for a specific purpose and can contain many forms, such as patent applications, news articles, e-mails and certificates. These forms (or genres) are being under-utilised in some parts of information research, for example, Information Retrieval (IR) and Information Seeking (IS). In order to resolve this problem, researchers need to understand how form is processed in Information Interaction and Interactive Information Retrieval. The large international IR communities, which include a variety of international academic organisations, commercial companies (e.g. Google, Yahoo, Microsoft), the text retrieval evaluation conference (TREC), and, the initiative for the evaluation of extensible mark-up language (XML) retrieval (INEX), understand the importance of (technologically and manually) structured texts for retrieval. However, as will be shown in Chapter 2, research in IR is based on the Cranfield II model, also known as the Laboratory Model. Ingwersen & Järvelin (2005) maintain that the IR communities are divided into two different communities, firstly, the IR community, which is concentrated around computing scientists who utilise algorithmic models to retrieve 'relevant' information and then use Precision and Recall metrics to measure the level of relevance. The second group consists of researchers in IS<sup>1</sup> and IR communities who reject the Laboratory Model; some of their reasons for rejecting the Laboratory Model are listed in Section 2.5.1. This thesis adopts the position taken by Ingwersen & Järvelin (2005), who maintain that IR is a small module within IS and this issue will be looked at closely in Chapter 2; in line with Ingwersen & Järvelin (2005) and in order to ensure clarity, IR and IS will be referred to as IS & R, except, of course, when differentiating between the two areas.

At present, genres or the forms that make up genres are being under-utilised. Although some research communities are using genre, for example, Computational Linguistics (CL) are studying the benefits of genre for categorising documents in digitally structured media using tags from Hypertext Mark-up Language (HTML), and library archivists are looking at the advantages of using genre for the storage and retrieval of digital media, more research is required to find ways of linking cognitive science modelling techniques, genre and IS & R.

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<sup>1</sup> The IS communities referred to have backgrounds leaning towards the library sciences and are typically involved in researching social sciences.

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This thesis aims to carry out a methodological investigation into the key elements of users' interactions with whole sections or singular elements of structured text – that is genre - within digital communities, for instance, typical university e-mail examples and the World Wide Web (WWW). The advantages that the utilisation of genre can offer IS & R are palpable, not only in every module of the traditional 'Laboratory model' of IR, i.e., relevance, indexing, queries, etc., but also in every aspect of Information Seeking research. The emphasis here is on determining the immediate benefits to the IS & R community, and also on illustrating the benefits to the information community as a whole.

The main focus of this thesis is on genre but, in addition, specific attention is paid to the overlaps of Information Behaviour (IB), IR, Interactive IR, IS and cognitive science, merging and utilising these to help to explain how structured texts are perceived and classified. Of particular interest, in this respect, is how the context of a "*community of practice*" (Wenger 1999) gives rise to standardised information forms which are socially-constructed communicative behaviours, that is, genres, produced by members of the community, and how these visual layouts of forms and their salient features can be exploited by retrieval technology to improve retrieval effectiveness. Most genre research is based around the analysis of one or more of the conceptual features, i.e., content, style, structure, and so on. This research will look at form and its interdependence with content as well as the ways in which people 'use' text, i.e., categorise and search by using genre and perception. Three other associated areas are also examined in this thesis: firstly, the determination of the value of the interaction of structures of text objects in an online community during IS. Secondly, how form or layout is perceived in structured texts. Thirdly, evidence will be obtained of different types of information processing during the eye tracking sessions by people who are using theoretical perception processes.

In the next section, the motivations (Section 1.2) for the research will be explained, as well as the problems which this research will help to resolve in the future, that is, the long-term goals. Section 1.3 introduces the research aims dealt with in this thesis that correlate with the studies in chapters 3 and 4b. Section 1.4 provides an outline of the organisation of the thesis.

## **1.2 Motivations**

There are two main motivations for this project: the first is based on the need to demonstrate the ways in which people can exploit genre within IS & R and to show what is sensed and how it is detected within a cognitive framework. Secondly, there is the aim of adding another, under-utilised

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method of filtering to large data collections to show how researchers can take advantage of genre. For example, when an 'information retrieval' query is input into an online search engine, the query results return many possible different types of genres of documents with specific forms, for example, school course notes, books, homepages of universities, biographical information, wikis, such as Wikipedia and other encyclopaedic documents. However, search engines do not utilise these genre features during the indexing of texts, so the genres cannot be exploited during the searching or categorising of results for the user. These facilities would help the searcher not only to find the required information more quickly, and arguably more accurately, but also in the post-search filtering and ranking of results.

Earlier research has shown that classifiers can be trained to categorise texts by genre, for example, Boese & Howe (2005); Clark & Watt (2007); Stamatatos et al. (2000a); Stamatatos et al. (2000b), but more work is required in this area to find out how a human being performs the task of genre identification during IS & R, and which features are used.

The question is whether texts in several domains, such as, e-mail and Wikipedia, can be filtered by genre for the user, and if so, how this can be done; to this end, the behaviour of users during IS, IB and Interactive IR and categorisation tasks needs to be closely examined and the feature sets used need to be recorded. In this context, proposals are made for the direction of future work, to consider how a machine can be made to emulate the behaviour of a human being during the reading process, that is, to understand a text quickly without the need to parse or read an entire document and the first step will be to gather empirical evidence of the ways in which humans perform these tasks.

### **1.3 Research Aims**

Copious amounts of literature have been published on IS & R, genre, theoretical perception, and cognitive models in literary/information science (IS & R and genre), cognitive (theoretical perception) and psychological (theoretical perception) but few researchers have examined all these areas in an assimilated manner. The research for this thesis, in the early stages, was focused on examining the usefulness of 'genre' to the domain of information retrieval and seeking; the specific aims were:

1. To expand research by Toms & Campbell and Watt (Toms 2001; Toms 2002; Toms & Campbell 1999a, 1999b; Toms et al. 1999; Watt 2009). To add a new dimension of cognitive data to Genre research.

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2. To explore how other research fields (English Literature, Neurology etc.) can benefit IR & S knowledge. To further advance the understanding of human genre interpretation.
  3. To implement user evaluations: search and categorisation scenarios revealing 'how' and 'why' users make decisions in a cognitive context.
  4. To collect evidence showing how users interact with textual features of structure and layout within a discourse community and to investigate the use of skimming and scanning by subjects during user studies in an IR & S context.
  5. To conduct a preliminary investigation into the evolution of structures, perception of features (Ecological & Constructivist) and layout of genre using ocular measurements in online communities.

#### **1.4 Thesis Outline**

The remainder of this thesis is divided into five chapters:

- Chapter 2 presents the literature review for the thesis. The structural layout is described in the Introduction (Section 2.1), and Section 2.2, provides a detailed examination of genre in areas such as classical interpretations, definitions, ecologies and shared concepts with IS & R. Section 2.2.8, describes the deep and shallow features currently used in research and Section 2.3 explains the definition of genre adopted in this thesis. The literature then examines appropriate areas of information science, i.e., IS & R, including techniques employed in reading and comprehension, such as skimming and scanning. At this point, cognitive science is introduced, and theoretical visual perception explained. Related genre studies are considered, which may be seen as having an influence on the thesis user studies. Penultimately, relevant definitions and eye tracking studies are described in the context of this research. Finally, in the last section, the research aims of this thesis are explained.
- Chapter 3 investigates the eye tracking of an e-mail collection, as an approach to the analysis of genre recognition. The first study focused on eight different types of e-mail, such as calls for papers, newsletters and spam, which were chosen to represent different genres. The study involved the collection of oculographic behaviour-derived data metrics, such as fixations, saccades and scanpath durations and lengths to highlight the ways in which people view the features of genres. This chapter shows that genre analysis based on purpose and form (layout features, etc.) is an effective means of identifying the characteristics of these e-mails.

- Chapter 4a presents an overview of the ways in which genres, or structural forms, develop in a discourse community/community of practice, in this case, Wikipedia. Data was collected by performing a small search task in the Wikipedia search engine to locate articles using a number of search queries. Searches were also carried out for biographical articles about well-known individuals and the differences in the articles were then noted. The data was examined to discover whether the articles have particular forms and whether some genres evolve, merge, overlap and connect with each other as well as to identify the ways in which the purpose and form of a biographical article have evolved over six years within this community. The short discussion in this chapter on the usefulness of Wikipedia as a vehicle for such genre investigations generated a number of research questions linked to the methods in which forms may act as descriptors of genre, and also provided pointers for the design of the experimental work.
- Chapter 4b reports on the task-based observational, logged, questionnaire study and analysis of ocular behaviour pertaining to the interaction of structural features of text in Wikipedia using eye tracking. Realistic tasks were set for searching Wikipedia online, with a focus on examining which features and strategies (skimming or scanning) were the most important for the participants to complete their tasks. This work presents results which will contribute to the long-term aims of studying the important features of genre for theoretical perception research within a web-based community of practice.
- Chapter 5 presents the Introduction to the Conclusions (5.1). In Section 5.2, the Contributions to knowledge are described in detail, beginning with the Introduction (5.2.1), which is followed by the Summary of Contributions (5.2.2). Section 5.2.2 is divided into two sub-sections, firstly, a list of Main Contributions (5.2.2.1) and second, Smaller-Contributions (5.2.2.2). Section 5.2.3 discusses the main contributions in more detail. In the penultimate Section, 5.3, the limitations are discussed and, finally, in Section 5.4 future work is shown.

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## Chapter 2: A Survey of Related Literature

### ***2.1 Introduction***

The following chapter provides an analytical review of the literature related to the research. Many overlapping multi-disciplinary areas of literature will be dealt with, such as theoretical visual perception, memory models in cognitive science, neurology, eye tracking, genre, IS & R, but since the primary focus of this thesis is on the value and perception of genre in the context of information-seeking and information-seeking behaviour in a cognitive sense, it seems relevant to begin with genre. An extraordinary amount of literature has been surveyed covering many domains, some of which overlap.

Genre is the main theme of this thesis. The whole of Section 2.2 (and sub-sections) provides a broad introduction to the subject of genre, describing it in a classical context (2.2.1) and explaining the inherent difficulties in defining genre (2.2.2.). In the following sections, genre and communities of practice (2.2.3), genres as organisational communication (2.2.4), evolution of genre, i.e., 'ecologies' (2.2.5), interpretation of genre by form (2.2.6), external and internal textual cues (2.2.7), concepts and features (deep and shallow features of genre) (2.2.8), and the definition of genre employed in this thesis (2.3) are all briefly covered. Section 2.4 explains the connections between that which has been covered up to now and what follows in the remainder of the chapter.

The next theme of the thesis involves explaining and defining Information Retrieval Interaction, Seeking and Behaviour (2.5), taking into consideration its deficiencies as well as the ways in which this area of research can benefit from embracing genre. In 2.5.1, IS & R are defined while the next Section, 2.5.2, explores a different but related domain of Information Interaction/Behaviour and Seeking. Section 2.6 is divided into the scanning and skimming of text (2.6.1) along with related user studies (2.6.2) and mixed studies involving skimming, IR, Natural Language Processing (NLP) and Artificial Intelligence (AI) (2.6.3). Section 2.7 concentrates on the deeply connected subject of theoretical visual perception (2.7.1). Section 2.7.2.2 examines many of the most prominent theories of theoretical visual perception.

Section 2.8 examines some of the most important literature related to this thesis, that is, previous user studies on genre, IR and perception. Previous studies are outlined in (2.8.1) and a discussion follows in (2.8.2). In the penultimate Section, 2.9, the eye tracking methodology is introduced

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(2.9.1), along with a background (2.9.2), types of ocular measurements (2.9.3) and metrics (2.9.4). In Section 2.9.5, an alternative method of eye tracking data analysis is defined, i.e., scanpaths, in which follows background and previous studies using the scanpath-derived metric. Section 2.9.6 looks at previous research using scanpaths and observed measurements while Section 2.9.7 examines eye tracking in cognitive science and information studies

Finally, in Section 2.10, the literature is summarised (2.10.1) and the research aims are modified and extended (2.10.2) to reflect what has been learnt and the direction in which the research is moving.

## **2.2 Genre**

One definition of the word ‘genre’ in the context of classical philosophy refers to a ‘kind’ of ‘communicative practice, type, class or category belonging to a particular group’ (Chandler 1997). Genre is often treated as the classification of, for example, movies and literature into groups and categories, such as, a ‘science fiction’ novel. Sometimes, clearly defined characteristics and distinctive features are exploited, such as the genre’s form (Music Sheet or Tutorial), the content (Novella or Crime Stories) or the style (Medieval or Shakespearean); the focus of this thesis, however, is on the form features of genre.

### **2.2.1 Classical Genre**

Genre, and in particular ‘form’, has been mused over for thousands of years. Earlier paradigms can be found in the context of Aristotle’s ‘rhetoric and poetics’ (Aristotle 1984) and Plato’s ‘ideas, forms or reality’ (Plato 1997). Aristotle disregarded Plato’s musings on ‘reality’; he considered that whatever was perceivable by the individual was reality. He believed that the entire ‘visual array’ was made up of substance and form; form was comprehensible when it specified the individual and could be abstracted from the objects in a process of perception. Forms have been the subject of considerable debate for thousands of years, for example, ‘Theory of Forms’ (Plato 1999) or ‘Substantial Forms’ (Hill 2007). Form in the context of this thesis is a part of the overall genre. Arguably, a genre can contain many overlapping concepts, such as style, content, functionality, action and form. Form, in this context, mainly exists of the ‘*Structural Features*’, ‘*Communication Medium*’ and ‘*Language or Symbol System*’ (Yates & Orlikowski 1992, p. 301) (to be discussed in more detail later in Section 2.3/Figure 2.4).



Genre has also been examined in relation to the European Romantic movement of the 18<sup>th</sup>/19<sup>th</sup> centuries, by the Russian Formalists and also by the language philosopher, Bakhtin, in his essay on “*speech genres*” he described primary (or *simple*) genres which are “*used in day-to-day communicative activities, and as the building blocks of secondary genres*” (Trace 2011, p. 7). Secondary (or *complex*) genres “*arise in more complex and comparatively highly developed and organized cultural communication*” (Bakhtin 1986, pp. 61-2).

A genre is often defined in terms of a topic, or a type of music or literature, or as its purpose and form (also referred to as substance in Dewdney et al. (2001), and a ‘fusion’ of substance and form in Miller (1984, p. 159) which scholars undoubtedly developed from Aristotelian ‘substance and form’). The Aristotelian visual array and forms are arguably linked to Gibson’s Ecological perception theory (Gibson 1986b) (and in particular the Ambient Optic Array (Gibson 1986a)). An explanation of Gibson’s ecological perception theory is given later in Section 2.7, with a discussion in Section 2.8, to help to show how the forms of genre, in some contexts, influence the ways in which the objects, such as texts, are perceived.

### **2.2.2 Difficulties in Defining Genre**

*“Genres are not just forms. Genres are forms of life, ways of being. They are frames for social action. They are environments for learning. They are locations within which meaning is constructed. Genres shape the thoughts we form and the communications by which we interact. Genres are the familiar places we go create intelligible communicative action with each other and the guideposts we use to explore the unfamiliar” (Bazerman 1997, p. 19).*

Many of the books and literature reviews that deal with genre, such as, Boudourides (2001), Freedman & Medway (1994a), Duff (2000), Bazerman et al. (2009); Frow (2006a); Kessler et al. (1997); Webber (2009) reveal an general lack of consensus on finding an appropriate definition of genre because so many questions remain unanswered with regard to how genres are created, evolve, function, overlap and interact with each other, which rules and patterns constitute a genre and how these characteristics are perceived. The specific contexts of the researchers guide the ways that they delineate genre: as Kwaśnik & Crowston (2005) argue, the researcher chooses the definition applicable to the current context of the study. However, some substantial common ground can be found among scholars: compare, for example, “*dynamism, situatedness, form and content, duality of structure, and community ownership*” (Berkenkotter & Huckin, 1995, p. 4) with *Genres of Organizational Communication* by Yates and Orlikowski (1992) and their emphasis on the community, social acceptance and community ownership. Berkenkotter & Huckin (1993, p. 478; 1995, p. 4) developed a theoretical genre framework:

- 
- 1) **Form and content:** Genre knowledge embraces both form and content, including a sense of what content is appropriate to a particular purpose in a particular situation at a particular point of time.
  - 2) **Community ownership:** Genres signal a community's norms, epistemology, ideology and social ontology.
  - 3) **Dynamism:** Genres are dynamic rhetorical forms that develop from responses to recurrent situations and serve to stabilise experience and give it coherence and meaning. Genres change over time in response to their users' sociocognitive needs.
  - 4) **Situatedness:** Genres are derived from and embedded in our participation in the communicative activities of daily and professional life. As such, genre knowledge is a form of 'situated cognition' that continues to develop as we participate in the activities of the ambient culture.
  - 5) **Duality of structure:** As we draw on genre rules to engage in various activities, we *constitute* social structures (in professional, institutional, and organisational contexts) and simultaneously reproduce these structures.

Yates & Orlikowski (1992) developed their own framework (c.f. Section 2.2 and Figure 2.4) and, as noted in Mayes (2003, p. 39), they were strongly influenced by Giddens's 'Structuration' theory in that "*genres can be viewed as social institutions that both shape and are shaped by individuals' communicative actions*". Miller (1984), too, in her seminal article, described *Genre as a Social Action* that "*...typified rhetorical actions based in recurrent situations...*". Miller explains that, in her opinion, purpose as opposed to resemblances of form (or other criteria for classification, such as style or function) is the key to determining a genre category. Swales was much influenced by the structural aspects of genres, especially in an academic setting (Swales 1990a).

Paré & Smart (1994, p. 151), both of whom were profoundly influenced by Bazerman, defined a genre framework as a distinctive profile of regularities across four dimensions:

- A set of texts referring to form aspects, such as document structure, style and formatting.
- The composing processes involved in creating these texts. These processes cover a wide range of activities, starting with the initiating event, such as information gathering and analysis, individual writing and the technique of text production.
- The reading practices used to interpret them. These practices refer to the way a reader approaches a text, how he negotiates his way through the text, how he constructs knowledge

from it, and how he uses this.

- The social roles performed by writers and readers determining what can and cannot be done by particular individuals, with regard to responsibilities, division of labour, and rights of access to information.

The many definitions of genre and lack of agreement are not the result of laissez-faire attitudes or lack of effort, but are rather a more positive indication of the diversity of genre. Three main approaches are currently employed in research on genre theory (Freedman & Medway, 1994a, pp. 9-10): the 'North American School', the 'Sydney School' and English for Specific Purposes (ESP). These have each been shaped by different scholars. Firstly, the North American School derives from the 'New Rhetoric', i.e. c.f. Burke (1950) and speech acts (Bakhtin, 1986) and has been influenced by the work of Miller (1984, 1994), who was in turn inspired by structuration theory (Giddens, 1979; Giddens, 1984).

Giddens (1979, p. 66) formulated the following rules of structuration:

- **System:** Reproduced relations between actors or collectivities, organised as regular social practices
- **Structure:** Rules and resources, organized as properties of social systems structure; exists only as 'structural properties'
- **Structuration:** Conditions governing the continuity of transformation of structures, and therefore the reproduction of systems.

Miller viewed genre as a socio-historical, rhetorically-oriented concept, with the emphasis placed on how texts function in social and interactional contexts. Miller also argued that genres decay, develop and evolve (Miller, 1984, p. 153) and this viewpoint has emerged in a great deal of other research on genre evolution, for example, in Bazerman (1988); Yates (1989). Around the beginning of the 1990s, a revisionist turn concerning genre started to take effect. An excellent description of this approach is found in *Anyone for Tennis* by Freedman (1994), who describes each genre action as analogous with a tennis game where the ball served has to be returned. According to this approach, genre is perceived as a "...socially embedded act" (Thayer, 2012, p. 7) "...as action rather than form, as text-type that **does** something rather than **is** something..." (Devitt, 1996, p. 606) and this dovetails neatly with Gibson's ecological theory (perception for action), described in Section 2.9.2. Secondly, the Sydney School is based on an applied linguistic approach, with the focus on formal textual features (Kress & Threadgold, 1988; Martin, 1999) and has been heavily influenced by the 'register' theory postulated by Halliday (1973, 1978); Halliday & Hasan (1989). The register theory was used

to demarcate the singular physiognomies of a text as determined by its context. The Sydney School focuses on the textual features by employing linguistic analyses or systemic functional linguistics that stress the static characteristics and rigid qualities. Johns et al. (2006); Johns (2002); Knapp & Watkins (2006) all used genre in teaching practice which is heavily influenced by Spinoza's ethics (Spinoza & Curley, 1994), and also genre, grammar and pedagogy. In contrast, the North American School emphasises the dynamic nature of genres, with the cornerstone of the theory based on interplay and interaction, and in particular, on the intricate associations between context and text. That said, as Freedman & Medway (1994b, p. 9) point out: "*Applications in research and pedagogy, however, have differed in ways that reveal implicit differences in theorizing*" because of the previously mentioned Hallidayan linguistic theories in the Sydney School compared to the North Americans' "*...unpacking complex relations between text and context*". Freedman & Medway (1994b, p. 9) also highlight two main differences, these being: "*...the implicit static vision of genre*" and "*prescriptivism*" in the Sydney School (Freedman & Medway, 1994b, p. 9). In spite of the core differences between the two main schools, some similarities can also be perceived: they both concede the dominance of the social in understanding genres and the role of context (Freedman & Medway, 1994b, p. 9). Additionally, they both highlight the value of community or social factors. The theories and frameworks of these two schools each have implications for this thesis: the textual features play a vital role, as do the interaction and interplay of dynamic and static genres.

The third approach that is widely employed in the study of genre theory today is English for Specific Purposes (ESP) which was shaped by Martin (1999) and inspired by Halliday (1973, 1978); Halliday & Hasan (1989) as Swales (1990a, 1990b) points out:

*"...[genre] emphasises both the social function and form of spoken and written language in academic and research settings, most notably research article introductions and grant proposals."* Swales defines genres as: "*A class of communicative events, the members of which share some set of communicative purposes. These purposes are recognised by the expert members of the parent discourse community, and thereby constitute the rationale for the genre. This rationale shapes the schematic structure of the discourse and influences and constrains choice of content and style.*" And Swales continues: "*...exemplars of a genre exhibit various patterns of similarity in terms of structure, style, content and intended audience.*" (Swales, 1990a, p. 58).

A large body of works on ESP has been produced, c.f. Dudley-Evans (2000); Flowerdew (2001); Johns et al. (2006); Johns (2002); Swales (1981, 1990a, 1990b); Swales & Mustafa (1984).

Much of the genre work that has been cited in this literature review is concerned with applied linguistics (Paltridge, 1994) and English literary studies (Frow, 2006a) but in the context of this thesis, a close examination of structure will also be carried out. The term, genre, in the perspective

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of the thesis, refers to a framed “*set of structures*” (Watt, 2009), such as cues, formatting devices and layout (e.g. alignment), which show the user the documents’ form and, to a lesser extent, purpose (Section 2.3 and Figure 2.4). In contrast, the approaches to the study of genre theory that have been employed by researchers in the three schools (referred to above) have contributed to the definition of genre that is used in this thesis, for example, textual features (Sydney School), dynamic genres (North American) and classes of communicative events providing examples of genres with patternations of resemblance in terms of form. The term ‘genre’ embodies a much wider range of contexts found in multiple overlapping research areas, for example, multi-disciplinary approaches have recently been employed to conduct research on genre for literary and cultural studies (Duff, 2000; Freedman & Medway, 1994a; Frow, 2006a; Paltridge, 1997; Swales, 1990a), pedagogy (Knapp & Watkins, 2006), corpus linguistics (Flowerdew, 2001), computational linguistics (Santini et al., 2009), information retrieval, information seeking and information behaviour (Aires et al., 2005; Clark & Watt, 2007; Freund et al., 2005; Iwayama et al., 2003); Freund (2013); Freund et al. (2006). In recent years, some scholars have used genre to try to model, understand and coordinate the types of communication used in organisations and businesses.

Freund et al. (2006) conducted a study on the use and value of genre classification in a software development division of a large unnamed ‘tech’ company. They developed a genre taxonomy by interviewing employees and analysing 40 websites that were in use in the domain and then performed experimental search sessions in “*automatic genre classification*” by using a light tool which implemented supervised ML algorithms. Yates et al. (1997, p. 52) investigated a hi-tech company, Mox, in the US, and studied the use of a software application, built for groupware to support organisations, known as ‘Team Room’<sup>2</sup>. They found three particular genre systems utilised by three teams within the organisation: “*meeting documentation*”, “*collaborative repository*”, and “*collaborative authoring*”. Using the theories developed in Orlikowski & Yates (1994); Yates & Orlikowski (1992), Yates et al. (1999); Yates et al. (1995) studied the patterns of communication structures, such as e-mail and also newsgroup messages, within a Japanese Research and Development (R & D) group project. The authors located and analysed two contrasting media patterns, i.e., implicit and explicit structuring of genre norms which provided small clues about the behaviour of the employees (organisational actors) when using new electronic media as well as showing how the use of such media evolves over a period of time. Bazerman (2004, p. 311) provided a comprehensive description of a system, defining the types of genres that are created in

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<sup>2</sup> A collaborative application created and maintained by Lotus Notes

an academic teaching and administration environment and suggesting how “...each text is embedded within structured social activities and depends on previous texts that influence the social activity and organization”. In addition, as Bazerman continues, “...each text establishes conditions that somehow are taken into account in consequent activities.”

As described previously, the North American School, the Sydney school and ESP scholars all share common values, and the fact that much commonality is also evident in the theories and frameworks employed by scholars, such as Bazerman (1994); Berkenkotter & Huckin (1993, 1995); Giddens (1979); Mayes (2003); Miller (1984, 1994); Orlikowski & Yates (1994); Paré & Smart (1994); Swales (1990a, 1990b); Yates & Orlikowski (1992), can be taken as a clear indication of the value of the “community” or, in the context of this thesis, “*Communities of Practice*” (CoP).

### **2.2.3 Communities of Practice (CoP) and Genre**

COPs are social institutions or sites where human agents draw on rules, such as structure, to engage in organisational communication which operate by producing, reproducing, or modifying such things as genres (Yates & Orlikowski, 1992, p. 305). As Toms & Campbell (1999b, p. 370) explain: “*Communities of academic, business, or professional groups in particular fields have developed and continue to develop conventions of presenting information*”.

A useful example is provided by Bazerman (2004, p. 311) who describes the nature of an academic organisation, such as the teaching faculties in a university and how they would first have to set a “*curriculum*” and advertise a new “*course catalogue*”. In the administration department, the “*syllabi*” are updated, reviewed by committees, and set out in procedures, after which the administration department documents the events into “*minutes*” for faculty-wide distribution. The students register for “*courses*”, and if the numbers of “*applications*” are insufficient, a “*memo*” may be sent to the lecturers. Each teaching term, the “*schedule*” of “*courses lists*” is made available for the registry department to create “*student lists*” and other “*enrolment documents*”. Eventually, after the students have passed all the courses in which they have enrolled, the final document is produced, that is, a very welcome “*certificate*”.

Giddens (1986) cited in Gauntlett (2002) suggests that:

“...human agency and social structure are in a relationship with each other, and it is the repetition of the acts of individual agents which reproduces the structure. This means that there is a social structure - traditions, institutions, moral codes, and established ways of doing things - but it also means that these can be changed when people start to ignore them, replace them, or reproduce them differently”.

A COP is one of many “...building blocks of a social learning system...” in which “...grow out of a

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*convergent interplay of competence and experience that involves mutual engagement. They offer an opportunity to negotiate competence through an experience of direct participation” (Wenger, 2000, p. 228)<sup>3</sup>.*

Nardi & O’Day (1999, p. 49) call COPs: “*Information Ecologies*” and define them as: “*...a system of people, practices, values, and technologies in a particular local environment. In information ecologies, the spotlight is not on technology, but on human activities that are served by technology*”.

As Wenger states: “*human beings have formed communities that share cultural practices reflecting their collective learning*”, whether, for example, as a “*tribe around a cave fire*”, or as a gathering of “*engineers interested in brake design*” (Wenger, 2000, p. 229). By participating in these CoP it is crucial to our education and development and it is at the very centre of what makes the human mind adept at the acquirement of significant knowledge and understanding (Wenger, 2000, p. 229). The human animal has almost always functioned better in communities that share practices developed from their cultural backgrounds or current contexts.

According to Yates & Orlikowski (1992, p. 301), “*In structurational terms, genres are social institutions that are produced, reproduced, or modified when human agents draw on genre rules to engage in organizational communication*”.

In this thesis, it is contended that if the genre behaviour of the community could be comprehended, (i.e. if the value of the features, layout and cues of form could be examined and recorded), this could all be exploited in the implementation of tools, for example, skimming implementations, such as Flexible Expert Retrieval of Relevant English Text (FERRET) for searching and retrieving important community objects<sup>4</sup>.

Collins et al. (2001) explained that what the community sees as important will be reflected in the implicit structures found in the objects they create and share - as Yates & Orlikowski suggested: “*...convergence on a set of standardised document structures is both natural and helpful*” (Yates & Orlikowski, 1992). These objects are genres which occur on the Internet, in e-mails, intranets, written on paper and so on. Communities of practice are certainly utilised, but further research is needed on the ways in which the message texts, e-mails and web pages structures are viewed and utilised as well as on which features are important. For example, when Yoshioka & Herman (2000) studied the *Hawaii International Conference on System Sciences (HICSS)* website, in order to trace the genres, they discovered that genres are utilised to coordinate information related to “*...aspects of coordination mechanisms, such as divisibility, concurrency, accessibility and timing, that help people*

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<sup>3</sup> A small discussion of COPs presented in Section 4.6 in regard to Wikipedia.

<sup>4</sup> FERRET and FRUMP will be introduced later in the thesis for future work directions (Chapter 5).

*improve the coordination of work processes*". The authors used a process knowledge repository entitled the "*Process Handbook*<sup>5</sup>" and described the potential benefits for

*"...system designers and users may benefit from an explicit recognition of the coordination provided by using genres and by exploration of similar coordination through the use of this repository"* (Yoshioka & Herman, 2000, p. 2).

#### **2.2.4 Genre as Organisational Communication**

*"A genre comprises a class of communicative events, the members of which share some set of communicative purposes. These purposes are recognized by the expert members of the parent discourse community and thereby constitute the rationale for the genre. This rationale shapes the schematic structure of the discourse and influences and constrains choice of content and style"* (Swales, 1990a, p. 58).

Many researchers have studied genre as organisational communication, Yates & Orlikowski (1992), for example, originally devised a very useful method of textually-oriented organisational genre analysis using the six questions: who, what, where, why, when and how. This method was later adopted by Marlow (2006) when he investigated the genre of technical communication (trouble ticket). Markus (1994) implemented Information Richness Theory (IRT), sometimes referred to as Media Richness Theory (MRT) to study the ways in which 'lean' media, such as, e-mail, is used by managers within organisations. She found that 'lean' media can be used even for complex communications and that rich media, such as face-to-face discussions, are not always preferable.

Collins et al. (2001) also studied the structural make-up of news stories by layers, especially the KMi Newsletter at the Open University. The authors wanted to analyse genre theory and genre for tools development within one paper and their declared approach was to *"...investigate genre in terms of identification, analysis and classification of communal artefacts"*. Their research was carried out using an electronic newsletter corpus called KMi Planet in the form of a webpage. The holistic aim of the initial examination was to verify whether community genres could be successfully perceived and used to support the sharing and retrieval of documents or messages within a community and, in this case in particular, whether the writers of the stories had developed a type of genre that could be exploited to allow the correct stories to be recovered with a high measure of precision.

The authors next proceeded to use a newspaper lead structure called the inverted pyramid (Figure 2.1) described by Keeble (1998), in which they deal with the questions: who, what, where,

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<sup>5</sup> <http://ccs.mit.edu/ph/>



when, why, and how.

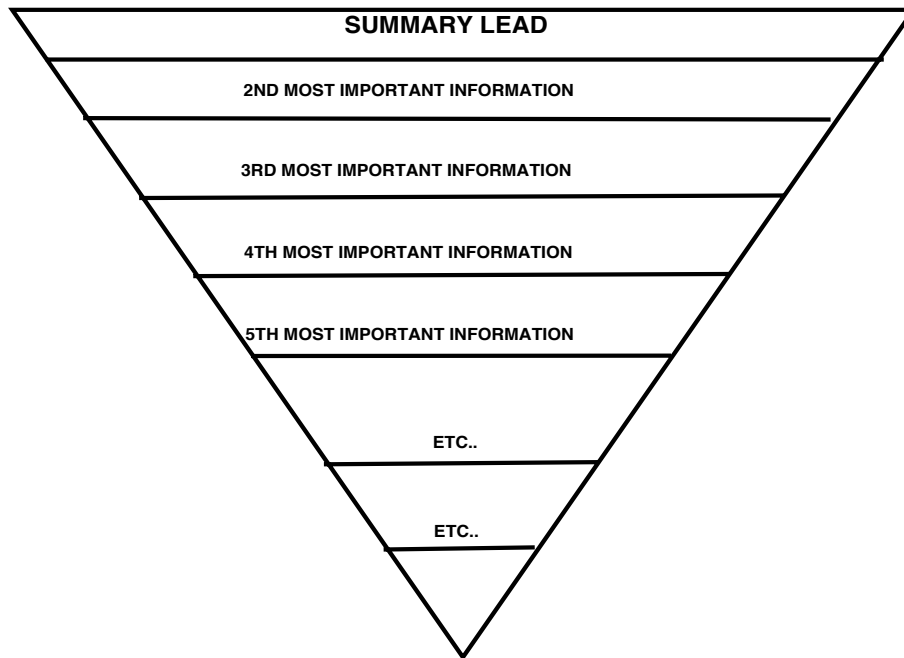


Figure 2.1: Inverted pyramid<sup>6</sup> described by Keeble (1998); Scanlan (2002).

In short, Collins et al. (2001), inspired by Keeble (1998), claimed to have discovered a “*style*” which imitated a journalistic practice genre. The revealed journal can be used to support the automatic analysis of the stories and IR. They argued that it would be useful to develop tools to make use of “*community genre*” to identify what is deemed important by a community. Collins et al. offer useful insights and methodology with regard to how structured texts, such as XML or naturally occurring e-mails, can be analysed for the presence of genre features. However, before undertaking any such analysis, more empirical evidence is required to show the ways in which genre features form, evolve and generally behave.

### 2.2.5 *Ecologies: how are genres formed?*

Duff (2000) pointed out that due to the existence of biological metaphors in genre theory, such as those described in Eriksen & Ihlstrom (2000); Kwaśnik & Crowston (2005), it was only natural that the evolutionary paradigms found in Darwin's “*Origin of Species*” (Darwin, 1859) would be used to model the ways in which literary forms change over time by evolving, being modified and being replaced.

Duff (2000) also highlighted the way that some genre theorists have also extended the biological

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<sup>6</sup> See Scanlan (2002) for more detailed information about the inverted pyramid.

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metaphor in “*quasi-Darwinian terms*” by describing some of the mechanisms of literary evolution as “*the competition of genre*”, that is, genres struggling for survival, their “*fitness*” for an environment and the “*possibility of extinction*”, but this could be seen as overworking the metaphor; to put it simply, the genre is “*supplanted*”.

Kwaśnik & Crowston (2005) provided an influential description of the ways that genres behave by extending Erickson's genre “*ecology*” metaphor (Eriksen & Ihlstrom, 2000). They compared a genre with an organism in an ecological community: these all rely on other organisms for their effectiveness, have an effect on each other, evolve over an unspecified course of time at different paces, and can even replace each other, i.e. the memo-genre. They maintained that these ecological habitats are CoPs (see Section 2.2.3), for example, Wikipedia and a law firm are both classed as CoPs. As is the case in most areas of research, however, there are issues with Web genres that have to be considered when studying digital media such as Wikipedia. Kwaśnik & Crowston (2005) described these issues and how the problems arise in a genre ecology by explaining two phenomena which occur more or less concurrently: firstly, the appearance of traditional genres on the Web and, secondly, the appearance of new unique genres appearing on the Web<sup>7</sup>. Both these phenomena have genres that divide, merge, transform and evolve. This is an important implementation issue that has to be taken into consideration because the genres have to be identifiable by all systems and perceptible to all users. One of the main challenges of this work is the collection of empirical data that can show how genres are interpreted by readers. At this point, an example of interpretation is helpful.


## **2.2.6 Interpreting Genre**

### **2.2.6.1 An Introduction to Interpretation**

An e-mail purporting to be from the United States tax authority enters an inbox.

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<sup>7</sup> A taxonomy of web genres are shown in Tereszkievicz (2010).

 **Summons**

In the matter of Ronald Weinland of [REDACTED]

Internal Revenue Service (Division): Criminal Investigation

Industry/Area (name or number): Southeast Area

Periods: 2004 through current

**The Commissioner of Internal Revenue**

To: Records Custodian for American Express and American Express

At: 200 Vesey St., New York, NY 10285

You are hereby summoned and required to appear before Special Agent S [REDACTED] or Designee  
 an officer of the Internal Revenue Service, to give testimony and to bring with you and to produce for examination  
 and other data relating to the tax liability or the collection of the tax liability or for the purpose of inquiring  
 administration or enforcement of the internal revenue laws concerning the person identified above for the period

**SEE ATTACHMENT**

Figure 2.2: Spam e-mail genre disguised as a 'Summons' e-mail genre purporting to be from US Tax office, namely the Internal Revenue Service (IRS).

The emboldened “*Summons*” headline and emboldened title of the sender, “*The Commissioner of Internal Revenue*”, along with the formal layout, shape and image as well as the formatting and layout of the content of the e-mail are all designed to scare the e-mail recipient into action, i.e., into revealing personal information.

The e-mail claims that the recipient is under criminal investigation and a similar e-mail/memo form is attached to name the person being summoned, i.e., from, to, address and subject header (in the matter of). The way that the information is presented in the Spam e-mail, that is, the formatting and layout used, can have a similar effect on the reader. Overall, whatever the medium the way information is presented has an effect (Frow, 2006b, p. 100). Frow (2006b, p. 100) based his semantic interpretation of such an e-mail on two questions:

*“First, what is it that’s going on here and, secondly, what kind of thing is this? The second question is about the genre of this e-mail, and when I have answered it, I can then answer the first question: I know what’s going on here.”*

When we perceive and interrelate with any object, in this context a book or textual document, we view in an “*unconscious*” (a misnomer in a real sense because in cognitive science, this is described as attention) or conscious sense for the elements of background “*information*” that are evoked by texts, generically shaped and specific (Frow, 2006b, p. 101). “*This is where the real complexity of texts lies*”, according to Frow. When viewing the texts, the reader cannot help but pay attention to the “*embedded assumptions*” and “*understandings*” (Frow, 2006b, p. 101). These attentive behaviours are structured by genre, specifically the “*frames*” and:

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*“The generic structure of [this] text is established, and many of these other dimensions activated, by a physical setting that takes on the force of a regulative frame. This frame differentiates the genre of this text from other possible genres, alerts us to the way it works (its rhetorical function), and draws our attention towards some of its features and away from others”<sup>8</sup> (Frow, 2006b, p. 9).*

Other scholars, like Frow, have also discussed theories of ‘Frames’, for example, Gardner’s model of eight modalities/capabilities, such as Visual-Spatial (Gardner, 1983) and Fillmore (1975); Minsky (1975).

Readers viewing text(s) are always involved or relate to the complete arrays of textual meaning. This is quite closely related to semiotic *“intertextuality”*, a term that is said to have been coined by the poststructuralist semiotician, Kristeva (1980). Theorists working in the field of intertextuality have suggested that the meanings of texts are shaped by preceding texts. For example, Devitt (1991) conducted a study on texts within a single community, i.e., tax accountancy, in which she examined: *“...how texts interact with past, present, and future texts...”*. However, intertextuality in the context of her study was used to widely:

*“...encapsulate the interaction of texts within a single discourse community, a single field of knowledge, and to enable the study of all types of relationships among texts, whether referential, generic, functional, or any other kind” (Devitt, 1991, p. 336).*

In other words, an author or artist refers to an earlier work and then converts a previous creation, which is subsequently referred to in the new text. As Beebee (1994) explains: *“The concept of intertextuality reminds us that each text exists in relation to others. In fact, texts owe more to other texts than to their own makers”* (Chandler, 2003). This gives rise to questions regarding the way that the reader is involved with genre and the purpose of the textual meaning. Beebee (1994, p. 250) states that *“...genre is the precondition for the creation and the reading of texts...”* and literary learning or academic research is secondary. Frow (2006b) extended Beebee’s idea, and claimed that that interpretation is led by genre due to the constriction of the process of signs (semiotics) and the *“production of meaning”*. In this and many other contexts, genre postulates the kinds of meaning that are suitable and pertinent in a specific situation or context.

Hirsch (1967, p. 76) as described by Frow (2006b, p. 101), explained that genre is not a set of texts or a list of the important *“...features of texts but an interpretative process called into being by the fact that ‘all understanding of verbal meaning is necessarily genre-bound.’”* Basically, when hypothesising on the genre of a text or on: *“...what kind of thing this is...”* (Hirsch, 1967, p. 76) the

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<sup>8</sup> For further detailed accounts of Frames see Frow (2006b, p.101-23).

guess stays the same until the initial interpretation is reformed because of an event which allows the viewer to re-evaluate the understanding of the meaning. Hirsch's explanation could be appropriately linked to the work pertaining to "*perceptual hypotheses*" by Gregory (2002) or, indeed, as this author likes to refer to it, '*perpetual*' perceptual hypotheses, where we are continuously trying to ascertain what an object or text is. Sometimes, even when an "*animal*" knows what an object is, the identification continues to be disputed.

Hirsch (1967) expressed the opinion that genre is an exposition of the "*kind-of-thing-this-is*" or a guess but this can lead to the reader being presented with the idea that "*...genre is not a property of a text but is a function of reading*". "*Genre is a category*" or classification that "*...we impute to texts, and under different circumstances this imputation may change*". Rosmarin (1985, p. 46) conjectures that: "*...genre is not, as is commonly thought, a class but, rather, a classifying statement*". These "*cues*" exist on the outside and internally of the "*frame*", and link the value and interdependence of perception and genre as follows (Frow, 2006b, p. 102):

1. Genre is neither located 'in' nor a property of texts.
2. Genre is neither located 'in' nor a projection of readers.
3. Genre exists as a part of the relationship between readers and texts, and it has a systemic existence.
4. It is a shared convention with a social force.

The internal cues "*...provide a set of continuing instructions on how to use a text*" (Frow, 2006b, p. 109). The imputations or hypotheses that we make about the applicable and related conventions to apply in a specific instance, or context, will direct our reading, controlling the progression it will take, and our expectancies of what it will lead to. However, they (imputations, hypotheses or conventions) are supported in the communities of practice in which genre has its social being: the institutions of classification in the broadest sense (Frow, 2006a). This thesis focuses on the effects of structural textual layout frames and cues, although an example of interpretation by content is also described (Frow, 2006a). The summons in Figure 2.2 was a simple example of possible textual interpretation by a reader which, as Frow explains, at the same time offers an explanation of the metacommunications process.

The cues (or metacommunications) of the frame offer the audience specific options with regard to the following questions:

1. How can I use the text?
2. What can I expect to occur at different stages?
3. What can I do if my expectations are not fulfilled?

The cues encountered can either be internal to the text or external: “...located at the margins of texts” (Frow, 2006a). There is clearly a relation between the frames described by Frow and Gardner (1983), because a frame in both contexts provides a structure of expectations, but this thesis concentrates on the frames described by Frow in order not to digress from the course of the review. Genette (1997) has highlighted examples of external cues (or paratexts) that surround a literary text, for example, the title, the foreword, name of the author, the figures or tables within the text (a list of cues and features along with related authors are shown in Table 2.1). All texts are accompanied by these types of cues which “*present*” the texts to the reader or ensure the presence of the texts in the world. This applies whether the medium takes the form of a book, a short piece of text or a movie.

#### **2.2.6.2 Interpreting by form**

Up to now, the structure that has been described has concerned the interpretation of e-mail (Figure 2.2) and content, but a similar progression of ‘structural interpretation’ is most likely used when viewing a textual form. As described in Paré & Smart (1994, p. 123):

*“Repeated patterns in the structure, rhetorical moves and style of texts are the most readily observable aspects of genre...”. “Thus, for example, one can identify individual components of a generic text, their usual sequence, and their common function or purpose. Covering letters or memos, title pages, tables of content, abstracts, introductions, problem statements, summaries, analyses of options, recommendations, conclusions and so on...”.*

Occasionally, however, a closer analysis is required for the interpretation of the genre just to make absolutely sure that what has been received is correctly classified, because some ‘spammers’ have developed ingenious ways of producing an evolving output that can get through any filters. For example, Cukier et al. (2006) conducted a close analysis of 300 e-mails over a time period of 15 weeks revealed the existence of many sub-genres of spam, consisting of many differing adaptations or a “*mish-mash*” of print “*forms*” replicated into digital format, such as “...*pamphlets, business cards, order forms, bulletins, advertisements and “Nigerian letters”* and so on. Cukier et al. thus established “...*that spam exploits genre by conforming to known forms while at the same time breaching those norms*” (Cukier et al., 2006, p. 69).

In the academic community, the layout of conference papers, journal papers or calls for papers

(Figure 2.3) have their own particular frames and interpretative cues. Depending on which cue gains the attention of the perceiver at first view, each subsequent cue will be interpreted, whether it is the whole textual shape, centred title, abstract, list of dates or bullet points and so on.

<p>-----          2007 International Workshop on Spatial and Spatio-          Temporal Data Mining  <a href="http://spatial.nvc.cs.vt.edu/sstdm07">http://spatial.nvc.cs.vt.edu/sstdm07</a>          -----          Call for Papers          -----          October 28, 2007          Omaha, NE, USA          In cooperation with IEEE ICDM 2007</p> <p>Widespread use of sensor networks and location aware devices has resulted in large amounts of spatial and spatio-temporal datasets in a variety of domains. The number and size of these datasets continues to increase rapidly, making their manual processing impossible. It is therefore, imperative that efficient and effective techniques are developed to extract useful information from these datasets. Traditional data mining techniques are ineffective in the spatial domain since they don't incorporate the special features of the spatial domain, e.g. spatial autocorrelation. The goal of the workshop is to bring together researchers, developers and practitioners in the field of spatial and spatio-temporal data mining together in order to identify current research foci, vital areas of need, and critical points of synergy. Selected papers will appear in the GeoInformatica journal as a special issue.</p> <p>TOPICS OF INTEREST</p> <p>Topics of interest include but are not limited to:</p> <ul style="list-style-type: none"> <li>• Theoretical foundations of spatial and spatio-temporal data mining</li> </ul>	<ul style="list-style-type: none"> <li>• Novel techniques for spatial and spatio-temporal data mining</li> </ul> <p>PAPER SUBMISSION</p> <p><a href="http://wi-lab.com/cyberchair/icdm07/scripts/ws_submit.php">http://wi-lab.com/cyberchair/icdm07/scripts/ws_submit.php</a></p> <p>IMPORTANT DATES</p> <p>Submission deadline: July 6, 2007          Notification of acceptance: August 6, 2007          Camera-ready version: August 17, 2007          Workshop date: October 28, 2007</p> <p>ORGANIZATION COMMITTEE</p> <p>Ashok Samal, Chang-Tien Lu, Shashi Shekhar</p>
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**Figure 2.3:** Call for papers: e-mail example.

### **2.2.7 External and Internal Textual Cues**

The internal and external cues that accompany or surround a text provide the viewer/reader with information about the kind of text that it is, and about the generic frame of the text. Two examples of the metacommunications that stand out well in a generic frame are the punch line in a joke and, as Frow says, a moral appended to the end of a fable. *“What we notice reinforces our sense of the kind of thing we’re reading, and this in turn activates for us the relevant ranges of information that we need in order to read it well”* (Frow, 2006a).

Miller described genres as *“typified rhetorical actions based in recurrent situations”* (Miller, 1984, p. 159). As Frow points out, however, there are non-typified rhetorical occasions when the utilisation, possibilities and meanings of the different cues either confuse the reader or are not clearly understood so that the cues do not always lead the reader to full comprehension of the text. This depends on the nature of the text and/or the expectations of the reader.

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Two useful categories of cues are “*Signaling Devices*” (Lorch, 1989) and “*Landmarks*” (Heffron et al., 1996). Signaling devices are text devices that “*emphasize aspects of the structure or content of the text, such as topographical features, titles, headings, etc.*” (Lorch, 1989; Toms, 1997, p. 184). In some instances, the semantic cues, such as words or phrases, provided by ‘Landmarks’ directly influence the direction in which the information seeker scans for information or may trigger a decision of relevance to change the search strategy (Toms, 1997, p. 184). Both Signaling Devices and Landmarks play a large part in the interpretation of texts and are potentially useful for categorisation and IS & R.

## **2.2.8 Concepts and Features of Genre in Communities of Practice**

### **2.2.8.1 Introduction - Shallow and Deep Features of Genre**

Genre holds considerable potential benefits for organisations, both financially and administratively, because it allows automatic and rapid information retrieval without the need for manual organisation and sorting. In particular, the sorting and filtering of e-mails and files held on internal servers can benefit large organisations by improving their operational capability and reducing time-consuming tasks. Two types of communication areas have been identified in which different types of genre occur: Wikipedia and e-mail collections. Two types of conceptual features, shallow and deep, have been identified within these domains.

#### **2.2.8.2 Shallow Features**

Several underlying concepts are persistent in genre definitions: the style, functionality, form and content of the document (Table 2.1). Web genres incorporate the style, form, and content of the document which are often considered as orthogonal to the topic of a document (Dimitrova et al., 2002; Finn & Kushmerick, 2003, p. 1509).

These four concepts are probably applied most consistently within NLP and CL circles. Taking style, form, content and function into consideration, there are hundreds of features that can be measured and the normal practice is to group them as feature sets. Examples of features could be whitespace and formatting (form), readability (style) and terms (content). Some documents do, of course, provide visual markers that allow the reader to conceptualise the format. Toms & Campbell (1999a, p. 2008) suggested that the conceptual features consisted of “*a set of distinct facets or layers*”, function, form and interface. The function is:

“*...the semantic content of the document as represented by the meaning of the words in the text*”, the



form is “*the visual appearance of the document, its structure, as manifested by its specific formatting and layout*” and, finally, the interface is “*the means by which the document is accessed and used, and the portal through which it is examined.*”

Documents contain distinguishable features, such as patterns, which allow the reader to identify the documents’ purpose and content, for example, a call for papers typically displays centred text at the top containing the date, location, etc., and below this, many bulleted lists showing the topics of interest, etc. The reader expects to locate a set of features which belong to the form (structural or layout) concept (a small selection is shown in Table 2.1).

The application of ideas to examine these conceptual features shows that many pieces of the genre classification research works being reviewed here fit with the concepts that Toms & Campbell (1999a) describe, including others, such as style (Table 2.1).

**Table 2.1: Concept examples of style, form, content and functionality**

<b>Concept</b>	<b>Small Selection of Feature Examples</b>
Style	Readability and Part-Of-Speech (P-O-S) statistics (Boese, 2005; Boese & Howe, 2005b; Finn & Kushmerick, 2003; Finn et al., 2002; Karlgren, 1999; Stamatatos et al., 2000a; Stamatatos et al., 2000b).
Form	Text statistics, whitespace, and formatting tag analysis (Boese, 2005; Boese & Howe, 2005b; Clark, 2005; Clark & Watt, 2007; Kennedy & Shepherd, 2005; Shepherd & Watters, 1998).
Content	Numeric types, Words in URLs & HTML title tag, punctuation, n-grams, Terms, B-O-W, closed-world sets (Boese, 2005; Boese & Howe, 2005b; Kennedy & Shepherd, 2005; Pritsos & Stamatatos, 2013; Stamatatos et al., 2000b).
Functionality	Number of links in a web page; number of e-mail links (Boese, 2005; Kennedy & Shepherd, 2005; Shepherd et al., 2004).

Content can be analysed by examining punctuation symbols, such as ; or ?, Closed World Sets; such as, Dr, Mr, Mrs or emoticons; or Bag-of-Words (B-O-W) in which “*a document is encoded as a feature vector, with each element in the vector indicating the presence or absence of a word in the document*” (Finn & Kushmerick, 2003, p. 1516). Style context systems include categorising document genre by punctuation frequencies or readability. For example, the document might use colons and semi-colons for elongated sentences, use long and/or conjunctive adverbs, such as ‘nevertheless’ and ‘otherwise’ or ‘indeed’, and are written in complete sentences.

Additionally, Parts-of-Speech (P-O-S) statistics could be utilised, for example Finn & Kushmerick

(2003); Finn et al. (2002), used P-O-S statistics which reflected the style of the language sufficiently to categorise different types of genre. Each text was denoted as a vector of Part-Of-Speech features (36 in total), one for every P-O-S identifier, articulated as a percentile of the sum total amount of terms contained within the textual document (Finn & Kushmerick, 2003, p. 1517).

With regard to form, the features to be examined here could include text statistics and XML analysis of the tag structure (Clark, 2005). The text statistics within the document could measure the number of words in a section and the number of paragraphs. There are, of course a multitude of additional features which could be included (Table 2.1) and these, it could be argued, belong to content, style, form and functionality; such decisions are subjective though. For example, Levering et al. (2008, p. 136) in their classification study, examined “*Visually Central Features*”, amongst others, which could be labelled as form or as content since they were looking at the positional information of normal textual content in a web page.

### **2.2.8.3 Deep Features**

Deep parsing methods to test whether genre could be useful for skimming texts by exploiting structural and layout cues and parsing the texts and matching the features by scripts c.f. FRUMP (Fast Reading, Understanding and Memory Program) and FERRET (Flexible Expert Retrieval of Relevant English Text<sup>9</sup>) by DeJong (1982); Mauldin (1991) respectively (Sections 2.6.3 and 5.5). The models and techniques can also be implemented in skimming for deep features by looking for phrases, local context and so on. Deeper genre rules and patterns which demonstrate the form and purpose of the genre were not considered in the works by DeJong (1982); Mauldin (1991).

A problem, identified by Riloff & Lehnert (1994) identified one particular problem with a system such as FERRET, pertaining to the fact that the implementation of the system requires a large explicit knowledge base, for example, rule base, semantic networks, patterns, or Mauldin’s case frames (FERRET); these, in turn, require a large amount of manual knowledge engineering which is a monotonous labour-intensive task. In the case of FERRET, the knowledge base of five scripts required 40 hours of manual labour by a graduate student. The skimming technique should, in theory, dovetail neatly with the frames theories, such as those introduced by Paltridge (1994, 1997), Frow (2006a) and the definition of genre for this thesis.

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<sup>9</sup> The parser incorporated within FERRET was named: McFRUMP

### 2.3 Thesis Definition of Genre

In the context of this thesis, the term, form, refers to the framed set of structures, such as formatting and layout, which show the user the documents' genre (Figure 2.4), regardless of or in addition to the topical or linguistic nature of the writing. However, purpose has not been totally discarded since this, in some cases, for example, e-mails, is very important.

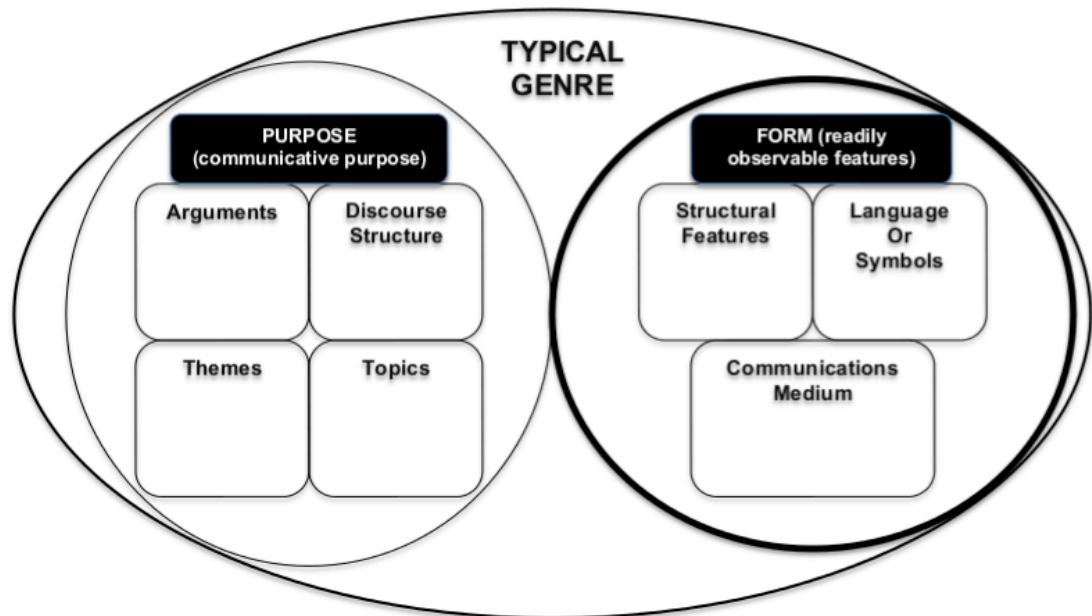


Figure 2.4: Definitions and attributes of genre framework (Purpose and Form) originally listed in Orlikowski & Yates (1994); (Yates & Orlikowski, 1992) and shown here in diagrammatic form.

What are purpose and form? Miller (1984, p. 152) delineates a semiotic framework, the properties of which are "*rhetorical*", the substance, "*semantics*", and form, the "*syntactics*". Form, in the context of this thesis, is closely related to Miller's definition, and simply refers to the easily perceptible features of the communication, such as those found in calls for papers, which include:

**Structural Features:** text formatting devices such as lists and headings, and devices for structuring interactions at meetings, such as agendas and chairpersons.

- **Communication Medium:** pen<sup>10</sup> and paper, telephone, or face to face.
- **Language or Symbol System:** linguistic characteristics, such as, the level of formality and the specialised vocabulary of corporate or professional jargon.

The purpose of the genre refers to the communicative purpose, in particular, the social motives, themes and topical nature assembled and perceived in the communicative genre, for example, the

<sup>10</sup> Toms & Campbell (1999a) compared Paper versus Digital documents.

purpose of a shareholders' meeting is to present the company's past accomplishments and future outlook to stockholders; a curriculum vitae is intended to summarise an individual's educational and employment history for a potential employer<sup>11</sup>. Orlikowski & Yates (1994); Yates & Orlikowski (1992) originally devised a very useful method of textually oriented organisational genre analysis using the six questions: who, what, where, why, when and how. This was later implemented by Marlow (2006) when he investigated the genre of technical communication (trouble ticket).

Although the definition of form and purpose that is described above may only look like a static method of classifying or categorising genres into groups or types, this was not the case in this thesis. In addition, the thesis also embraces genre being perceived as a “*socially embedded act*” (Thayer, 2012, p. 7) “*...as action rather than form, as text-type that **does** something rather than **is** something...*” (Devitt, 1996, p. 606) and this dovetails neatly with Gibson’s ecological theory or the ‘perception for action’. However, it is contended here that genre is perceived as *action* and *form* and **does** and **is** something. Indeed, as will be shown in Chapters 4a & 4b, this study also looks at the evolutionary dynamism of genre and the ‘actions’ that result from this.

## **2.4 Summary**

The next section describes the Information Retrieval and Information Seeking Behaviour communities. The IR community have sporadically contemplated and published work on genre on the margins of the discipline (Brooks et al., 2006; Muresan et al., 2006). However, the Information Seeking/Social Library Science community has remained mainly open-minded and has become aware of other potential areas of research which can be embraced and be of benefit, i.e., genre. The next section highlights IR and the IR Interaction, Seeking and Behaviour fields and what the domains could do to gain some improvement.

## **2.5 Information Retrieval Interaction, Seeking and Behaviour**

According to Borko, Information Science:

*“...investigates the properties and behavior of information, the forces governing the flow of information, and the means of processing information for optimum accessibility and usability. It is concerned with that body of knowledge relating to the origination, collection, organization, storage, retrieval, interpretation, transmission, transformation, and utilization of information”* (Borko, 2007).

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<sup>11</sup> A full overview of genre key issues and definitions can be found in Boudourides (2001) excellent and thorough literature review.

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Although the above-quoted defining paragraph by Borko can be seen as directly related to genre, the nouns in the second sentence are obviously of particular significance.

### **2.5.1 Information Retrieval & Seeking**

IR is not easily defined in an educational or academic sense. A summation of the topic IR into small parts is no easy feat, since it has many linked and interrelating domains, such as Machine Learning (ML), Information Extraction, Categorisation, and so on.

IR analysis of documents has traditionally been based on the indexed content of documents using statistical occurrence of common terms. The typical task for the operator is to form and input queries into a search device, for example, a library search engine. The device will then attempt to match the input query to a set of web pages, images or whatever data collection has been searched. Once matched, the search engine will display the results in ranked order (van Rijsbergen, 1979). There are many problems to resolve in IR, such as how to find and display the results with the highest 'relevance' to users' needs, in the form of text, images or another problem: word ambiguity<sup>12</sup>. As a result, searching by entering queries into a search engine has been perceived as the most notable aspect of IR and, since about 1950, has been given the most recognition. One early 20<sup>th</sup> century invention was Emanuel Goldberg's automatic document retrieval machine (photoelectric microfilm selector) or "*statistical machine*", which was patented in 1931 (Buckland, 1992). If a layperson were asked to define IR, then 'searching for information' would arguably be the reply, whether this referred to searching for files on a desktop, e-mails from a client, such as Outlook, intranets with a '*home made*' search client or the World Wide Web (WWW) with Bing or Google. However, the typical infrastructure for a search system is (Figure 2.5):

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<sup>12</sup> Words can have many meanings, such as "Jaguar", can be a aircraft, mammal, car brand and so on.

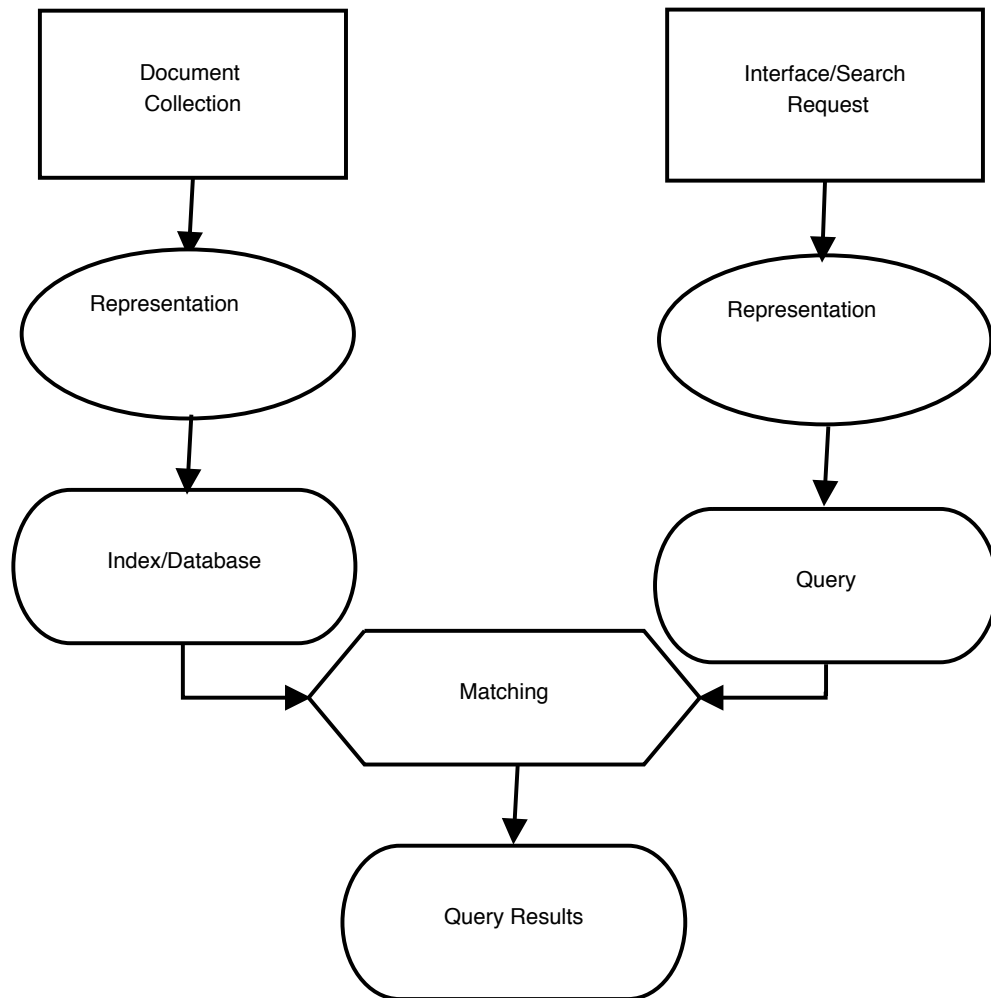


Figure 2.5: Typical IR model (edited). Original appears in Ingwersen & Järvelin (2005)

At the retrieval stage, IR systems often deal with documents and queries, where “*queries are statements of information needs*”. For example, a patent search engine (Hunt et al., 2007) would be used by the patenting lawyers for searching (extremely thoroughly) for existing patents that are similar to the current application in front of them. These patent queries are presented to the IR system and are matched to documents’ representations stored in an index. The results of the query, which are usually ranked, are finally displayed to the user. Relevance results in the ranked results are ranked by precision and recall metrics and averaged in terms of a binary value, i.e., between 0 and 1, which reflects the quality of the retrieval system in retrieving relevant documents. The documents in these systems are data objects and are internally represented or modelled. The details of many IR models are profoundly theoretical in a mathematical sense. The models are set-theoretical (Boolean, fuzzy etc.), algebraic (Vector Space, Latent Semantic Indexing (LSI) etc.) and also probabilistic models (Binary, Language Models etc.), “*Retrieval models form the theoretical basis for computing the answer to a theory*” (Fuhr, 2001, p. 21) but it is beyond the scope of this project to

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describe them here in great detail<sup>13</sup>. The system developers, however, were confronted with the problem of finding a way to evaluate IR systems, and their efforts to deal with this challenge resulted in the development of the Cranfield experimental research setup, reported in Cleverdon (1967). The archetype set out the methodology for evaluating IR systems (Figure 2.6). Evaluation is essential because the user needs to determine whether a system is suitable and effective and, for this purpose, has to compare different systems. The evaluation processes also assist in re-assessing all relevant terms and functionality, such as weighting, selection and ranking. The effective evaluation of IR experiments involves many different dimensions and types of performance measurement, such as *Precision* and *Recall*. In addition to Cranfield, the System for the Mechanical Analysis and Retrieval of Text (SMART) was developed at Cornell University (Salton, 1971, 1991). This system, in particular, integrated the CRANFIELD paradigm (Figure 2.6) within its infrastructure and examined such things as *Relevance Feedback* using the *Algebraic Vector Space Model*.

In particular, system developers were asked to produce topics from the test collection, in which queries were derived from the topics, and relevance assessments. The Text REtrieval Conference (TREC) used 'experts' to produce so-called independent relevance assessments, but this, in reality, was held to be slightly controversial in some circles<sup>14</sup> of Information Science since relevance is subjectively determined by the searcher alone and a wide range of issues, such as user behaviour, cognition and context are not taken into consideration.

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<sup>13</sup> For further information on models in IR, see Fuhr (2001, pp.21-50).

<sup>14</sup> See objections below and in Ingwerson & Järvelin (2005, p.313).

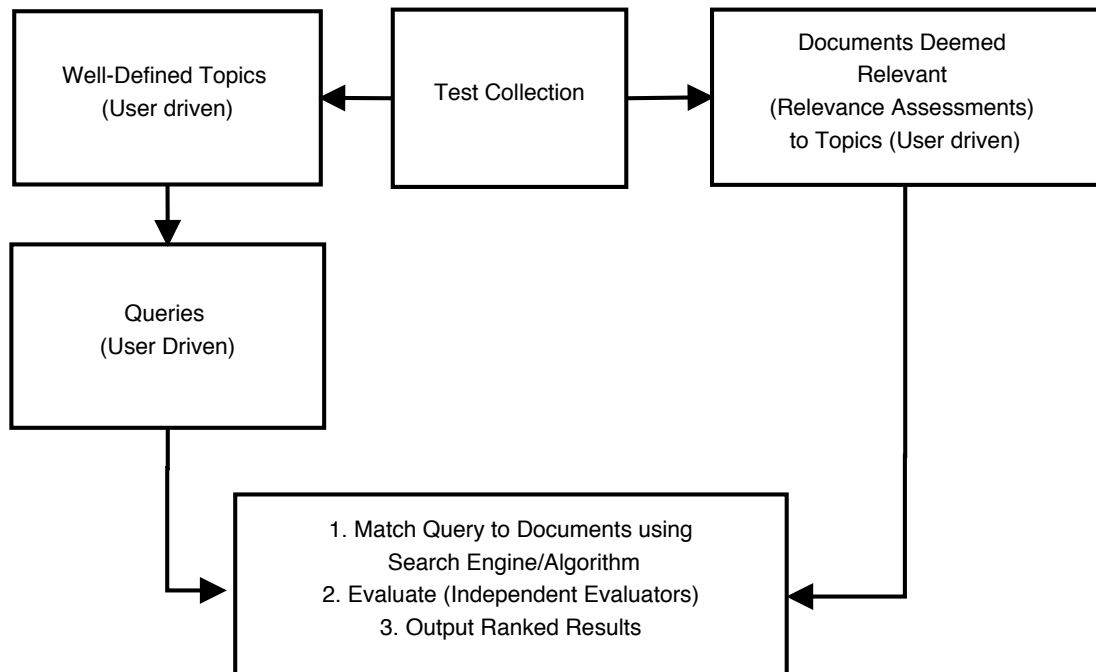


Figure 2.6: The Cranfield Paradigm.

There is a dominance of the Cranfield (Figure 2.6) and SMART paradigms which have been labelled under many names, such as Laboratory IR, (Ingwersen & Järvelin (2005, p. 186), system-oriented (Fuhr et al., 2008), and system-centred (Saracevic, 1999, p. 1057). Research has been based normally around modifications of algorithms and then evaluation is conducted by academics in computer science departments and then presented at the TREC/INEX conference<sup>15</sup>.

The proponents of information seeking in the context of the users' behaviour, cognition, and interaction with information systems are mainly situated in academic institutions, departments of information science and libraries (Cool & Belkin, 2011) or as Ingwersen & Järvelin (2005, p. 2) state "*...Information Seeking is rooted in Social Science with a background in Library Science*". The advocates of information seeking in the context of cognitive models formulated ten objections to Laboratory/Systems IR, and the six which are most relevant for this thesis are presented below (Ingwersen & Järvelin, 2005, pp. 6-9):

1. **Objection 1- Lack of users and tasks:** no real users, tasks, situations or contextual task information considered within the Laboratory Model, which is based on judgements by "*objective*" assessors, for example, TREC evaluation.
2. **Objection 2- Lack of interaction and dynamic requests:** real interaction involves user

<sup>15</sup> The work presented at TREC/INEX is not peer-reviewed.



learning, problem redefinition and dynamic relevance in contrast with batch mode evaluation.

3. **Objection 5- Lack of user-oriented relevance:** tests are centred on algorithmic/topical relevance. As a result, the user's situation, tasks and state of knowledge are not taken into account, c.f. Belkin & Kwaśnik (1986) Anomalous States of Knowledge (ASK) .
4. **Objection 7- Assuming document independence and neglecting overlap.** There are unrealistic assumptions regarding document independence (some may be relevant only if juxtaposed) and user saturation (repeated reproduction of very similar "relevant" information results in irrelevance in real-life situations).
5. **Objection 8- Insufficiency of recall and precision:** the recall and precision metrics are not sufficient as evaluation measures, particularly because recall is often totally irrelevant to the user and is more system-oriented, but also because the metrics do not describe the users' attainment in information problem elucidation.
6. **Objection 10- Merely document retrieval:** Laboratory IR is merely document retrieval, where little attention is paid to document/information presentation or use (for example, genre).

All these objections are particularly important when it comes to understanding how genre can be utilised by users of systems when they are searching and seeking for information. All the previously named 'factions' in IR could benefit from genre by simply attending to the objections when they are indexing documents, user queries, tasks and so on.

### ***2.5.2 Information Interaction/Behaviour and Seeking***

Ingwersen & Järvelin (2005) issued a challenge to other Laboratory IR researchers who wanted to extend the IR paradigm to include user-centric research: they proposed building a bridge between the two different groups of proponents, namely, Interactive IR and the work in this direction is still on-going, despite the fact that the idea of a bridge has not been greeted with open arms. In all these fields within user-centric and system-centric research, most of the research funding is allocated to the latter, and user-centric research, it could be argued, only receives minimal funding with which to maintain an existence, particularly in comparison with commercial researchers, for example, such as Google and Microsoft. However, attitudes are slowly changing, for example, the rising importance of such symposia as *Information Interaction in Context (IliX)*.

User-centric research in the context of this thesis is focused on Information Seeking and

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Behaviour along with Cognition (Ingwersen & Järvelin, 2005). There are many definitions of Information Seeking and Behaviour or as Vakkari (2005) prefers to describe it, information searching. Vakkari (2005, p. 414) highlights the following components in searching:

- The kind of information that is needed and searched for
- The query formulation process, including the choice of search terms and operators
- Search tactics
- The use of search support tools
- Relevance and utility judgments regarding the information found.

User studies of human behaviour in IR have also been gaining prominence. These look at ways of monitoring users' behaviour, the design of studies and task complexity, for example, Collaborative Information Seeking (CIS) (Hansen & Järvelin, 2005), Contextual IR issues (Ruthven, 2011), Human Computer Interaction Retrieval (HCIR) (Borlund, 2003), eye tracking (Granka et al., 2004; Joachims et al., 2005) and Cognitive IR (Ingwersen, 1996).

In Laboratory IR, formatting and layout of text from documents is typically stripped out and stored in an index or database. First of all, investigating the features of layout and structure along with the modelling of human interactions with information can be useful. As Freund (2013, p. 1111) states: "*...far fewer studies have been conducted on the effect of genre on information behaviour...*". This thesis emphasises the importance of maintaining the textual format by not discarding the documents' original form and layout, and by modelling and understanding users' behaviour during any skimming, scanning and categorising processes involved in gaining textual information during IS. In order for the research questions to be answered, a thorough understanding of the useful, prominent features of the textual information is crucial for the user studies.

One important aim of this thesis is to examine the skimming and scanning processes in order to see how such reading techniques feature in the search behaviour of searchers when they are engaged in information seeking. Definitions of the skimming and scanning processes, along with previous works in these areas, including some user-related studies, are presented in the next section, which also includes a sub-section on IR, NLP and AI studies involving skimming and scanning.

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## ***2.6 Text Scanning and Skimming***

### ***2.6.1 Scanning & skimming defined***

Two techniques, skimming and scanning, are used for searching a stimulus, such as text or imagery, at speed. Scanning is a technique that is used when a reader is looking for something, such as a keyword or key phrase: readers move their eyes over the text mostly horizontally and sometimes consciously fixate on the stimuli while looking for content; this process, in essence, demands the full attention of the reader, so the duration and length of the scanpath will be greater. Scanning (see Figures 4.12, for example) is usually employed by a reader who is looking at words, numbers, or letters, for example, by a student who is looking for a definition in a dictionary, a phone number in a telephone book, or a bus-schedule on a timetable. It is conducted at a faster speed than normal reading (Rayner, 1998, 2009). Sometimes, the formatting of words (in italics or in bold) assists the reader to identify the object of the scanning.

Skimming is a technique which a reader uses to identify the main points or essence of a text without consciously taking in every word; this requires less attention (cognitive activity, i.e., less fixations (counts and durations) and negligible saccadic regressions) and can be indicated by vertical movements rather than horizontal on the part of the reader looking at English texts from right to left (see Section 3.2.4 for details of how the data was processed). A reader can also use this technique in order to decide whether a text is interesting and worth further reading. It is performed at a speed several times faster than usual and is normally employed when a reader has a large amount of text to read within a limited time and does not need to understand every word, for example, when a student has to perform a literature search, an abstract could be skimmed to judge whether a particular article would be useful/relevant for the current research.

Many consider skimming and scanning to be techniques related to searching as opposed to strategies for reading, for example, Just & Carpenter (1987). Cole et al. (2010) showed in his user study, the ways in which people switch between skimming and reading behaviours as inherent indicators of their current type of task. In fact, they are two separate strategies that are useful for research in both areas, but reading and searching are two different contexts. In the context of this research, the visual searching of text and not reading per se will be examined.

Scanning and skimming are two separate processes that substantially benefit such areas of research as reading and searching. Scanning, as described in Treisman & Gelade (1980) and cited in

Liversedge & Findlay (2000, p. 7) is utilised for “...more demanding tasks required a sequential attention scanning of elements. This scanning has often been assumed to be covert, using a ‘mental spotlight...’”. The mental spotlight, or as Treisman & Gelade (1980, p. 133) state the: “*spotlight of attention*”, is quite a helpful analogy to describe a task, such as searching for a keyword etc. Masson (1983) describes skimming “*for most of us, rapid reading involves some form of skimming in which we try to focus on information relevant to our goal and skip over irrelevant information*”.

Masson also suggests that skimming in the task that was set for his participants involved ascertaining the “*selective processing of the gist*”. Holmqvist et al. (2011) suggests that a “...sequence of long saccades is likely to reflect skimming over the text”. Treisman & Gelade (1980, p. 99) cited in Liversedge & Findlay (2000, p. 7) argued that, *some simple search tasks might be accomplished by preattentive processes*”, i.e., skimming.

The reasons for deciding when, where and in which context to move the eyes are dependent on many different variables, e.g., the search task type; context, such as urgency of task, tiredness, age and interest in task. As Rayner (2009, p. 1484) points out, equivalents between scene perception and visual search are more appropriate than with reading and comprehension because “*visual saliency plays a greater role in directing fixations*”. By way of example, a search for a pack of nappies on a supermarket shelf amongst a huge quantity of products or a search within a large illustration for a particular character (e.g., Where's Wally) or for a word in an e-mail may well generate strategies that differ greatly from those used during the processes of skimming and scanning a text for a word. In each case, different ocular behaviour would be expected. Many readers look only at the abstract, the title, the first and last paragraphs, or even only the keywords. One main contention of this research is that an important aspect of the document structure, i.e., the form of genre, is understated when considering the ocular behaviours in previous reading detection, skimming and scanning and comprehension experiments, for example, Just & Carpenter (1987); Just et al. (1982b); Masson (1982, 1983).

### **2.6.2 Skimming and Scanning - User Studies**

Many methodologies and algorithms have been devised for the detection of reading processes: first of all, data is collected to establish a baseline or ‘ground truth’, and then these results are compared with other data to detect skimming, scanning or both these activities, for example, Campbell & Maglio (2001), Buscher et al. (2008b) and Buscher et al. (2008c). The definitions of scanning and skimming used by these authors may, however, differ slightly, for example, in

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Campbell & Maglio (2001) skimming is defined as cognitively “*medium interest*” and scanning as “*low interest*”. The studies which follow in Chapters 3 and 4b argue that during skimming, saccades are mainly used to take a holistic view of the stimuli being presented, during which the Short Term Memory (STM)<sup>16</sup> is low due to the suppression of cognitive activity, i.e., saccades and vice versa.

Many user studies have been carried out that are based on skimming (also referred to as speed-reading), for example, Just & Carpenter (1987); Just et al. (1982a); Masson (1979, 1982, 1983). However, as Just & Carpenter (1987, p. 428) point out, these studies have sometimes been of little use due to the lack of comprehension testing or poor control conditions afterwards, for example, Rauch (1971) cited in Just & Carpenter (1987) reported fairly high and implausible comprehension scores for participants who quite obviously had not read the passages.

Nevertheless, several such studies have obtained promising results by looking at the “*phenomena*” and comprehension testing. Firstly, the study by Just et al. (1982a), extended in Just & Carpenter (1987), recruited some control group participants, ‘speed readers’ and “*normal readers*”, who were each taught how to measure their reading speed using the “*hand as a pacer method*”. The participants were also taught how to make fewer fixations during reading and how to use prior comprehension to arrange the information that was being read. The “*speed*” readers were asked to skim-read the provided texts (circa 600-700 Words Per Minute (WPM)) and the “*normal*” readers, to read at their normal speed (circa 250 WPM). The results were analysed by means of post-reading tests, and these showed that the performance of the two types of readers was the same with regard to answering questions on the meaning of the text or their general level of comprehension. However, other findings were reported (Just & Carpenter, 1987):

- Speed readers were unable to answer questions if they had not fixated upon the location of the answer
- Normal readers that indicated fixations with a greater density than that of the speed readers were capable of providing a comparatively satisfactory answer to the given questions
- An analysis of the normal readers’ and speed readers’ text skimming “*comprehension measures*” and ocular behaviour patterns showed similar results for both control groups.

The study reported in Rayner (1998) and Just et al. (1982a) showed that, firstly, the participants had really only skimmed the text and had not digested every single word during the reading tasks.

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<sup>16</sup> For more details on STM and Attention see Section 5.4 Future Work.

Secondly, Just & Carpenter (1987) conducted four far-reaching experiments which examined the ability of the participants to comprehend and remember the textual stimuli when carrying out text ‘scanning’ tasks. The speed-readers were compared with participants who skimmed and also only read the text “*normally*”. The participants were asked to read texts consisting of between 400-1000 words, after which the participants’ “*recognition memory*” performance was tested (Masson, 1982). The authors argue that the speed-readers have an advantage over “*normal*” readers due to conceptual-level processing rather than perceptual. In other words, they use more top-down processing (using previous knowledge) than bottom-up (perceiving words and sequences of words) than ‘normal’ readers. Masson (1979, 1982) reported four experiments on memory recognition (reading comprehension) during the skimming (at different speeds) of texts consisting of between 400-1000 words. The speed-reading was controlled and manipulated, firstly, by experimenter instruction(s) and then in the remaining three tests by the use of a time-controlled methodology.

The purpose or meaning of text was assessed by asking the participants to judge whether the test statements consistently contained information. The statements insinuated that the test texts contained information that was either “*important*” versus “*unimportant*” or required participants to make an interpretation using information contained within the text. Masson, like Just & Carpenter, concluded that the participants used conceptual selective processing to understand the gist of a text.

### **2.6.3 Skimming IR, NLP and AI Studies**

Important early research on skimming texts was carried out by Just et al. (1982a) and Mauldin (1991), who worked in NLP and IR domains respectively, but these were all focused within narrow domains; the research in this thesis targets broader domains, such as e-mails and Wikipedia, looking at naturally structured documents which are created through social consensus. DeJong (1982) used only the positional content which was skimmed without taking the **structure** and **layout** into account; it could be argued that this was a costly oversight regarding accuracy. The infrastructure of DeJong’s system had two integral interlocking modules: the “*Predictor*” and the “*Substantiator*”, which worked together: the Predictor looked for a particular piece of information and then the Substantiator tried to find a match from the word array.<sup>17</sup>

FRUMP, an AI implementation, was “*fed*” newspaper stories from the United Press International (UPI) news wire and then asked to analyse and understand them, i.e., understand the gist. According

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<sup>17</sup> This is only a simplified description of FERRET; for a more detailed description of this complex system, see Mauldin (1989) and Mauldin (1991).

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to DeJong, Frump successfully managed to actually understand 10% in total of the stories, requiring a mean of 20 seconds per story. According to DeJong cited in Mauldin (1991) FRUMP is potentially capable of understanding up to 50% of the news stories. Mauldin's system, the FERRET has three main modules:

- the text parser derives from FRUMP and is aptly named McFRUMP,
- the case frame matcher,
- the query parser.

The structure of FERRET is similar to the classical IR infrastructure with McFRUMP embedded within the architecture. The system operated by skimming textual inputs with the aim "*...to determine their main themes without slogging through each and every word*" (Mauldin, 1991, p. 350). In simple terms, the texts and queries are parsed and the Predictor/Substantiator attempts to "*understand*" the input text and comprehend the "*story*" (Mauldin, 1991, pp. 350-1). Mauldin's FERRET used 22 user queries, using typical Boolean keywords, on a text collection produced from 1065 documents originating in the astronomy domain. He reported that Precision increased from 35% to 48% and Recall from 19.4% to 52.4% which is a significant improvement.

There is a need for research methods which are able to extract and classify information from whole documents consisting of single or many pages as well as from individual sections of texts. Wilkinson, for example, exploited section-types, such as abstracts and summaries, although in Wilkinson's case these were pre-labelled (Wilkinson, 1994, p. 316). In contrast to the usual document collections, or bags of words, here it is proposed how the retrieval can be accomplished solely by focusing on structural items, such as lists, tables, abstracts, footnotes, centred and emboldened amongst other conceptual features.

In this section, approaches to Genre, IS Behaviours & R, NLP, AI and skimming and scanning have been discussed. The studies mentioned here have one weakness in common: none of them has measured the influence of genre. Too few research studies have been guided on the outcome of genre on information-seeking behaviour and awareness of the significance of this is growing (Freund, 2013). Masson (1982) or Duggan & Payne (2009) could have used different representations of genre instead of text sizes or Mauldin (1991) could have implemented research into frames (much like those described by Frow (2006b); Paltridge (1997)) could have looked at text representation, such as form, and used the system to interpret textual genres.

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## 2.7 Theoretical Visual Perception

### 2.7.1 Introduction

Some acquaintance with the literature on cognition and how human beings visually perceive information is crucial to our understanding of the ways in which human behaviour, genre and the exploitation of structured text can benefit IS & R research. This section provides information on theoretical visual perception which links to the research on information seeking and genre presented in Section 2.8.

The studies in Chapters 3-4b all aim to collect and examine any evidence of the following perceptual theories during the categorisation and information seeking tasks described later in this thesis. The eye behaviours can offer clues as to which 'type' of perception is aligned with ocular behaviour in eye tracking, which will be described in Section 2.9.

Perception, as argued by Norman (2003, p. 73), calls "*...for a broader definition where perception is seen to encompass both conscious and unconscious effects of sensory stimulation on behavior*". However, it should be pointed out that the terms 'conscious' and 'unconscious' used by Norman (2001, 2003) and others are potentially misleading, since these are part of medical terminology. In this context, 'awareness' and 'processing' without any awareness or below awareness level would be more appropriate terms. In general, it may be believed:

*"...that the constructivists view perception as a conscious..."* (processing without any or with minimal awareness) *"...interpretation of the proximal stimulus..."* based on *"a comparison of it with some stored representation"*. *"The ecological view, on the other hand, is that perception is the direct pickup of information about the ambient environment, a process that is not necessarily conscious"* (no processing with heightened awareness) (Norman, 2001, p. 137).

As Pike & Edgar (2005) point out, perception for recognition and perception leading to action are different mechanisms which may involve different neural processes. That said, it might sometimes be desirable to get in the way of an object: for example, if a cricket batsman times a shot badly and edges the ball to second slip, the man at slip will need an entirely different perceptual mechanism to that required by a policeman having an unexpected object thrown at him during a riot, that is, recognition of the threat posed by an empty bottle.

The Ventral system (Table 2.2), in simple terms, is normally aligned with the constructivist faction said to have been founded by Helmholtz (1866, 1968), but can be traced back as far as the



12th century (Rock, 1977), whilst the Dorsal system (Table 2.2) is aligned with the ecological movement founded by J. J. Gibson (1986b) and later with his wife E.J. Gibson (2000). As already mentioned, the two main factions in visual perception theory are the ecological, such as Michaels & Carello (1981); Stoffregen (2000); Chemero (2006) and the constructivist, such as Rock (1977). Both claim ascendancy for their own particular beliefs. The ecological school believes that we perceive in order to act and the constructivists assert that we perceive for recognition. It is worth noting that some scholars, such as Goodale & Milner (1992); Goodale & Milner (2006); Norman (2001, 2003) have tried to reconcile the two groups, maintaining that perception is a dual process and that the two systems are complementary as well as important in their own right.

The fierce debate on the Two Streams Hypothesis and the way that each theory works also extends to the collection of evidence when each system is used, including the tasks, contexts and the dominant nature of each. An example of such a discussion of Affordances can be found between Chemero (2003) and Stoffregen (2003). However, Goodale & Milner (1992) in the fields of psychology and neuroscience, have collected empirical evidence to compare and contrast the Ventral (Constructivist) and Dorsal (Ecological) systems to strengthen their opinions. Additionally, see Norman (2003), for an overview of the empirical evidence of brain behaviour regarding the two streams, regarding "*patient D.F.*".

### 2.7.2 Prominent Theories

Firstly, **Direct Perception**, Gibson's alternative (bottom-up) direct perception framework for perception (Figure 2.7):

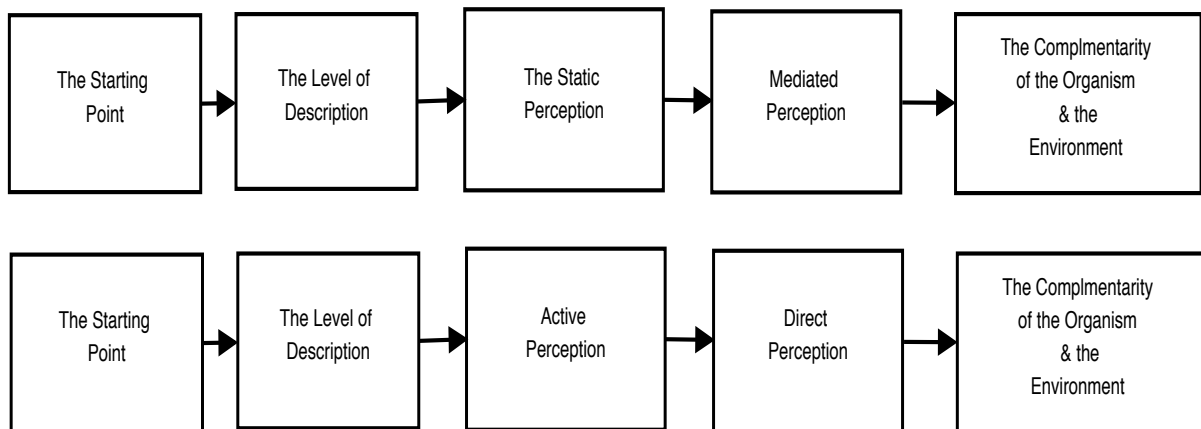


Figure 2.7: Visual perception 'traditional' stages (top) and Gibson's proposed Ecological stages (bottom)

J.J. Gibson believed in an alternative (bottom-up) direct perception framework for perception (Gibson, 1986b) which included an ontology, this being his theory of affordances, as quoted here: "*The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill.*" (Gibson, 1986c, p. 127). The notion of "*affordance*" that was first coined by Gibson

did not only present arguments about how the stages of perceptions occur but declared that affordances contain the following attributes (Gibson, 1986c, p. 127):

- Affordances provided by the environment are what it offers, what it provides, what it furnishes, and what it invites.
- The "*values*" and "*meanings*" of things in the environment can be directly perceived. The "*values*" and "*meanings*" are external to the perceiver.
- Affordances are relative to animals. They can be measured only in ecology not in physics.
- An affordance is an invariant.
- Affordances are holistic. What we perceive when we look at objects are their affordances, not their dimensions and properties.
- An affordance implies the complementarity<sup>18</sup> of the perceiver and the environment. It is neither an objective property nor a subjective property, and at the same time it is both. It cuts across the dichotomy of subjective-objective. Affordances only make sense from a systemic point of view.

This highly influential theory reconstructs the ways in which perception and meaning are linked. The HCI guru, Norman (1988) a good friend of Gibson, expressed a firm belief in the affordances of interfaces. In this context, instead of perceiving the affordances of interfaces, readers perceive "*textual affordances*" (Toms, 1997) which ultimately lead to meaning (this is one of the main tenets of Gibson's theory of affordances, that is, that perception is followed by action). Watt states: "*...there are visual combinations of invariant properties of objects which cue a reader about how to act in relation to these objects...*" or offer action possibilities based upon these texts; in the context of genre, these are layout cues (Watt, 2009, p. 170).

Secondly, Helmholtz is seen as one of the founders of **Indirect** perception (Constructivism) which can be traced as far back as the 12<sup>th</sup> century).

*"The sensations of the senses are tokens for consciousness, it being left to our intelligence to learn how to comprehend their meaning...". "The only psychic activity required for this purpose is the regularly recurrent association between two ideas which have often been connected before"* (Helmholtz, 1962, pp. 533-5).

Indirect perception is summarised as the following (Pike & Edgar, 2005, p. 102):

- What you see as a stimulus depends on what you know, i.e. top-down processing

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<sup>18</sup> A relation between two opposite states or principles that together exhaust the possibilities (Webster's Dictionary).

- Sensory data being incomplete, a description is completed by accessing stored knowledge
- Gregory postulated that sensory data is always incomplete, so we generate perpetual hypotheses about what an object may be
- Using stored information can lead to hypotheses that are perpetually inaccurate, which is why we may be fooled by some visual indicators.

To sum up, taking all the information described in this section and in Norman (2003), the following Table 2.2 displays how the two different theories (ecological and constructivism) are said to function.

**Table 2.2: The DAN and VAN compared in detail; neurologically, perceptively and details of how they work**

<b>Factor</b>	<b>Dorsal system (cognitively suppressed)</b>	<b>Ventral system (cognition active)</b>
<i>Ocular</i>	Skim	Scanning/Reading
<i>Theory</i>	Ecological	Constructivist
<i>Flow</i>	Bottom-Up	Top-Down
<i>Function</i>	Visually guided behaviour (Ambient Optical Array (Gibson, 1986a))	Recognition/identification
<i>Sensitivity</i>	High temporal frequencies - motion	High spatial frequencies - salient details
<i>Memory</i>	Short-term memory	Long-term stored representations
<i>Speed</i>	Fast	Slow
<i>Consciousness</i>	Low Awareness	High Awareness
<i>Frame of reference</i>	Egocentric or viewer-centred	Allocentric/ Object-centred
<i>Visual input</i>	Across retina	Parafoveal or Foveal
<i>Monocular vision</i>	Large effects, for example, motion parallax	Small effects (generally)

Many other theoretical models have been proposed for the study of visual perception, for example, “organizational” or “perceptual grouping”, known as Gestalt theory, was steered by the principle that: “the whole is greater than the sum of its parts” (Pike & Edgar, 2005, p. 78), according to which:

*“In perceptual terms, this meant that an image tended to be perceived according to the organization of the elements within it, rather than according to the nature of the individual elements themselves” (Pike & Edgar, 2005, p. 78). “Gestalt psychologists believed that objects are perceived as Gestalten (‘organised wholes’, ‘configurations’ or ‘patterns’ rather than combinations of isolated sensations” (Gross, 2005, p. 226).*

The laws, normally under the main title of the *Laws of Prägnanz*, of closure, proximity, and similarity are important to this theory and do have implications for this work. This is due to the highly organised grouping of forms which do not only delineate the shapes of genres but also aid the perceiver to recognise and locate the salient features. According to Gestalt scholars, the most efficient way of perceiving is to see things as symmetrical, stable and uniform (Gross, 2005). Gibson, who devised the ecological theory, was a strong opponent of the Gestalt theory but did agree with the Gestalt psychologist, Kurt Koffka, that perception was **the** greatest problem with the contemporary approaches to psychology at that time (Neisser, 1981). A full description of Gestaltism is beyond the scope of this review but will be discussed at various points throughout the thesis, since it does have some implications for the research.

Rock (1977) is critical of the claim put forward in the Gestalt theory that perception is not a high level process. He collected empirical evidence, for example, from his ‘tilted square experiment’, in order to support his contention that perception is, on the contrary, a very high level mental process. Another perception theory was provided by Marr (1982), who identified different stages of perception to those identified by Gibson and, most importantly, put forward the theory that the final stage in perception was recognition and not action. Finally, there is also the structuralist approach, which derives from the work of early psychophysicists, such as Weber (1834), who believed in “*Absolute Thresholds*” and “*Difference Thresholds*” (also known as “*Just Noticeable Difference*”) which became known as ‘Weber’s’ or ‘Weber-Fechner’ law.

## **2.8 IR, cognition, theoretical visual perception and genre – previous studies**

In this section several studies of a think aloud (Kelly, 2009) protocol nature are described (Toms, 1997, 2001; Toms & Campbell, 1999a, 1999b; Toms et al., 1999; Watt, 2009), which have served to inspire the experiments pertaining to the perception of genre and the examination of useful structural and formatting characteristics along with textual shapes.

Section 2.8.1 is devoted to descriptions of users’ studies and Section 2.8.2 to a discussion of the previous Section (2.7), to compare theoretical visual perception theories with relevant user studies.

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### 2.8.1 Previous studies

Toms & Campbell (1999a, p. 2008), in the first of the three studies described in this section, put forward the hypothesis that the characteristics of a genre govern the reader's ability to correctly identify and categorise a document, and thus act as an *"interface metaphor"*.

In the pilot study, they asked fifteen participants from a university faculty to examine a collection of documents. There were three variables described (Toms & Campbell, 1999a, p. 2010):

1. Genre variable: each converted into two *"surrogates"*: form (text replaced by X's and numeric by 9's), and function (formatting was stripped out leaving only semantic content).
2. Six types of text: *"course reading list, journal article, departmental memo, dictionary, minutes from meetings and course calendar"* (the types were sourced by surveying thirteen students and academics and asking which were the most commonly used types of documents in the six month period before the study. Whether any or all of the thirteen students and academics surveyed also participated in the pilot study was not mentioned).
3. Medium: digital versus paper versions.

Each participant was asked to examine eight paper and eight digital versions; four of these were form and four, function. The whole procedure, to control order effects, was randomised comprehensively. During the identification process, each participant was asked three questions (the answers were recorded and transcribed): *"...what type of document is this?; what characteristics lead you to believe that the document is"* [...given answer to first question]?; *"What is the most discriminating characteristic that lead you to believe that the document is"* [given answer to first question]? The measures used were genre recognition by time and response, number of documents correctly identified and amount of time taken to identify a document. The data was analysed using one-way/repeated measures ANOVA and by using descriptive statistics.

The results obtained from a close analysis of the data provided empirical evidence that the form characteristics of a genre play a very important part in the process of interpretation and identification of analogous texts (whether digital or paper), and suggest that the form of genre has many potential benefits by serving as an *"interface metaphor"* (Toms & Campbell, 1999a)<sup>19</sup>.

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<sup>19</sup> See 2.8.2 for further discussion of the user behaviours and findings related to this pilot study.

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Toms & Campbell (1999b) later reported two think aloud studies. Study one (pilot) involved 15 participants from an academic background. They used paper and digital representations of texts: “*journal article, dictionary, course reading list, memo, meeting minutes*” and “*course calendar*” into two “*surrogates*”, i.e., form and content. The participants were asked to identify “*eight print and eight digital documents*” (four form; four content). The identification and time taken to identify were recorded along with oral identification of features and characteristics that were useful, which were then transcribed. Form in this experiment was not completely useful in all genres. However, structural features in the documents did provide significant pointers about the type of genre in some cases, and digital and paper representations were equally distinguishable.

In part one, the authors concluded they had proved their concept in that the participants were able to identify texts solely by visual clues and did encounter some difficulties when there was no structure.

In study two, in the paper (Toms & Campbell, 1999b; Toms et al., 1999), the authors tested the “*shape of information*” with 72 participants (36 academic/36 general public). The types of variable used were types of document: bibliography, call for papers (and those used for study one); genre element: form versus content versus original; and membership in the community, that is, academic versus non-academic. Each of the participants was asked to identify each document once (and in only one version, that is, form, etc.). Two impartial observers were asked to check the labelling of the documents for ground truth (Kappa =.082). The participants were asked to study two sets of documents which consisted of eight documents (control set for training) immediately followed by sixteen from the surrogates. Using an audio recorder, the participants were asked the following questions while they were viewing each image and the answers were transcribed:

1. What type of document do you think this is?
2. What feature of the document was most helpful in making your decision?
3. Were there any other features that assisted you in making your choice?
4. Were there any features which puzzled you, or seemed inconsistent with your choice?

The quantitative data was examined by using descriptive statistics and repeated-measures ANOVA. The results reported in Toms & Campbell (1999b); Toms et al. (1999) indicated that visual form plays an central role in document detection and when “*shape*” was particularly distinct, the document was instantly perceptible to participants. In addition, when the participants were asked to scan semantic content, it took them longer to ascertain the “*...gist of the document and an extrapolation of its contents*”. They went on further, to identify the “*conventions*”, in particular, the

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visual cues (columns, headers, lists etc.) and structural shapes (groups of columns) that facilitate document use within discourse communities. The visual cues, in their opinion, form a shape which acts as an interface metaphor during a user's interaction with a text. For example, an academic calendar, an Information Technology Services (ITS) downtime e-mail (oil company or university etc.), and a Call for Papers are all-specific in their purpose and have distinct forms. Toms & Campbell (1999b, p. 370) "*...suggest that a digital document typically has a configuration of visual features that characterize it as a particular genre*". The results of the research carried out by Toms & Campbell showed that genre recognition features play an influential role during information-seeking and categorisation tasks.

An examination of the transcripts in Toms & Campbell (1999b, p. 370) revealed that the reader first perceives and then recognises the cues by means of a process of interpretation (much like that described by Frow): in which their participant(s): "*...identifies the document as an instance of a particular genre class, and loads a set of expectations at the very outset of the reading experience*". They also put forward the claim, endorsed in this thesis, that when the features of formatting for a genre are consistent, this can be helpful for "*automatic document recognition, filtering and retrieval*".

This was very much the paradigm in other ML classification work but Boese & Howe (2005a); Clark & Watt (2007); Pritsos & Stamatatos (2013) utilised features which were not really naturally perceivable, for example, XML tags character n-grams. Toms & Campbell, however, sound a note of caution, pointing out that the digitalisation of texts may lead to the negation of the usefulness of genre in some contexts. Yates & Orlikowski (1992, p. 305) also warn that the "*...undue proliferation of genres may also weaken the usefulness of the concept*".

Watt (2009, p. 171) performed a small pilot study with eight participants from an academic community. These participants were asked to categorise calls for papers (with which they were familiar) in the form of e-mail messages. Two questions were of particular interest with regard to gathering information during the study: firstly, "*...whether layout assisted people in classifying texts*", and secondly, "*...whether layout features were independent of linguistic features*". Each participant was requested to categorise the messages after being presented with 24 call for papers e-mails matched with 24 (unspecified) other e-mail messages all of a comparable size and the date of sending being very similar. Additional variables were also used in this experiment, (similar to Toms & Campbell (1999a): semantic information was transformed (letters to Xs) and the layout was altered (whitespace to single spaces; punctuation and non-linguistic information removed). The task was timed-response in kind, i.e., the speed and precision of the responses for each e-mail was

documented. After a meticulous evaluation of the data, Watt determined that the layout and semantic characteristics were not autonomous of each other. This suggests, according to Watt, that it would not be acceptable to augment any discovered features of layout into the collected attributes in a machine-learning algorithm of a Bayesian/Bayesian-derived nature. Instead it is far more feasible, he argues, “...that the layout features are providing invariant cues about which parts of the texts to attend to...”, which both decreases the labour involved in the classification process and speeds it up (Watt, 2009, p. 172). The author goes on to state that:

- People can classify texts more precisely than algorithms, and can achieve text categorisation at an unexpected speed.
- Appropriated with the timed-reaction results, the measurements suggest that the participants were “...using layout perceptually to assist the classification process...”, undoubtedly by highlighting particular segments of documents, and fundamentally applying a method which “combines” substantiation in fragments, as opposed to dealing with the entire amount of evidence concurrently.
- This research, Watt suggests, matches with other research on “natural categories”, such as Rosch (1973), “...where classification can undergo strange reversals: people often classify things differently when time is very limited compared with when it is open” (Watt, 2009, p. 172).

### **2.8.2 Discussion**

From the perspective of cognition, “Attention is guided by genre information”, according to Claire Michaels (2007)<sup>20</sup>. For example, the abstract of an academic article allows a filtering decision to be made on whether the article is relevant or not; the filtering of the information load allows the reader to decide whether or not an entire document should be read, because the genre provides invariant cues to the relevance of the document in its structure. Watt (2009) suggested that genres behave as “affordances” and that they can, in essence, be filtered and categorised by form. As Frye put it, some years earlier, “the study of genres is based on analogies in form” (Frye, 1957, p. 95).

Gibson’s affordances, as described by Watt (2009, p. 170):

“...is an attempt to restructure the ways in which meaning and perception are related: it argues that, instead of perceiving objects (such as texts) and then adding meaning later, there are visual combinations of invariant properties of objects which cue a reader about how to act in relation to these objects”.

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<sup>20</sup> E-mail Personal Communication



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In the context of genre, these “*invariant properties*” or features are primarily structural signalling indications, rather than semantic signals (although, admittedly, they can sometimes be both); they occur in two areas and are referred to in this project as shallow (or surface) features and deep features. There appears to be little consensus, however, on where these cues and features are located. Frow and Gibson seem to agree that the cues and features are located between the reader and the text in the “*visual array*” (Frow, 2006a) or in the “*Ambient Optic Array*” (Gibson, 1986b).

In addition to the issue of investigating features (or invariants) there is also a case for exploring the possible actions which are afforded to the perceiver of documents; this is one of the main tenets of the Gibsonian theory of “*perception for action*”. The affordances of genre could be defined in terms of drawing the attention of the reader (the perceiver) to salient properties of the e-mail communication which could trigger a decision that a document is relevant to his/her search for a small item of information, such as, what is showing at the cinema that evening or even a large knowledge-seeking task, such as a literature review.

Alternatively, Toms & Campbell (1999a), leaned towards the Constructivist (perception for recognition) process, since they aimed to contrast the content (function) and form in order to discover whether readers can perceive and process form on its own or need semantic content to identify it. They also aimed to question whether a participant referred to previous knowledge to identify a text, such as a web page, or used a different technique. Toms & Campbell (1999a) contended that the genre “*attributes*” of a document allow it to be precisely recognised and showed that features of genre perform a meaningful part in recognising textual documents. The authors suggested that form is scanned and content is read so that possibly two processes are actually on going at the same time, and that function provides semantic hints, which demonstrate the “*purpose of the documents*”. When the structure of a document was shown, however, Toms & Campbell (1999a, p. 2014) stated that “...*participants had to match their sensory response with the corresponding representation stored in long-term memory*”. They also claimed that, first of all, in order to identify a document using form, the user scanned and translated some or all of the visual cues present at the same time to locate the semantic clues. Secondly, the participants constructed or “*loaded a set of expectations*” which were founded on the available visual clues in the texts. In a later summary of all her studies, Toms (2001) claimed that form is important but substantiated her claims related to perception with the following explanation:

*“Because the form takes on a distinctive visual appearance, document form essentially represents the shape of a document.”(...)* *“Ultimately, the unique shape triggers a user’s mental model of that class*

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*of genre. In interpreting the shape, a user develops a set of expectations about the document without first having to read the semantic content.”*

Toms & Campbell stated that their results showed that perception is a top-down process, in contrast to the ecological claim that it is a bottom-up process, where the readers recognise the genres through the attributes of the layout which forms the basis of document recognition (or perception for recognition), and although Toms & Campbell (1999a), like Lakoff (1987), refer to the bottom-up process and suggest that genres may “*act as a single Gestalt*” they do not explore other possibilities, such as perception for action when the document is displayed to a reader (in all fairness Watt (2009) also fails to explore the perception for recognition concept). In their conclusions, however, Toms & Campbell (1999a, p. 2015) query how the form of the document affects a user in the first few seconds of the interaction and this gives rise to the question of how the form features of a genre assist in text interpretation and use. This is one of the key questions dealt with in this thesis.

Although the research carried out by Watt (2009), Toms & Campbell (1999a), Toms (2001), Toms et al. (1999) Toms & Campbell (1999b), may seem to indicate a leaning towards one process or another (Watt/Ecological and Toms/Constructivist), the latter does explore the visual cues that serve as “*interface metaphors*” and are thus akin to affordances (Toms, 1997); it may emerge that they are both correct (or indeed incorrect), but with regard to different information-searching tasks and in different contexts. It is possible that documents are identified and used in differing ways depending on the context of the task, the skill and expertise of the reader, the reading and the use, for example:

- If the reading task is to be performed quickly, skimming is important, but if more time is available, more intensive reading (scanning) may occur.
- If a user is looking for a familiar text that has already been seen, then the recognition process (scanning) is important but if the search is a fresh task looking for a particular genre, then the ecological process could be vital, to save time.

These texts could arguably be called “*created affordances*” crafted partly because the human being’s visual framework is outstanding at pre-conscious processing. Genre features reduce the number of “*chunks*” (related to the cognitive system) of information that needs processing to make a decision on the relevance or category of a piece of information. Outside objects impose upon the senses, and due to the power of reason, the mind is able to extricate the form, which determines the nature of the perceived object.

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One of the most promising methods of analysing the way that genre is perceived is that of eye tracking, in order to observe ocular behaviour, to observe the cognitive attention paid to structural features which make these forms, and to record any skimming and scanning behaviour that occurs during the information seeking process.

The studies described in Section 2.8.1 have one thing in common, that is, they were all think-aloud protocol and paper exercises. In addition, they were only pilot studies. To enhance this research, a more precise methodology needs to be employed for data capture and analysis which does not only rely on participants' observations and speaking aloud but is also able to record ocular behaviours. For this purpose, the next section examines eye tracking and related research which is relevant to the methods and metrics that are required.

## **2.9 Eye tracking Research**

### **2.9.1 Introduction**

Technological advances have facilitated the collection of large amounts of informative data for many different purposes, such as medical studies, marketing strategies and IS studies. Eye tracking offers opportunities to conduct much more advanced experiments than think-aloud protocols to examine ocular behaviour for the purpose of gathering clues to prove the importance of genre, as well as to substantiate or question the theories related to perception and cognition. The eye tracking data described below (2.9.4) provides very useful metrics to aid the identification of ocular behaviours, such as location of gaze, skimming and scanning.

### **2.9.2 Background**

Eye movement research began in the very early 20th century. Before the contemporary eye tracking equipment was developed, several methodologies were employed which might now sound somewhat barbaric and highly invasive. For example, the Electro-oculographic method required electrodes to be mounted on the skin around the eye of a participant so that the researchers could record and measure any changes in "*electric*" potential to detect eye movements<sup>21</sup>. Eye tracking has been used extensively in many fields of research, for example, interface development (Goldberg & Kotval, 1999), understanding how users read webpages (Nielsen, 2006) understanding sign language (Muir & Richardson, 2005), understanding how users view images (Underwood et al.,

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<sup>21</sup> For a more fuller description of other methods over the last 100 years or so the reader is recommended to read Pike & Edgar (2005, pp.71-112).

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2008), recording parts of the document the user reads and subsequently using this information on the subdocument level as implicit feedback for query expansion and re-ranking (Buscher et al., 2008a) and also for IR, in particular, click-through data as implicit feedback (Joachims et al., 2005).

### **2.9.3 Types of Ocular Behavioural Measurements**

The main metrics in eye tracking generally come under the category of fixations, saccades, gaze data and scanpath measurements. Fixations are the moments when the eyes are relatively still, maybe cognitively trying to decode information; saccades are the rapid eye movements which occur between fixations (Rayner, 1998).

### **2.9.4 Metrics**

For both fixations and saccades, many metrics are available (Goldberg & Kotval, 1999, pp. 637-43; Poole & Ball, 2005, pp. 214-8):

- Mean fixation duration, which is a metric typically interpreted to indicate the complexity of information, that is, the higher the duration the more complex the mental load/task
- Mean gazing time
- Saccadic rate per second, which differs depending on task difficulty/mental load changes, that is, if the task is difficult and cognitive processing increases, then saccadic rate per second decreases and vice versa
- Number of total fixations – more fixations may mean less skimming and more scanning for certain features or information and more cognitive processing.
- Fixation duration – more duration means attention-getting information or lack of understanding of certain information
- Number of saccades – may indicate more skimming with cognitive action suppressed
- Regressive saccades - may indicate less meaningful cues (in this case text formatting, keywords etc.) and more scanning over areas already searched
- Pupil dilations – changes in pupil size during a task
- Scanpaths (saccade/fixation ratio, scanpath durations/lengths, Spatial Density, Transition matrix and Distance based methods/String-edit-Distance (Goldberg & Kotval, 1999, p. 638; Underwood et al., 2008, pp. 128-32)).

### **2.9.5 Scanpath definitions**

A scanpath, also referred to as fixation sequences and scan patterns, is the path our eyes follow when presented with a stimulus, such as a photograph or webpage. Measurements of observed

scanpaths are useful for analysing attention, the suppression of cognitive activity, interest, and salience. Each scanpath “...represents the exact spatial sequence of eye-movements...” for each user during an eye tracking session (Coco, 2009, p. 369). Previous findings showed what was used or ignored during recognition to reinforce the previous findings (the scanpaths, however, also reinforce previous findings). The scanpaths are not only individually useful but should also be evaluated by comparing them with each other. Scanpaths are also useful for indicating how the subjects react and what they react to in the first few seconds of being shown each individual stimulus. The eye tracking software package that was used records raw gaze location data at the sampling rate of 60Hz, which allows an eye movement to be recorded every 16.67 microseconds.

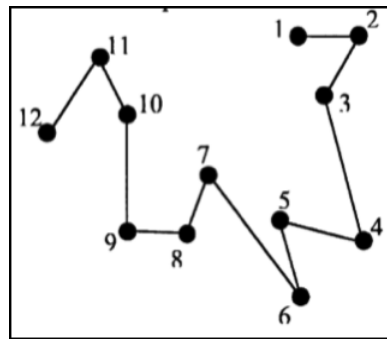


Figure 2.8: Example of scanpath duration from Goldberg & Kotval (1999, p. 638)  $12$  (fixations)  $\times$   $16.67$  (gaze sample) =  $200$  microseconds.

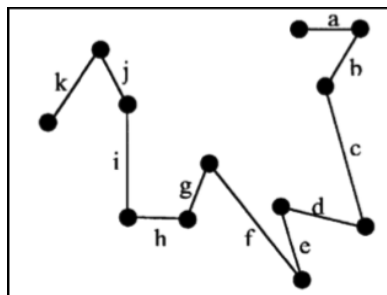


Figure 2.9: Scanpath length from Goldberg & Kotval (1999, p. 638) is computed by measuring (in pixels) the distances between each of the gaze point samples, for example, =  $a + b + c + d \dots + k$

The scanpath mirrors clearly the “...unfolding of visual attention over time, indicating precisely which contents of the visual context are attended” (Coco, 2009). The movement represented by these scanpaths are not random, rather they reflect the “...viewer’s frame of mind, expectations and purpose” (Yarbus, 1967). A scanpath encompasses the sequential chain of the saccade-fixation-saccade (e.g. Figure 2.8 and Figure 2.9.), which can represent the patternations of ocular behaviour across the visual area of the stimuli. User scanpath behaviour can help to explain how a user navigates through the presented stimuli.

In particular, the two scanpath metrics examined in this thesis (durations and lengths) tell us different things in comparison to simple fixation counts, durations and so on; firstly, the scanpath

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durations metric indicates how much time is spent on processing information and the complexity involved or inversely the lack of attention to some features, for example, a short scanpath duration indicates that participants are spending less time processing information and that the processing of information is less intensive; secondly, wide ranging scanpath lengths (spatial) are deemed to indicate efficient/inefficient scanning behaviour measured in pixels and because these are formed by computing the fixations and saccades, this allowed us to make inferences about the allocation of the user's attention to the stimuli.

### ***2.9.6 Scanpaths previous works - observed measurements***

Measurements of observed scanpaths have been used in a multitude of different domains, such as, dyslexia research (Adler-Grinberg & Stark, 1978), cognitive computation (Humphrey & Underwood, 2011) and social phobias/anxiety disorders (Horley et al., 2003). Goldberg & Kotval (1999) conducted computer interface or Graphical User Interface (GUI) evaluations with twelve participants using the interfaces whilst analysing their scanpath behaviour. The authors used scanpath duration, spatial density, transition matrix, saccade/fixation ratio, scanpath regularity and the spatial coverage (calculated with convex hull area). From the analysis, they determined that the better GUI led to fewer, and very dissimilar fixation durations than the poor GUI. Poorer interfaces led to less efficiency in search behaviour.

Goldberg et al. (2002) set out to evaluate several measures based upon eye movement position metrics, e.g., the number of fixations, saccades and scanpaths (scanpath durations and lengths), were evaluated here as well. They aimed to gauge their legitimacy for the evaluation of GUI presentation appropriateness. So-called "good and poor" GUIs for a "drawing tool selection program" were created by controlling group locations of the "tool" symbols then Lorigo et al. (2006), in an extension of the work in Pan et al. (2004) used scanpath fixations pattern-finding to equate the variances in sex and task type during a sessions of searching the Web. Differences were found in scanpaths according to gender and the task comparison results, although mixed, did not reveal any effects related to task type on scanpaths. Joachims et al. (2005) used scanpath measurements to examine the dependability and consistency of the implicit feedback produced by click through data during Web searches. Brandt & Stark (1997) showed their participants' visual imagery of irregularly chequered diagrams. The analysis involved the string-edit methodology and they found that the arrangement of the fixations correlated with the spatial pattern of sub-features in the diagrammatic imagery; for an illusory picture, the eye actions were closely compared with the eye actions while viewing the same image and were deemed as correlated.

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### 2.9.7 Eye tracking in Cognitive Science and Information Studies

Eye tracking is used for a multitude of different purposes. This research employs a categorisation experiment and a web search experiment, but there is a wide variety of different categories of research in which eye tracking is employed, and some of these will be described in this section.

Hornof (2002, p. 1) examined cognitive modelling along with eye tracking to examine the improvements that needed to be made and the potential usefulness of “*cognitive assistance*” which can be afforded by “*data visualisations*” and “*complex data displays*”. At first, the searching and perception stratagem constraints “*...must be established through experimentation that examines, isolates, and extracts fundamental human performance characteristics and clarifies the details of visual perception, visual search strategies, and ocular-motor behavior*”. Hornof states that the research findings contribute “*directly to models of more complex tasks and displays*”.

In a related study that examined cognitive strategies, Hornof & Halverson (2003) investigated the ocular behaviour of 16 participants while they were searching for a “*known item*” in a “*hierarchical computer display*”. Simulated cognitive models were developed computationally (using the previously mentioned EPIC architecture) to replicate the “*visual-perceptual and oculomotor processing required to search hierarchical and nonhierarchical displays*”. The eye tracking data was amassed and then 13 metrics with the recorded predictions of eye movements were compared with the actual observations of the models. This research showed the importance of “*...cognitive modeling for predicting, explaining, and interpreting eye movement data, and how to use eye tracking data to confirm and disconfirm modeling details.*” (Hornof & Halverson, 2003, p. 249).

Cutrell & Guan (2007, p. 407) highlighted the multitude of tasks and contexts in which users needed search interfaces and the balance that was required to be met by designers in order to meet the needs of the users and not to alienate them. A user study was implemented to examine the most suitable layout of information, and to compare and contrast the effects on search and ocular behaviour when the participant was shown different representations of search results. The metrics used were: total summed duration of fixations on snippets, total time on task, total number of search results fixated for the task, total summed duration of fixations on titles and total summed duration of fixations on URLs (Cutrell & Guan, 2007, p. 413). The authors established that “*adding information to the contextual snippet significantly improved performance for informational tasks but degraded performance for navigational tasks*” (Cutrell & Guan, 2007, p. 407). They found that the main reason for the two outcomes (improvement and degradation) was the fact that when the

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length of the snippet was enlarged, the attention of the participants was shifted to the snippet and much less to the Uniform Resource Locator (URL) which was positioned at the base of the search outcome. Guan & Cutrell (2007, p. 417) re-organised the Web search engine ranked results list and the location of the information. Their experiment examined the users' ocular behaviour adjustment when the target outcomes were presented at altered locations for navigational and informational tasks.

During the informational task, more time was paid by the participants in searching but were less efficient in locating the relevant information, partly because, as the ocular data showed, they (not surprisingly) seldom looked at the bottom of the ranked list and were over-reliant on the effectiveness of the search engine (ranking). The navigational task gave rise to different actions in the participants; this was more apparent from the information task as the users tried out the uppermost ranked results on the search engine list, even if those results were observed to be less pertinent to the task in hand.

Rehder & Hoffman (2005, p. 1) replicated an experiment conducted by Shepard et al. (1961) but with the addition of contemporary eye tracking equipment. The work by Shepherd et al. as well as a significant tranche of research since 1961 has led to the postulation "*...that category learning [or classification] often involves learning to selectively attend to only those stimulus dimensions useful for classification*". Rehder & Hoffman found that, firstly, learners of categorisation did actually allocate their attention in an optimal sense and that, secondly, learners of categorisation were recorded fixating on all stimuli measurements at a very early stage in the learning process.

Blair et al. (2009, p. 1196), in a related categorisation (or learning) eye tracking study, also argued that human beings have an exceptionally adaptable capability to classify "*...regularities in their environment, in part because of attentional systems that allow them to focus on important perceptual information*".

Traditionally, most models of attention and classification are "*...typically modelled with weights that selectively bias the processing of stimulus features*". The theories predict the degree of adaptability according to which attention can be implemented in reaction to the properties of the stimuli. The authors conducted two eye tracking studies, the first with 27 participants, and the second with 38, in the course of which the participants were shown stimuli "*...designed to resemble amoeba-like micro-organisms containing three features that resembled organelles. Individual features varied between one of two binary options, allowing for eight combinations*" (Blair et al., 2009, p.



1198).

The studies showed that the participants learned to apportion attentiveness skilfully to adherents of distinct groups and that they provided “...*the first direct and unequivocal evidence that different stimuli in a categorization task can elicit different attentional allocations*”. They also “...*found clear temporal regularities in how attention was allocated within a categorization trial*” (Blair et al., 2009, p. 1203). This has a direct bearing on the first study presented in Chapter 3 in this thesis, that is, it validates the e-mail classification task using the genre features, in which the study task does require “...*stimulus responsive attention in a categorization task*”. Additionally, Blair et al. also presented evidence of “...*temporal patterns in the shifting of attention within trials that follow from the informativeness of particular stimulus features*” (Blair et al., 2009, p. 1196).

## **2.10 Summary of Literature Review**

### **2.10.1 Summary**

It has become obvious that genre is a rich research area which should be exploited to the full by the IS & R community. A thorough review of the literature describing Watt (2009), Toms & Campbell (1999a), Toms (2001), Toms et al. (1999) Toms & Campbell (1999b) and Toms (1997) and a wider collation of genre literature from many domains, such as Frow (2006a); Paltridge (1994, 1997), has revealed a lack of forward momentum in work that builds on the previous findings. Although the authors mentioned above describe potential future work in their literature, their research has effectively come to a standstill, with little progress being made and few studies being carried out recently. In this thesis, the definition of genre by Yates & Orlikowski (1992) (inspired by Giddens (1984) Structuration theory) will be examined and their work will also be extended by looking at e-mails in which “...*human communicators, through their patterns of use grounded in recurring situations, shape the characteristics of communicative genres over time*” (Emigh & Herring, 2005). Yates & Orlikowski (1992) state that e-mail “...*may imbue communication in that genre with certain structural properties*” (Emigh & Herring, 2005).

The form and purpose of e-mail genres will be examined in order to assess the potential benefits that the important structural properties described by Yates & Orlikowski (1992) can offer to IR. The potential ecological nature of Wikipedia in the context of genre will also be explored, because it has become an important area for IR research, particularly since being used by the INEX group as an IR

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collection since the 2005 corpus was developed<sup>22</sup>.

Given the standstill situation described above, the decision was made to take forward the work carried out by Watt (2009), Toms & Campbell (1999a), Toms (2001), Toms et al. (1999) Toms & Campbell (1999b) and Toms (1997) and move into more contemporary domains, employing a more accurate data capture methodology and analysis.

### **2.10.2 Research Aims**

As a result of the wide ranging and comprehensive literature review the aims from Section 1.3 were expanded to take this into account.

1. To study the usefulness of form for IS & R in two domains: e-mails in university accounts and Wikipedia
2. To examine the ocular behaviours involved in viewing text structure by conducting experimental user studies that employ eye tracking metrics and exploit temporal, distance and quantity based measures
3. To analyse ocular behaviour for any evidence of theoretical perceptual processes, e.g., constructivist, ecological, Gestalt, etc.
4. To investigate the ocular behaviours involved, for example, in the skimming and scanning of e-mails and Wikipedia articles
5. To assess the potential usefulness of 'Frames' (Frow, 2006b; Gardner, 1983; Paltridge, 1997), "Landmarks" (Heffron et al., 1996) and "Signaling Devices" (Lorch, 1989) for IS & R: for example, interpretation and categorisation methods
6. To collect empirical evidence data on useful form features in e-mail texts, e.g., call for papers, spam
7. To investigate how users utilise formatted text as well as plain text when categorising texts, and whether format alone is enough to identify texts effectively
8. To conduct a search and analysis exercise looking at the pages within the English version of Wikipedia studying the types of structural attributes of form
9. To evaluate the usefulness of Wikipedia for a study of structural features and tasks using genre
10. To investigate how genres (forms) emerge and evolve in Wikipedia by recording new evolving and interlinking articles

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<sup>22</sup> The INEX 2005 collection was re-crawled and updated ready for use in 2009.

11. To investigate how biographies and lists are perceived in those first seconds using eye tracking
12. To collect empirical ocular evidence of useful genre features in Wikipedia articles, e.g., lists, biographies
13. To investigate which features of Wikipedia are most and least important during the search tasks
14. To investigate and compare structure versus non-structure in Wikipedia.

Research questions were developed from the aims and appear at the beginning of each study in Chapters 3-4a/b. The next two chapters (3 & 4a/b) will explore stimulus features along with attention, by describing two user studies that focus on genre features and how they are used within two communities of practice.

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### Chapter 3: Study One- Form & Purpose in an E-mail Community of Practice

*“...Yates and Orlikowski (1992), drawing on the structuration approach of sociologist Anthony Giddens (1984), observed that human communicators, through their patterns of use grounded in recurring situations, shape the characteristics of communicative genres over time. Yates and Orlikowski simultaneously noted that the medium with which a genre is conventionally associated (for example, email for contemporary organizational memoranda) may imbue communication in that genre with certain structural properties (formatting, stylistic features, etc.)” (Emigh & Herring, 2005, p. 99a).*

The research aims and summary in the previous Section (2.10) describe how this research will progress. First of all, the structural properties and characteristics of organisational communication Yates & Orlikowski (1992), i.e., e-mail, are examined. This chapter presents the first user study, which involves an e-mail categorisation task to further advance comprehension of the values of the ‘form’ aspect of genre (in comparison with no structure) for a perceiver during human interaction, i.e., locating and following the users’ gaze during categorisation. For this purpose, a thorough analysis was required using fixation, saccade and scanpath derived eye tracking metrics.

Section 3.1 provides a brief background to the chapter, which is followed by the method (3.2): this is divided into five Sections: experimental setup (3.2.1), ethics and informed consent (3.2.2.), apparatus (3.2.3), descriptions of the types of eye tracking data, data recording, capture, preparations and analysis (3.2.4), and finally, the corpus (3.2.5.). Section 3.3 introduces the Research Questions for this chapter and the Measurements (3.4). The Procedure (3.5) followed by the Participants (3.6) in the experiment is followed by the Independent Variables (3.7). Section 3.8 contains multiple sections and sub-sections which are all related to the Results and Analysis. This does not only include the Debrief (3.8.1) and Post Experiment Remarks (3.8.2) but also three sections presenting Timed Response Results (3.8.3), Fixation and Saccade Derived Results (3.8.4) and Scanpath Derived Results (3.8.5) which are tested using high level statistical testing. Section 3.9 presents a Discussion & Summary of Findings which answer the Research Questions one-by-one. Finally, Section 3.10 presents the chapter Summary which leads in to the next study chapter.

#### **3.1 Background**

The work that has been published to date on the effects of form during the interpretation and identification of text has resulted in the generation of more questions than answers. Previous think-aloud experiments, such as Watt (2009) and Toms & Campbell (1999a), represented a good start but were limited in the range of data that could be gathered and the analysis methodology. After

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some research, it was decided to utilise eye tracking equipment which collects ocular data to examine the importance of structured text, in particular form, in a CoP communicative domain collection compiled from various e-mail accounts in the university.

### **3.2 Method**

#### **3.2.1 Experimental setup**

This task-based study was observational/logged in design, based on questionnaires and end users' feedback in nature. Twenty-four participants took part in the experiment. Prior to beginning the identification task, each subject was given a three-minute introduction to the eye tracker as well as a guidance sheet as to what could be expected. Each participant was then asked to sign a consent sheet followed by the calibration with the system before the eye tracking experiment commenced; the Viewpoint PC-60 system calibrates the user's eyes with the camera. The experimental setup of the evaluation was based on commonly used standards c.f. Joachims et al. (2007) and Kelly (2009). Similar settings were also used in previous task-based evaluations, such as Harper & Kelly (2006), Huang et al. (2006), White & Kelly (2006). The experimental procedures, such as the time allowed for tasks and questionnaires, were based on methods and protocol used by previous interactive experiments in Dupont et al. (2010); Harper & Kelly (2006); Huang et al. (2006); Kelly et al. (2008); Kelly et al. (2007); White et al. (2002); White & Kelly (2006).

The two questionnaires used five-point Likert (psychometric) scales. The first (entry) questionnaire was used only to record demographic information, such as age, web and e-mail experience, etc. The second (exit) questionnaire was used to compare and contrast the participants' familiarity with e-mails, and task evaluation. The questionnaires were web forms hosted on a local web server and resulting answers were then sent to the experimenter by secure e-mail. Once the design was complete, it was necessary to apply to the ethics board for approval of the experimental design.

#### **3.2.2 Ethics and informed consent**

Due to the nature of the experiments, an ethics application (c.f. ethics paperwork forms in Appendix: A1 and A2) for research involving human participants was completed. There were two main reasons for this:

1. **A safety issue arose from the exposure to infrared irradiance.** Arrington, the

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manufacturers of the headfixed Viewpoint (Arrington Research Inc., 2005) eye tracker PC-60 (software version 2.8.3 released July 2005), assure the users that exposure to these lesser than IR amounts are completely harmless in short term exposure. An experiment length of a maximum of thirty minutes for each participant results in negligible exposure and in total results in a lower exposure to radiation than anyone would encounter during the course of a normal day.

- 2. The ethical issues involving the storage of user data for a set of experiments using eye tracking equipment and the questionnaires.** The eye tracking was recorded on a separate monitor using Wink desktop recording software for the user study described in this chapter. Audio recording was also used to record the participants' genre identification in this user study, but no web camera or other recording device would be positioned to record the users' behaviour in any other way. This meant that neither type of recording could be used to identify the participant and all the data was stored on a secure external hard drive. Financial inducements were not offered to the potential participants in the study described in Chapter 3; the task was relatively short and a large group of colleagues and friends throughout The Robert Gordon University had previously offered to help without any financial recompense. Only the researcher (this author) and his supervisors would be able to access the data and any data taken would be anonymised. Before taking part, the twenty-four participants each signed a consent form and the hard copies of these consent forms were stored in a locked cabinet. The e-mail questionnaires (not live) data was stored on a secured mobile hard drive. The experiments which are described below were all approved without any modification of the design.

### **3.2.3 Apparatus**

The eye tracker used in the experimental sessions was the Arrington PC-60 Viewpoint (Arrington Research Inc., 2005). The eye tracker is a desk-mounted device that allows the experimenter to detect the type of ocular behaviour exhibited by each user when shown a stimulus. In addition, there is a camera and a video capture module that affords ocular effort recording at a maximum refresh rate of 60 Hz. The Viewpoint software computes instantaneously and has blink detection and suppression. Temporal resolution is measured in Hertz (Hz), and records how many times per second (p/s) the eye tracker can sample the eye position. Temporal accuracy, in this case, was set at the maximum of 60Hz. The software logged: gaze location (X/Y axis), delta times, width and height of pupil (to within 0.03mm), Regions Of Interest (ROI), and total session timings in which fixations, gaze times and saccades for each stimuli can be computed and recorded in an ASCII file (Arrington

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Research Inc., 2005). The monitor viewed by the participant was recorded by the Freeware application Wink which records using Flash. This allowed a playback of the session for each participant. The experiment was run using, at the time, a high specification dual core PC running Windows XP that had two monitors inter-connected to the same PC. The stimuli were shown randomly on a 15-inch monitor of 1024 x 760 pixel resolution. The recording was performed on another 15-inch monitor of the same type and resolution. The eye tracking interface was controlled by the experimenter(s) on one monitor whilst the other monitor showed the stimuli to the participants. Figures 3.1-3-6 show examples of the stimuli viewed by the participants when making their judgements.

The smoothing algorithm used for the gaze data was the Simple Moving Average (SMA). The “*SMA method uniformly averages N pointsBack, i.e., all points having equal weight*” (Arrington Research Inc., 2005, p. 57). The SMA rallies implementation during a fixation, but inclines to diminish the unexpected saccades from one fixation to the next. However, for this task it was considered suitable enough, since not too much excessive ocular behaviour was expected between users. The Exponential Moving Average (EMA), which is similar to the SMA, could have been used but the EMA places more weight on the latest data. IBM SPSS<sup>23</sup> and Microsoft Excel (version 2011 for the Mac) Spreadsheet software was also used to prepare and then analyse the data statistically.

#### **3.2.4 Eye tracking data\data recording, capture, preparation and analysis**

The eye tracking software records a large amount of types of data, such as:

- logging -fixations
- pupil dilations, queries
- screenshots
- timestamp
- x/y location of the eye

The experimental eye tracking data was input into the SPSS software and then statistically evaluated. The raw data types, such as XY gaze points were used to determine the fixations and saccades data. Saccades, as stated in Holmqvist et al. (2011, p. 23), are:

*“...the rapid motion of the eye from one fixation to another (from word to word in reading, for instance) is called a saccade. Saccades are very fast - the fastest movement the body can produce-typically taking 30-80 ms to complete,..”*

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<sup>23</sup> <http://www-01.ibm.com/software/uk/analytics/spss/>

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In direct contrast to saccades, there times when the eyes are relatively still for tens of milliseconds, and fixations lasting several seconds can occur: “...for example, when the eye temporarily stops at a word during reading”. Firstly, to compute the Scanpath Lengths and Durations for each person raw data was exported into Microsoft Excel. A formula (see Figures 2.8-2.9), shown by Goldberg & Kotval (1999)) for each metric was implemented to compute the means for the lengths and durations. Secondly, the experimental eye tracking scanpath data was then collated with the fixation and saccade derived data into the IBM SPSS software and then statistically evaluated. The data was used for cross-referencing to discover the ocular strategies, attention allocation (Scanpath Length) and cognitive processing complexity (Scanpath Duration).

In order to summarise the methodological stages of data processing to detect scanpath metrics and skimming and scanning occurrences:

- 1) Data was exported from Arrington to Spreadsheet.** Raw gaze data was exported from Arrington logs (Arrington use .WKS files<sup>24</sup>). After the tasks of detecting the scanpaths and the skimming and scanning techniques had been completed, the data was exported to SPSS for statistical analysis, as shown in Sections 3.8.5.1 (duration) and 3.8.5.2 (length).
- 2) Scanpaths detected.** The scanpaths were first detected and isolated from the gaze data for each stimulus, i.e., 64 images for each participant (n=24). A function was then implemented using the formulae shown in the Figures in Goldberg & Kotval (1999, p. 638) to calculate Length (Figure 2.9) and Duration (Figure 2.8).
- 3) Skimming and scanning.** The techniques were detected using the methodology employed in Campbell & Maglio (2001, p. 3) and Buscher et al. (2008c), with some modifications. These two papers reported on the detection of skimming and reading techniques, not skimming and scanning techniques. The following study, however, took the form of a visual search and categorisation task and, in this case, it was unlikely that a participant would have had time to ‘read’ a stimulus. If this had occurred, it would have shown up in the data from the timed-response metric, i.e., the time taken to make an identification. Below is a summary of the steps taken to detect skimming and scanning (most of the data processing was calculated using Microsoft Excel):
  - a) The mode switch scoring system was adopted using “*pooled evidence*” described in Table 1 of Campbell & Maglio (2001, p. 3) to identify any changes of mode (scanning or skimming) within a “*tokenized stream of eye-movement data*” Campbell & Maglio (2001, p. 3).

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<sup>24</sup> Primarily an IBM Spreadsheet file extension



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- b) It should be noted that for the setting of the parameters, some research was necessary: first of all, the fixation duration descriptions in Table 1 of Rayner (1998) were examined. He states that during the reading process, the fixation duration averages between 225ms and 250ms. The mean fixation durations within the scanpaths were on average 270ms, similar to that described by Rayner for Visual Search. To sum up: if a mean fixation duration in a sequence has more than two instances greater than 270ms, this could be taken as an indication that scanning had played a part in the scanpath, whereas instances under 270ms could be indicative of skimming. Secondly, the data which was not over the stimuli in the unformatted representation e-mails (U and UX described in Section 3.7) was excluded from the analysis. This was simple to implement: the X/Y boundaries of the text were calculated and any data which was outside the e-mail text co-ordinates was ignored (it was not necessary to look for any instances of the scanpath 'drift', as the cut-off parameters were offset to allow a margin of error). Thirdly, mirroring the Campbell & Maglio (2001) methodology, the data was quantised by averaging the gaze points from 60Hz per second to 20Hz per second. Fourthly, the scanpath length scores calculated were exploited by using the methodology (Figure 2.9) to formulate heuristics for categorising short, medium and long saccades in addition to that written below, for example, take average score for genre/representation from averages in Section 3.8.5.2 then compute:
- below average score =short saccade
  - equal to average length = medium saccade
  - above average score = long saccade
- c) The use of skimming and scanning techniques was detected by referring to the 20 possible permutations found in Campbell & Maglio (2001) and Buscher et al. (2008c). Scoring was based on the short, medium or long movements, which were given a particular score whenever they occurred on the X or Y axes gaze point. In the analysis, the definitions of skimming and scanning shown in Section 2.6.1 were used. Medium and long saccades with low value fixation durations and multiple changes in directions were taken as indications of skimming; short and medium saccades, with at least one regression and mean fixation durations over 270ms, were taken as indications of scanning. The scoring system method used in this research differed from that shown in Table 1 in Campbell & Maglio (2001, p. 3): the term "*skimming*" in this work was used to refer to the "*long movement*" mentioned by Campbell and scanning to refer to the "*short movement*". An example (X is along the horizontal plain; Y is along the vertical plain):

(1)

$$= 10 (\text{shortright } X (\text{readforward})) + -5 (\text{shortup } Y (\text{scanjump})) + -5 \text{shortup}Y (\text{scanjump}) \\ + -10 (\text{shortleft } X (\text{regressionsaccade})) = -10$$

According to Campbell & Maglio (2001, p. 3), a positive number is evidence that reading has taken place and a negative number is evidence of skimming. Therefore, in the example shown above (1), the scanpath can be seen as pooled evidence of scanning; the detection of a sequence of reading forward, small saccades and regressions is likely to reflect this behaviour because of the nature of the task.

### 3.2.5 Corpus

The e-mails collected for this task (Table 3.1) came from two sources. Firstly, e-mails sent from the university, such as information technology services (ITS notices), seminars and the library. Secondly, external e-mails, such as calls for papers, cinema, spam, newsletters and orders.

**Table 3.1: Types of E-mails for the eye tracking experiment**

Type	E-mail Purpose	E-mail Form
Information Technology Services (ITS) Notices	<b>Internal e-mail:</b> announces downtimes of servers and systems	<b>Structural features:</b> title uppercase, emboldened text items listing outage information.
Seminar	<b>Internal e-mail:</b> similar to calls for paper but internal announcement of invited talk.	<b>Structural features:</b> uppercase titles centred, block of text about speaker, abstract, and block of text about organiser (Figure 3.1 and Figure 3.2).
Library (Lib)	<b>Internal e-mail:</b> message from library; reminder that a book is ready for collection/return.	<b>Structural features:</b> block of centred text, recipient details in uppercase. Opening salutation. Block of text (two paragraphs) terms and conditions, list of renewal item(s) referred to
Call for papers (CFP)	<b>External e-mail:</b> calls for submissions for conferences and workshops by announcing	<b>Structural features:</b> large title, block of centred text (sometimes uppercased). Block of text explaining

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	the requirements and important dates.	the event. Bullet points explaining scope of subjects for conference. Important dates / titles and dates in list format
Cinema (Cin)	<b>External e-mail:</b> announces cinema listings, dates and times.	<b>Structural features:</b> uppercased cinema name/title rectangular block of text with name of film, rating, length, times per day of show.
Spam (Spm).	<b>External e-mail:</b> scam letters with the motive of deceiving people to send money for a fraudulent cause.	<b>Structural features:</b> spam uses "letter" variation format. Top lines indicate type of spam i.e. Nigerian letter, lottery scam etc. (Figure 3.3. and Figure 3.4).
Newsletter (NL)	<b>External e-mail:</b> summarises all the weekly news from an organisation, i.e. Aberdeen Football club.	<b>Structural features:</b> lists of items emboldened. Opening salutation to the recipient. Emboldened title with small summary paragraph and URL below each for the e-mail. URL at end to un-subscribe.
Orders (Ord)	<b>External e-mail:</b> confirmation from a business of an order for item(s) online i.e. Next, Tesco, etc.	<b>Structural features:</b> Order number and "thank you for the order details". Table created with format using lines consisting of symbols (-*/) with details of the order: quantity, item ordered unit cost and, at very bottom, total cost. Delivery address uppercased and the date of delivery of the order (Figure 3.5. and Figure 3.6).

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Although e-mails are genres in their own right, e-mails today contain sub-genres with their own individual purpose and form. The definition of these e-mail genres was decided in a prior

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investigation of the types of e-mails that commonly occurred in the e-mail accounts of several colleagues in the faculty, with the result, of course, that the participants in the experiment might not have been familiar with the selected e-mail types. None of the participants in the experiment contributed any e-mails to the study. These eight types of e-mails used in the study are normally composed of several layers or sections, organised in a certain form using observable features and cues such as uppercasing of text, centring of sentences/paragraphs, blocks of text or numerical values and tables containing some of the features above. In the study design, all the e-mails were ASCII format and normalised by length to prevent the possibility of the different results being due to the length of the e-mails rather than genre or representation. Occasionally the e-mails were artificially changed by length: in the Orders e-mails some of the items purchased were removed or Cinema movie lists normalised to make the e-mails the same length uniformly.

However, in most cases, only e-mails within a certain agreed length were chosen and picked. During the experimental analysis of ocular data and feedback from the participants via the questionnaires, there was no indication that the length of the e-mail was a characteristic used to identify specific e-mails either by genre or representation. Just like Watt (2009) - in his timed response design - the stimuli were balanced for length and still found a very strong effect (an interaction - between layout representations) which indicated that genre speed was a factor independent of length. A pool of similarly sized images containing six examples of each genre was collected giving a total of 48 e-mails. The relative roles of purpose and form in identifying e-mail genres were of great interest in the study. To test these, the same data formatting approach previously used in Toms & Campbell (1999a), and later e-mail work by Watt (2009) was followed. Here, form refers to the structural formatting of the e-mails whereas purpose is not only seen as the content but also as the meaning. Each e-mail was altered into four representations making 192 images in total. The four representations are listed in Section 3.7.

COMPUTING SCIENCE SEMINAR  
TUESDAY 7TH NOVEMBER 2006 AT 10.00 AM  
MT3  
1st FLOOR GEOLOGY DEPT

Meston Building  
University of Aberdeen

King's College

Asst. Prof. Giuseppe Carenini  
Computer Science Department  
University of British Columbia, Vancouver  
(currently visiting prof. at the University of Trento,  
Trento, Italy)

WILL PRESENT A TALK ON ~

Interactive Multimedia Summaries of Evaluative Text

ABSTRACT:

Many organizations are faced with the challenge of summarizing large corpora of text data. One important application is evaluative text, i.e. any document expressing an evaluation of an entity as either positive or negative. For example, many websites collect large quantities of online customer reviews of consumer electronics. Summaries of this literature could be of great strategic value to product designers, planners, manufacturers and consumers. In this seminar, I will first present and compare two approaches to the task of summarizing evaluative arguments. The

first is a sentence extraction-based approach, while the second is a language generation-based approach. These approaches have been tested in a user study.

<<http://www.cs.ubc.ca/~carenini/>><http://www.cs.ubc.ca/~carenini/>

Figure 3.1: Screenshot shows RGU Internal Seminar e-mail original (N)

XXXXXXXXXX XXXXXXXX XXXXXXXX  
XXXXXXXX 9XX XXXXXXXX 9999 XX 99.99 XX  
XX9  
9xx XXXXX XXXXXXXX XXXX

Xxxxx Xxxxxxx  
XXXXXXXXXX xx Xxxxxxx

Xxxx'x Xxxxxxx

Xxxx. Xxxx. Xxxxxxxx Xxxxxxxx  
XXXXXXXXX Xxxxxxx XXXXXXXXXXXX  
XXXXXXXXXX xx Xxxxxxx Xxxxxxxx, Xxxxxxxx  
(XXXXXXXXX XXXXXXXX XXXX. xx xxx XXXXXXXXXXXX xx  
Xxxxxx, Xxxxxx, Xxxxx)

XXXX XXXXXXXX X XXXX XX ~

XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX xx XXXXXXXXXXXX  
Xxxx

XXXXXXXXX:  
Xxxx XXXXXXXXXXXXXXXX xxx xxxxx xxx xxx XXXXXXXXXXXX  
xx XXXXXXXXXXXXXXXX xxxxx XXXXXXXX xx xxxx xxxx. Xxx  
XXXXXXXXXX XXXXXXXXXXXXXXXX xx XXXXXXXXXXXXXXXX xxx, x.x.  
xxx XXXXXXXX XXXXXXXXXXXXXXXX xx XXXXXXXXXXXXXXXX xx xx  
XXXXXX xx XXXXXXXX XXXXXXXXXXXX xx XXXXXXXXXXXX. Xxx  
XXXXXXXX, xxx XXXXXXXXXXX XXXXXXXX xxxxx XXXXXXXXXXXXXXXX  
xx XXXXXXX  
XXXXXXXX XXXXXXXX xx XXXXXXXXXXX XXXXXXXXXXXXXXXX.  
XXXXXXXXXX xx xxx XXXXXXXXXXXXXXXX XXXXX xx xx XXXXX  
XXXXXXXXXX XXXXX xx XXXXXXXX XXXXXXXXXXXXXXX, XXXXXXXX,  
XXXXXXXXXXXXXXXX xxx XXXXXXXXXXX. Xx xxx XXXXXXX,

X xxxx xxxxx xxxxxxxx xxx xxxxxxxx xxx xxxxxxxxxxxxxx  
xx xxx xxxxx xx xxxxxxxxxxxxxxxx xxxxxxxxxxxxxx xxxxxxxxxxxxxx.  
Xxx xxxxx xx x xxxxxxxxxxx xxxxxxxxxxxxxxx-xxxxx  
xxxxxxxxxx, xxxxx xxx xxxxxxx xx x xxxxxxxxxxx  
xxxxxxxxxxxxx-xxxxx  
xxxxxxxxxx. Xxxxx xxxxxxxxxxxxxxx xxxx xxxx xxxxxxx xx x  
xxxx xxxxx.

<xxxx://xxx.xx.xxx.xx/~xxxxxxxxxx/>xxxx://xxx.xx.x  
xx.xx/~xxxxxxxxxx/

Figure 3.2: Screenshot shows RGU Internal Seminar e-mail (as Figure 3.1) but semantic content removed (X's and 9's), with structure maintained (X).

EU GAMING INCORPORATION!!!  
E.U LOTTERY ONLINE  
LOTTERY AND GAMING CORPORATION,  
MONTH OF DECEMBER LOTTERY,  
WINNING NUMBER: FLO-56458867

Dear Winner,

You won the sum of (Five Hundred Thousand Euro only) from the database of internet email users, from which your email address came out as the winning coupon.

We thereby contact you to claim your winning amount quickly as this is a monthly Lottery. Failure to claim your winning will result to rollover or reversion of the winning sum to the next promotion month. We also use this medium to notify you that the expiring or lapse date to claim your winning prize is limited to 20 days only.

To claim your winning prize, contact our approved agent office for your region with your winning number.

E.U LOTTERY ONLINE AGENCY  
MISS. LILLIAN MORGAN.  
MR. MOORE S. BROWN  
DIRECTOR OF WINNING CLAIMS DEPARTMENT  
TEL: 614-157-928  
E-MAIL: euolagency11@aim.com

Once again, congratulations.

Best regards,

Mr. John Williams  
Director of E.U Lottery Online

-----  
DISCLAIMER: If you have received this e-mail in error, please immediately notify the sender by email at the address shown.

Figure 3.3: Screenshot shows Spam e-mail original (N)

```

XX XXXXXX XXXXXXXXXXXXXXXX!!!
X.X XXXXXXXX XXXXXXX
XXXXXXXX XX XXXXXX XXXXXXXXXXXX,
XXXXX XX XXXXXXXX XXXXXXX,
XXXXXXXX XXXXXX: XXX-99999999

Xxxx Xxxxxx,

Xxx xxx xxx xxx xx {Xxxx Xxxxxxx Xxxxxxxx Xxxx
xxx} xxx xxx xxxxxxxx xx xxxxxxxx xxxxx xxxxx,
xxxx xxxxx xxx xxxxx xxxxxxxx xxx xxx xx xxx
xxxxxx xxxxxx.

Xx xxxxxxx xxxxxxx xxx xx xxxxx xxx xxxxxxx
xxxxxx xxxxxxx xx xxx xx x xxxxxxx Xxxxxxx.
Xxxxxx xx xxxxx xxx xxxxxxx xxx xxxxxx xx
xxxxxxxx xx xxxxxxxx xx xxx xxxxxxx xxx xx xxx
xxx xxxxxxxxxx xxxxx. Xx xxx xx xxx xxxxxxx xx
xxxxx xx xxx xx xxxxxxxx xx xxxxx xxx xx
xxxx xxx xxxxxxx xxxxx xx xxxxxxx xx 99 xxx
xxx.

Xx xxxxx xxx xxxxxxx xxxxx, xxxxxxx xxx
xxxxxxx xxxxx xxxxxx xx xxx xxxxxxx xxx xxx
xxxxxx xxxxxx.

X.X XXXXXXXX XXXXXX XXXXXX
XXXX. XXXXXXXX XXXXXXX.
XX. XXXXX X. XXXXX
XXXXXXXX XX XXXXXXX XXXXXX XXXXXXXXXXXX
XXX: 999-999-999
X-XXXX: xxxxxxxxxxx99@xxx.xxx

Xxxx xxxxx, xxxxxxxxxxxxxxxxx.

```

Figure 3.4: Screenshot shows Spam e-mail original (as Figure 3.3.) without semantic content (X) but, with structure maintained (X).



-----  
Thank you for shopping with NEXT Directory Online.  
Your order details are as follows:  
-----

The following items should be delivered within 4-5  
Working Days.

Item : 999-445-G42  
Description : Teal Embroidered Top  
Size : 12  
Quantity Ordered : 1  
Price : 20.00

Item : 101-792-X38  
Description : Khaki Suede LaceUp Shoes  
Size : 44  
Quantity Ordered : 1  
Price : 10.00

The following items will be delivered according to  
their individual stock status:

Item : 111-194-G42  
Description : Teal Camisole  
Size : 12  
Quantity Ordered : 1  
Price : 12.00  
Stock Status : This item should be despatched within  
2-4 weeks.

Item : 123-745-G42  
Description : Fine Stripe Mock Layer Top (Turquoise)  
Size : 12  
Quantity Ordered : 1  
Price : 5.00  
Stock Status : This item should be despatched within  
2-4 weeks.

-----  
Stock Status : This item may be delayed up to 5  
days.  
-----

Item : 122-917-X38  
Description : Black And White Georgette Stripe Dress  
Size : 16  
Quantity Ordered : 1  
Price : 15.00

Figure 3.5: Screenshot shows an Order e-mail (NEXT) original (N). Other Orders' e-mails were used such as online orders for a well-known global Supermarket chain.

```

-----
Xxxx xxx xxx xxxxxxxx xxx XXXX XXXxxxxx
Xxxxx.
Xxxx xxxxx xxxxxxxx xxx xx xxxxxxx:
-----
Xxx xxxxxxxx xxxxx xxxxxx xx xxxxxxxx xxxxxx
9-9 XXXxxxx Xxxx.
Xxxx : 999-999-X99
XXXXXXXXXXXX : Xxxx XXXXXXXXXXXX Xxx
Xxxx : 99
XXXXXXXXX XXXxxxx : 9
Xxxxx : 99.99

Xxxx : 999-999-X99
XXXXXXXXXXXX : Xxxx Xxxx XxxxXx Xxxxx
Xxxx : 99
XXXXXXXXX XXXxxxx : 9
Xxxxx : 99.99

Xxx xxxxxxxx xxxxx xxxxx xx xxxxxxxx xxxxxxxx
xx xxxxx xxxxxxxxxx xxxxx xxxxxxx:
Xxxx : 999-999-X99
XXXXXXXXXXXX : Xxxx XXXxxxx
Xxxx : 99
XXXXXXXXX XXXxxxx : 9
Xxxxx : 99.99
Xxxx Xxxxx : Xxxx xxxx xxxxxx xx xxxxxxxxxx
xxxxx 9-9 xxxxx.

Xxxx : 999-999-X99
XXXXXXXXXXXX : Xxxx XXXxxx Xxxx Xxxx Xxx
(XXXXXXXXX)
Xxxx : 99
XXXXXXXXX XXXxxxx : 9
Xxxxx : 9.99

Xxxxx Xxxxx : Xxxx xxxx xxxxxx xx xxxxxxxxxx
xxxxx 9-9 xxxxx.
-----
Xxxx : 999-999-X99
XXXXXXXXXXXX : Xxxx xxxx xxx xx xxxxxxxx xx xx 9
xxxx.
-----
Xxxx : 999-999-X99
XXXXXXXXXXXX : Xxxx Xxx Xxxx XXXXXXXXXXXX Xxxxx
Xxxx
Xxxx : 99
XXXXXXXXX XXXxxxx : 9
Xxxxx : 99.99

```

Figure 3.6: Screenshot shows an Order e-mail (NEXT) (as Figure 3.5.) but semantic content removed (X's and 9's), with structure maintained (X).

### 3.3 Research Questions

The first study was designed to find the answers to the following research questions:

- RQ1. What are the relative contributions of form (structure) and purpose towards identifying genre in a timed-based response experimental format?
- RQ2. Are two kinds (ecological and/or constructivist) of processes present in genre 'recognition' tasks?
- RQ3. What oculographic methods do humans use when viewing and utilising the invariant layout cues, such as formatting features, that constitute genres? Are such features fixated upon and/or merely viewed with saccadic behaviour, such as regressions?
- RQ4. What are the relative contributions of form in the fixations during the identification of genres of e-mail? Are there instances of mutually dependent elements? How do the form

features of a genre assist in text interpretation and use? Is format alone enough to identify texts in some instances? Do participants 'fixate upon' shapes/features of the layout of e-mail texts in four different representations (conditions 1-4) by predominantly using fixation ocular behaviour?

RQ5. Is there any evidence of the "Frame" theory (Frow, 2006a, pp. 103-9) (see 2.1.7), Lorch's "Signaling Devices" (Lorch, 1989) or the "Landmarks" (discussed in Heffron et al. (1996)) in user activities involving internal and external cues, while they are identifying the e-mails?

RQ6. Are there instances of skimming and scanning behaviour, particularly in shapes of features of the layout of e-mail texts in four different structural representations?

RQ7. What are the relative contributions of form in the scanpaths during the identification of genres of e-mail? Are there instances of mutually dependent elements?

RQ8. Do the lengths and durations (gaze point samples) of scanpaths significantly differ between each e-mail structural representation or genre?

The research questions for study one are cross-referenced with measurements.

### **3.4 Measurements**

The metrics used were:

1. Mean fixation duration: used to indicate any information difficulty, that is, the higher the durations more complex the mental load/task (RQs 1-5).
2. Mean Fixation Count: measures how many fixations were on a stimulus to determine cognitive processing (RQs 1-5).
3. Saccadic rate per second: which differs depending on task difficulty/mental load changes, that is, if task is difficult and cognitive processing increases then saccadic rate per second decreases and vice versa (RQs 2-3).
4. Regressive Saccades: records whether a user returns to the same zones repetitively due to fewer meaningful cues (RQs 1-3, 5).
5. Identification of genre: the number of e-mail genres identified correctly by each participant. The number of genres correctly identified measured the influence of the genre type (RQs 1-3).
6. Gaze Time: the length of time it took each participant to identify each e-mail genre. The time appropriated measured the effect of the e-mail form on the participant (RQ 1).

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7. Scanpaths (RQs 2-3, 6-8):

- a. Durations: measure how much time participants spend on processing information and 'complexity'
- b. Lengths: Shorter scanpaths indicate information is well organised and easier to locate. Lengthy scanpaths indicate fewer occurrences of efficient scanning behaviour.

### **3.5 Procedural task**

Each participant was shown a total of 64 e-mails, and asked to identify each genre by voice, while the eye tracking system recorded the ocular behaviour of the participants when shown each stimulus. The eye tracking equipment was fixed to the desk; only a simple answer to identify the genre was possible, because detailed discussions (head/face movements) would have interfered with the eye tracking.

To reduce any possible 'order effects', the e-mail types and their allocation had to be randomised. The eye tracker software had this functionality built in by using a four-by-four Latin Square for each participant. The order of activities was consent form and information sheet (Appendix A3), short training session, calibration of eye tracking system, entry questionnaire (Appendix A4), show each stimulus: four x blocks of 16 images and ask for an identification of type of genre whilst eye tracker records viewing behaviour, exit questionnaire (Appendix A5). There was a two-minute rest break after 32 images (two blocks of 16 images) after which the calibration was repeated and the second set of 32 images was shown. The reason that the procedure was split into blocks was two-fold:

- The ability of the participants to remember all the eight genres that they were identifying was discussed during the design and, once the pilot was complete, the task was found to be very difficult, so the genres were split into four blocks.
- The equipment would have caused discomfort for the participants if they had had to use it while sitting in one position without a break during the entire process; the images were therefore split into four blocks to allow the participants to have a break in between viewing each block of two images, if they wished. In addition, if screen recording was continued with the Screen Capture software Wink<sup>25</sup> for a long period of time, the system would crash and there would be no visual data to examine as a result of running out of Random Access Memory (RAM) and the software causing an Out Of Memory (OOM) exception.

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<sup>25</sup> Available at: <http://www.debugmode.com/wink/>

There were some similarities with the pilot study conducted by Toms & Campbell (1999a), for example, whereas the participants were asked: (1) “*what type of document is this?*” during the eye tracking recording. However, the participants were not asked (2) “*what characteristics led you to believe that the document is [answer to 1]*” or (3) “*what is the most discriminating characteristic that led you to believe that the document is [answer to 1]*” because the information could be extrapolated from the eye tracking data. However, these questions were asked in the post experiment questionnaire for cross-referencing.

### 3.6 Participants

Twenty-four unpaid volunteers, made up of six faculty members, fourteen students and four administrative/technical staff, took part in the experiments. The average age of the participants was 31.5; all were between 20-48 years old. The participants dealt with e-mail on a daily basis and could be expected to be familiar with the genres contained within the corpus. All participants were fluent in written and spoken English.

Participants were asked whether they were familiar with the eight types of genres collected for the study and the findings are displayed in Table 3.2 below. The majority, i.e., at least 18 of the participants, were familiar with each genre (score of at least three). The exceptions were cinema and seminar announcements, with which over one-third of the participants were largely unfamiliar.

**Table 3.2: E-mail familiarity amongst participants recorded from the questionnaire. Familiarity (1=completely unfamiliar 5=completely familiar) N.B. percentages rounded down.**

Type	Familiarity (1=completely unfamiliar/ 5=completely familiar). N.B. percentages rounded down				
	1	2	3	4	5
<b>CFP</b>	5%	13%	18%	30%	34%
<b>Cin</b>	25%	16%	29%	16%	12%
<b>Spm</b>	0%	0%	4%	29%	66%
<b>NL</b>	8%	16%	16%	37%	20%
<b>Ord</b>	4%	8%	12%	28%	45%
<b>ITS</b>	4%	4%	8%	32%	48%
<b>Sem</b>	12%	24%	12%	28%	20%
<b>Lib</b>	16%	12%	20%	32%	16%

---

### 3.7 Independent variables

The variables tested were as follows:

1. Type of e-mail genre (Table 3.1).
2. Form - three comparisons:
  - i. Blocks: Blocks 1 & 2 (genre types: Calls for Papers, Spam, Cinema and Newsletters. Blocks 3 and 4 (genre types: Information Technology Services (ITS) Notice, Seminar, Library and Orders genres). A comparison is carried out between blocks 1 and 2 and between blocks 3 and 4 in order to ascertain whether there are any significant cognitive differences between the scanpaths from block to block.
  - ii. Genre types: Call for Papers, Spam, Cinema and Newsletters, Information Technology Services (ITS) Notice, Seminar, Library and Orders genres. A comparison is carried out between blocks 1 and 2 and between blocks 3 and 4 in order to ascertain whether there are any significant cognitive differences between the scanpaths from genre to genre. This comparison can indicate the differences in cognitive processing as the experiment progressed, for example, is there is a pattern showing that the scanpaths became shorter or longer from genre to genre?
  - iii. Representations: the four representations of the above eight genres were: original e-mail (condition 1) with no formatting or content changes; the e-mail with the original formatting but with semantic content replaced with X or 9s (condition 2). This version retained possibly useful structural formatting clues but did not provide any content for the semantic identification of the e-mail. Successful identification of genre based on this version would indicate the role played by structural form in identifying genre; the e-mail with the original textual content but all structural formatting removed (condition 3). This version retains punctuation but presents the text as a stream of text; condition 4 was the e-mail with all content replaced by Xs or 9s (as in condition 2) and all structure removed (as in condition 3). This version gives no indication of content and acts as a baseline to measure participants' attempts to identify e-mail genre. A comparison is carried out between representations in order to ascertain whether there are any significant cognitive differences between the scanpaths from representation to representation.

---

### **3.8 Results and Analysis**

#### **3.8.1 Debrief**

Each participant was requested to scale the experience on a psychometric *Likert scale* of three to state how enjoyable it was and if not enjoyable, to state the reasons why. Three people stated that it was not enjoyable because the calibration on the Arrington system was too sensitive to changes of position, i.e., slight movements, so it was recommended that the calibration be improved; there was, of course, no immediate remedy on hand because the design of the equipment could not be changed. One participant expressed annoyance with the categorisation task but did not explain why. Seventeen participants rated their experience as “*neutral*” and four said it was “*enjoyable*”. When asked for an opinion of the ease of the task on a three point Likert scale, six of the participants said it was frustrating, five said neutral and thirteen replied that it was easy. Six of the respondents who expressed frustration did not give any reasons for this in the free form text box, but it can be inferred from the previous ‘enjoyment’ question that their “*frustration*” was probably related to the calibration.

All the participants were asked if they had consciously used a strategy for classification (Likert Scale of five). One person was Completely Unsure; two were Not Completely Sure, three stated they Didn’t Know; twelve were Quite Sure they had and three Completely Sure they had. Again, on a Likert Scale of five, on being asked if they had “*Consciously Altered the Strategy*”, three were not really sure, four Didn’t Know, eleven Quite Sure and four Completely Sure (nobody stated condition one, Not at All Sure). In the free form text box to describe what the strategy was originally and whether any alteration had been made, there were two replies: firstly: “*I was continuously trying to match up what I had seen before. I was guessing to start with*” and secondly, (and mistakenly) the next participant said: “*I dont[sic] think so. Textual content is the most important feature, thenstructure[sic]*” which is an interesting opinion but not really relevant for this free form text input box.

#### **3.8.2 Post Experiment Remarks**

The discriminating features listed were from two sources: firstly, the most characteristic features noted down during the analysis of the data, and secondly, those drawn from the post-experiment questionnaire. During the experiment, each image was displayed to each participant and then, on the screen, eye tracking scanpath activity was captured by screen recording. The fixation

clusters/scanpath activity over the areas of interest, i.e., features such as emboldened titles, were then interpreted by examining each screen shot manually.

Post-experiment, the participants pointed out the most characteristic attributes(s) of the images and later justified briefly, in a post-experiment interview, how they arrived at that judgement. Overall, the conclusions regarding the features made by the participants were analogous (listed in Table 3.3), with little variation. However, there were dissimilarities between participants at the feature level, which as Toms & Campbell (1999b) found precludes the specification of an exclusive parsimonious set of attributes per genre.

**Table 3.3: Feature(s) deemed important by the participants quoted in questionnaire responses (from content with and without structure representations)**

Genre	Features: comments in quotes are real responses from questionnaires. None-quotes are extrapolated from eye tracking data analysis.
Calls for papers	<ul style="list-style-type: none"> <li>• <i>“A conference title followed by a blurb and an item list of dates”. “Key dates, title of conference or journal, lots of capitals, information separated out”</i>.</li> <li>• Title of journal/conference, e-mail addresses, themes, article/paper specifications</li> <li>• <i>“Key dates, title of conference or journal, lots of capitals, information separated out”</i></li> <li>• <i>“Call at start, asterisks or separators, deadline for submissions, address at end standard header with date, list of topics”</i></li> <li>• Conference name, location/date etc., deadline, links to conference website</li> <li>• heading, organisation and venue, return e-mail address, date</li> <li>• <i>“Central main heading, Format and Content”. “Standard header with date, list of topics bold text, letter format”</i></li> <li>• structured title and brief, followed by denser passage of text, and contact details. A notice saying: call for papers</li> <li>• Big heading with organisation and venue, return e-mail address, date e-mail address in middle/end of text (@ symbol)</li> </ul>



Cinema	<ul style="list-style-type: none"> <li>• Lots of blocks/lists times, dates</li> <li>• Table of films</li> <li>• <i>“movie titles, blocks of times and places”</i></li> <li>• <i>“rows of text followed by numbers noting times.”</i></li> <li>• <i>“Film names, times and days list time”</i></li> <li>• <i>“Times, I.E, 99:99 (colon)”</i></li> <li>• <i>“times, movies names, tabular format”</i></li> <li>• <i>“what's on, list of films/times/dates. Cost of any tickets. Special offers”</i></li> <li>• <i>“digits (times), list of titles”</i></li> <li>• <i>“list of titles, times</i></li> <li>• <i>“table of films</i></li> <li>• <i>“lots of blocks/lists times, dates</i></li> <li>• <i>“name of cinema, list of film times/dates, links to book</i></li> <li>• <i>“film title, time of showing, location, price of ticket</i></li> <li>• <i>“not sure, unfamiliar with these</i></li> <li>• <i>“Content (like movie title, date)”</i></li> <li>• <i>“Film titles and times/dates”</i></li> <li>• <i>“Short messages notifying of an expiry date or similar”</i></li> <li>• <i>“Posters of movies showing on particular days.”</i></li> </ul>
Newsletter	<ul style="list-style-type: none"> <li>• List of headlines, multiple blocks. List of headlines, multiple blocks of text with links at bottom of each block.</li> <li>• <i>“Common/identical or linear structure split into sections”</i></li> <li>• <i>“Columns of small text, like a newspaper, bold headings”</i></li> <li>• <i>“Quite long, name of company/organization etc., at top, date/month of newsletter, a number of short paragraphs on various topics, possibly a number of links to get more information on the various topics listed.”</i></li> <li>• Newsletter title</li> <li>• <i>“These tend to vary but generally columns or linear paragraphs”</i></li> <li>• <i>“A list of headlines, followed by multiple blocks of text with links”</i></li> </ul>

	<ul style="list-style-type: none"> <li>• <i>“Blocks of text at the top denoting main headings, blocks of text titled at the top possibly in bold.”</i></li> <li>• <i>“Different long paras of text - again more dependent on who writes it. More scope for differences.”</i></li> <li>• <i>“large blocks of text/lists, overall longer message mostly text, some numbers. Hard to tell from spam.”</i></li> <li>• <i>Latest news, header - text type layout.</i></li> <li>• <i>“common structure split into sections title, large block of text, sender details title of what the news is about”</i></li> <li>• <i>“big title. Really obvious. Keyword”</i></li> <li>• <i>“newsletter title, different sections, these tend to vary but generally columns or linear paragraphs”</i></li> <li>• <i>“Format, normal letter format”</i></li> <li>• <i>“Neutral language (not colourful), Possibly separated news with page break”</i></li> </ul>
Spam	<ul style="list-style-type: none"> <li>• <i>“keywords (e.g. Viagra) possibly misspelt, short messages, not much coherence. Capitals, mangled English, laid out like a letter uppercase titles”</i></li> <li>• <i>“Could be anything, wide ranging. Money usually mentioned</i></li> <li>• <i>“capitals, exclamation marks, letter style ('dear sir',etc.)”</i></li> <li>• <i>“Specific words e.g. congratulations or exclamation marks”</i></li> <li>• <i>“Fairly to very short, sometimes unformatted random or quasi-random text, financial info”</i></li> <li>• <i>“random - usually has a headline title that stands out, usually a you have won message lots of symbols/uppercase”</i></li> <li>• <i>“Words that seem in depth at first but at closer in spection [sic] are rubbish, or an unknown e-mail address”</i></li> <li>• <i>“Lengthy wordings, mostly uncoordinated text”</i></li> <li>• <i>“Poor layout, product names, large font”</i></li> <li>• <i>“Currency symbols, certain unfamiliar names”</i></li> </ul>

	<ul style="list-style-type: none"> <li>• <i>"Lists of costs, totals, store name/address, buyer"</i></li> </ul>
<p>Information Technology Services Notices</p>	<ul style="list-style-type: none"> <li>• <i>"Spread out, a list of dates/times and a block of text attempting to describe the problem."</i></li> <li>• <i>"Headings, blocks of text perhaps titled in bold contact details of ITS at bottom."</i></li> <li>• <i>"table with what was out, when, who it affected, when they are going to (not) fix it..."</i></li> <li>• <i>"Short, times, spaces between short statements"</i></li> <li>• <i>"Technical IT terms, minimal e-mail formatting"</i></li> <li>• <i>"Fault, users affected, time, usually in box/table standard order and form of contents RGU logo, pictures, column text"</i></li> <li>• <i>"Title, user group affected section, times/dates on separate [sic] lines"</i></li> <li>• <i>"Table with departments affected, small paragraph. Times and dates."</i></li> <li>• <i>"Time, duration, type of system down"</i></li> <li>• <i>"Structured content with lines between sections"</i></li> <li>• <i>"Content, e.g., words "Computer" or "system"</i></li> <li>• <i>"Subject as ITS (or similar) and outage in the text"</i></li> <li>• <i>"Name of organisation inviting me for the seminar, Salutations and secretary signature at the end."</i></li> <li>• <i>Fault, departments affected, time, box/table</i></li> <li>• <i>"ITS notice heading at top, short message usually in the format of a table indicating the time/date/reason of outage."</i></li> <li>• <i>"Dates, problems summary, solution in a table"</i></li> </ul>
<p>Library</p>	<ul style="list-style-type: none"> <li>• <i>Expiry dates of book due back, list of book titles, links to online library.</i></li> <li>• <i>Dates, list of items</i></li> <li>• <i>Book names, name, address details</i></li> <li>• <i>"Bold text, formatting, post code at end (xx99 9XX)"</i></li> <li>• <i>RGU address and contact details (RGU specific) your address and account details, details of items recalled/due name and address, date</i></li> <li>• <i>"Paragraph formatting, positioning of numbers."</i></li> </ul>

	<ul style="list-style-type: none"> <li>• <i>“library address at start, date, list of books, library id, dear student, book names”</i></li> <li>• <i>“list of items with small headline, and block of text at bottom</i></li> <li>• <i>book name”</i></li> <li>• <i>“don't know/no separate[sic] paragraphs”</i></li> <li>• <i>“Details of books etc. requested, general library info at bottom”</i></li> <li>• Library word, return date, book title</li> <li>• <i>“Not sure, an address?”</i></li> <li>• <i>“Dates and title of book”</i></li> <li>• <i>“Short messages notifying of an expiry date or similar”</i></li> </ul>
Seminar	<ul style="list-style-type: none"> <li>• Name of speaker, abstract of research, time and place.</li> <li>• A big block of text (abstract), with a clear title.</li> <li>• <i>“Date, time, subject, speaker, more fluid in structure depending on who was writing it”</i></li> <li>• Invitation. Date, speaker, title, abstract, name/address of Seminar organiser</li> <li>• Speaker's name, title of seminar, date/time/place of seminar, maybe abstract, contact details of seminar organiser.</li> <li>• Big and bold text for the headlines; pictures and lengthy, well articulated and coordinated words thereafter</li> <li>• Name of organisation inviting me for the seminar, salutations and secretary signature at the end.</li> <li>• Abstract, speaker name, blurb of research, location and time”</li> <li>• <i>“As with cfp [Call for Papers], address details, title at top”</i></li> <li>• <i>“date, time, subject, speaker, more fluid in structure depending on who was writing it”</i></li> <li>• <i>“date, time, title, speaker, detached summary, formatting, e-mail addresses”</i></li> <li>• <i>“Name of seminar, academic e-mail address standard header with title and speaker”</i></li> </ul>

	<ul style="list-style-type: none"> <li>• <i>“notice format, some bold text notice saying seminar”</i></li> <li>• <i>“seminar title, time, date, location not sure, these tend to vary in format”</i></li> <li>• <i>“Content (like “Seminar”)”</i></li> <li>• <i>“An introduction with times/dates after preceded by a name</i></li> <li>• <i>Details of orders, summary, receipt of orders made.</i></li> </ul>
Orders	<ul style="list-style-type: none"> <li>• <i>Decimalised numbers, lists, tables, £ symbology, address block.</i></li> <li>• <i>“prices, items shipped, address of shipment Yes, @ and numerics”</i></li> <li>• <i>“Organised mainly in a list with descriptions[sic], quantities and prices decimalised numeric”</i></li> <li>• <i>“addresses, list/table of goods purchased, name of store £ signs, prices, list and total”</i></li> <li>• <i>“Formatting of paragraphs with item description, E-mail at end of text.”</i></li> <li>• <i>“Currency, tabular layout format lists of costs, totals, store name/address, buyer, name address numbers (reference and currency) prices, order number, short letter tight structure outline of items &amp; expenses, totals etc. price and thank you message numerics, dates”</i></li> <li>• <i>“numbers prices pound symbol”</i></li> <li>• <i>“company name, date of order, list of items ordered, possibly delivery date, general company information at the bottom and links to shop webpages.”</i></li> <li>• <i>“very structured with pricing format”</i></li> <li>• <i>“Format and Content (e.g., price)”</i></li> <li>• <i>“Professional, with id numbers and prices.”</i></li> <li>• <i>“Details of orders, summary and sometimes, receipt of orders made. Block text”</i></li> </ul>

### 3.8.3 Timed-response metrics

These metrics are designed and formed as an accumulation of evidence based strategy, which asks participants to fixate on a juxtaposition of advantageous features based on immediacy for attention and relevance, and building up evidence to a point where a decision can be made - this strategy is driven by the timed response format. Several types of numerical data were collected to

account for any observations, provide an evaluation, along with statistical tests, and interpretation of the results for discussion.

### 3.8.3.1 Rate of correct genre identification

On average, 53% of the e-mails were correctly identified. Breaking these figures down (Table 3.4) showed that the identification of the:

- original (N) format averaged 78%
- original format with semantic content removed (X) averaged 71%
- semantic content with no structure (U) averaged 44%
- version with no semantic content and no structure (UX) averaged 22%.

Table 3.4: Average identification of genres and representations.

Genre	N	X	U	UX	Avg
CFP	79%	82%	47%	21%	57%
Cin	73%	56%	30%	18%	44%
ITS	79%	68%	44%	12%	51%
Lib	79%	71%	47%	18%	54%
NL	70%	59%	36%	15%	45%
Ord	79%	75%	47%	9%	53%
Sem	76%	65%	38%	38%	54%
Spm	85%	91%	62%	41%	70%
Avg	78%	71%	44%	22%	

Eliminating all identifying features, not surprisingly, showed the lowest performance, as there were no semantic or structural cues. However, with all blocks results added together it is higher than the one in four performance that might have been estimated from pure guesswork! A Wilcoxon significance test was conducted on the identification for all four conditions. Preserving format over content did indicate more positive and precise genre identification (original e-mails (N) identified significantly more accurately than no form/no content (UX), (Mdn=55.5)  $z=-2.524$ ,  $p=0.012$ ,  $r=.51$ ; formatting with no content (U) significantly more accurately than no form/no content (UX), (Mdn=49.0)  $z=-2.371$ ,  $p=0.018$ ,  $r=.48$ ; content with no formatting (U) significantly more accurately than no form/no content (UX), (Mdn=49.0)  $z=-2.521$ ,  $p=0.012$ ,  $r=.51$ . This denotes that retaining either content or form significantly improves genre identification compared with merely speculating a genre identification.

As might have been predicted, a common genre which was encountered by the participants on a regular basis (Spam 70%, Call for Papers 57%, Seminars and Library both 54% were identified correctly most regularly while the Cinema genre 44% was the least identified. Newsletters were identified 45% of the time, Orders 53%, and ITS Outages, 51%.

### 3.8.3.2 Identification of genre gaze time-form

The interval it took to classify a genre was recorded and measured (Table 3.5). The time recorded was measured from when the image was shown to the time when the participant gave an oral genre identification. The eye tracker system recorded this to the thousandth of a second. Average measures were taken for each representation of genre of e-mail as well as standard deviation. Some genres were more quickly identified than others: the Orders genre was recognised most rapidly (4.23 seconds on average), while Call for Papers took the longest to identify (6.30 seconds on average).

Table 3.5: genre identification response in seconds

Genre	N	X	U	UX	Avg
CFP	3.76	5.24	5.72	10.50	6.30
Cin	3.20	4.30	5.08	6.57	4.78
ITS	2.72	4.43	4.03	7.16	4.58
Lib	3.48	3.87	4.76	6.32	4.60
NL	4.31	4.54	6.70	6.13	5.42
Ord	3.03	3.43	3.89	6.57	4.23
Sem	3.13	4.63	4.20	5.66	4.40
Spm	4.14	5.02	6.27	6.42	5.46
Avg	3.47	4.43	5.08	6.91	
SD	2.19	3.24	4.23	7.79	

A pairwise significance test was conducted on the average response times for the four conditions. Retaining either e-mail formatting or content led to significantly faster identification than removal of both (original e-mails (N) identified significantly faster than no form/no content (UX), (Mdn=4.99)  $z=-2.524$ ,  $p=0.012$ ,  $r=.51$ ; formatting with no content (U) significantly faster than no form/no content (UX), (Mdn=5.45)  $z=-2.371$ ,  $p=0.036$ ,  $r=.48$ ; content with no formatting (U) significantly faster than no form/no content (UX), (Mdn=5.93)  $z=-2.521$ ,  $p=0.012$ ,  $r=.51$ . This indicates that retaining either content or form significantly improves genre identification compared with simply guessing a genre.

The original (N) e-mails were identified significantly faster than any other condition ((Mdn=3.82)  $z=-2.533$ ,  $p=0.12$ ,  $r=.51$ , against formatting with no content (X); (Mdn=3.96)  $z=-1.970$ ,  $p=0.49$ ,  $r=.40$ , against content with no formatting (U); (Mdn=4.99)  $z=-2.524$ ,  $p=0.12$ ,  $r=.51$ , against no format with no content (UX);) indicating that both form and content are important for fast identification of e-mail and their occurrence together leads to optimal identification. The original e-mail was identified fastest for all genres.

The version of the e-mails that retained structure but no content was identified significantly faster than the version with content preserved but no formatting (U) (Mdn=4.49)  $z=-2.524$ ,  $p=0.012$ ,  $r=.51$ . The only genres for which the e-mails with structure preserved were more slowly identified were the ITS and Seminar.

### **3.8.4 Results and Analysis using Fixation and Saccade Derived Metrics**

#### **3.8.4.1 Fixation derived metrics**

The eye tracking data was analysed to investigate how the participants' eye movements shed light on how certain types of texts may cause certain types of processing. According to Rayner (1998, 2009), amongst others, fixations have been linked to intense cognitive processing. In Table 3.6 the average fixation count for each genre is shown. There are two statistical differences. The original (N) version of the e-mail vs. no form with content (U) (Mdn=6.48)  $z=2.521$ ,  $p=0.012$ ,  $r=.51$  and the original (N) e-mail vs. form no content (X) had fewer fixations (Mdn=13.79)  $z=-1.820$ ,  $p=0.069$ ,  $r=.42$ .

**Table 3.6: Genre identification mean fixation count**

<b>Genre</b>	<b>N</b>	<b>X</b>	<b>U</b>	<b>UX</b>	<b>Avg</b>
<b>CFP</b>	7.62	8.91	9.77	8.85	8.78
<b>Cin</b>	5.02	7.10	6.18	8.06	6.59
<b>ITS</b>	3.75	10.04	5.65	5.60	6.26
<b>Lib</b>	6.73	7.38	7.85	6.65	7.15
<b>NL</b>	7.85	6.20	8.91	5.45	7.10
<b>Ord</b>	4.94	5.73	5.22	7.02	5.72
<b>Sem</b>	4.49	9.46	6.23	6.09	6.56
<b>Spm</b>	8.75	9.97	9.83	5.45	8.50
<b>Avg</b>	6.14	8.09	7.45	6.64	
<b>SD</b>	5.875	8.145	7.04	6.37	



Table 3.7: Genre identification mean fixation duration (microseconds)

Genre	N	X	U	UX	Avg
CFP	270	282	305	948	381
Cin	269	370	253	286	295
ITS	299	313	302	334	312
Lib	617	294	277	309	374
NL	269	370	253	286	295
Ord	227	392	028	027	169
Sem	278	336	292	297	301
Spm	291	293	296	270	288
Avg	315	296	251	345	
SD	278	313	277	297	

In Table 3.7, the mean fixation durations for each genre are shown. The mean fixation duration is measured in microseconds (ms) and Rayner (1998, p. 373) claims this affords a useful guide to the archetypal speeds at which the participants accomplish specific tasks. There were no significant differences between the fixation durations for the numerous formats.

#### 3.8.4.2 Saccade derived metrics

The saccadic rates per second (Table 3.8) signify fewer instances of/no cognitive processing (Rayner, 1998). The original (N) e-mail had a significantly higher saccade rate than the versions with no formatting (U and UX) but not the version (X) that retained the formatting (original (N) vs. no form/content (X), (Mdn=21.43)  $z=-2.521$ ,  $p=0.012$ ,  $r=.51$ ; original (N) vs. form/no content (X), (Mdn=21.65)  $z=-.980$ ,  $p=0.12$ ,  $r=.20$ ). The version that retained formatting but obscured the content (X) had a significantly higher saccade rate than the version no formatting or content (UX) (Mdn=19.74)  $z=-2.100$ ,  $p=0.036$ ,  $r=.42$ .

Table 3.8: Genre saccadic rate per second (p/s)

Genre	N	X	U	UX	Avg
CFP	41.13	49.01	29.39	22.85	35.59
Cin	27.51	21.08	19.38	21.61	22.40
ITS	21.25	21.29	21.23	19.84	20.90
Lib	20.34	18.98	18.67	15.24	18.31
NL	22.01	19.65	19.95	16.08	19.42
Ord	25.81	18.17	17.16	19.37	20.13
Sem	26.40	27.13	22.93	18.98	23.86
Spm	23.53	20.74	21.21	14.21	19.92
Avg	26.00	24.51	21.24	18.52	
SD	24.67	20.91	20.58	19.17	

Regressive saccades denote signs of fewer meaningful visual cues or features that may cause the eye to search repeatedly over the same zones looking for clues to identification during the search (Table 3.9).

Table 3.9: Genre Regressive Saccades

Genre	N	X	U	UX	Avg
CFP	12.07	10.20	15.55	14.48	13.08
Cin	6.47	9.90	13.58	14.60	11.14
ITS	9.05	8.98	12.67	20.33	12.75
Lib	9.55	11.35	12.21	12.16	11.32
NL	10.54	11.63	14.33	26.30	15.70
Ord	8.16	7.44	13.05	17.14	11.44
Sem	8.75	12.67	7.31	22.73	12.87
Spm	7.84	13.08	14.56	20.52	14.00
Avg	9.05	10.66	12.90	18.53	
SD	8.90	10.78	13.32	18.74	

The original e-mail (N) caused fewer regressive saccades than either version with no formatting (U & UX) (original vs. no form/content, (Mdn=12.12)  $z=-2.521$ ,  $p=0.017$ ,  $r=.51$ ; original vs. form/no content, (Mdn=9.73)  $z=-1.400$ ,  $p=0.012$ ,  $r=.28$ , indicating that the loss of formatting did not only cause more searching but also that the participant regressed to areas already scanned. The version

that retained formatting but obscured the content (X) had a significantly lower regressive saccade rate than (UX) the format which removed both content and formatting (Mdn=12.88)  $z=-1.960$ ,  $p=0.012$ ,  $r=.40$ .

The results according to the four conditions of each genre can be summarised as follows:

- the original (X) e-mail was identified correctly more often and more quickly than any other version (N, U or UX).
- the version with content removed, but formatting retained (X), were identified less quickly than the original (N) e-mail. However, there were no significant differences between this version (X) and the original in terms of number of fixations, duration of fixations and number of saccades. This version (X) also had a similar regressive saccade rate to the original (N) e-mail, indicating that the formatting gave useful structural clues.
- the versions with structure removed (U and UX) were identified correctly on fewer occasions than the original (N) or the versions with no content (U and UX). They also resulted in more fixations than the original (N) and fewer saccades indicating a higher level of cognitive processing.
- the version with no structure or content (UX) had a low level of correct identification, high fixation duration and low saccade rate. In this case, it is interesting that participants were obviously, as the response time and eye tracking data revealed, attempting to make sense of these e-mails rather than simply hazarding a guess as a response.

### ***3.8.5 Results and Analysis using Scanpath Derived Metrics***

#### ***3.8.5.1 Scanpath Durations***

Scanpath durations measure how much time participants spend on processing information and “complexity” (Goldberg & Kotval, 1999, p. 638); longer scanpath duration indicates participants are spending more time processing information and hence classifying information is far more ‘intensive’. For each variable, a one-way ANOVA was conducted to assess scanpath durations by blocks (Table 3.10), genre (Tables 3.11 & 3.12) and representation (Table 3.13). There were significant differences between blocks 1 & 2<sup>26</sup> ( $p=0.001$ ) and blocks 3 & 4<sup>27</sup> ( $p=0.001$ ).

The scanpaths in this case, most notably, became temporally shorter in duration (measured in microseconds) between the blocks 1 & 2 and 3 & 4. This might be an indication that the participants

<sup>26</sup> Blocks 1 & 2 (genre types: Call for Papers, Spam, Cinema and Newsletters).

<sup>27</sup> Blocks 3 & 4 (genre types: Information Technology Services (ITS) Notice, Seminar, Library and Orders genres.)

found the e-mails easier to process cognitively & thus 'identify' as time went on. It might also show that cognitive processing diminished over time as the tasks became easier.

**Table 3.10: Mean scanpath durations by block**

<b>Block 1</b>	<b>Block 2</b>	<b>Block 3</b>	<b>Block 4</b>
1490 m/s	1164 m/s	570 m/s	470 m/s

Block 2 indicated temporally shorter durations of scanpaths compared with Block 1. It may therefore be assumed that from the cognitive processing perspective; the first four types of e-mails became less complex when presented during the experimental session. The scanpath durations in Blocks 3 & 4 followed the same trend, but all showed much shorter durations which indicate that the task became easier as the experiment progressed, and/or the four genres were less cognitively complex. Three of the four genres in Blocks 3 & 4 were internal types of e-mail obtained from The Robert Gordon University, which may also have been a relevant factor due to familiarity, although familiarity was not statistically significant.

**Table 3.11: One-way ANOVA mean scanpath durations by genre in microseconds**

	<b>Numerator (DF)</b>	<b>Denominator (DF)</b>	<b>F-Value</b>	<b>Sig</b>
Genre	7	1535	29.222	p=0.000

**Table 3.12: Bonferroni post-hoc comparison tests of Genres mean scanpath durations**

<b>Genre</b>	<b>Durations (microseconds)</b>	<b>Longer</b>	<b>Significance</b>	<b>Shorter</b>	<b>Significance</b>
Call for papers (CFP)	1372	ITS Notice, Lib, Ord & Sem	p<0.001		
Cinema (Cin)	1193	ITS Notice, Lib & Ord	p<0.001		
Spam (Spm)	1338	ITS Notice, Lib, Ord & Sem	p<0.001		
Newsletter (NL)	1405	ITS Notice, Lib, Ord and Sem	p<0.001		

Orders (Ord)	518			CFP, Cin, NL & Spm	p=<0.001
Information Technology Services (ITS) Notice	385	Semi	p=0.011	CFP, Cin, Spm & NL	p=<0.001
Seminar (Sem)	776	ITS Notice	p=0.025	CFP, NL & Cin	p=<0.001 (except Cin p=0.011)
Library (Lib)	414			CFP, Cin, NL & Spm	p=<0.001

As shown in Table 3.12 the Block 1 & 2 e-mails' (Calls for Papers, Spam, Newsletters and Cinema) scanpaths were temporally much longer than those of Blocks 3 & 4 (ITS, Library, Order and Seminar) and thus generally seemed more complex to decode overall. The ITS e-mails had the shortest durations in Blocks 3 & 4, and the seminars, the longest. In Blocks 1 & 2 (see Table 3.12), the Cinema e-mails were the least complex and the Newsletters, the most complex; the latter result was not surprising since the Newsletters had the least amount of formatting to assist in the decoding of identification by the participant<sup>28</sup>.

**Table 3.13: One-way ANOVA mean scanpath durations by representation in microseconds**

	<b>Numerator (DF)</b>	<b>Denominator (DF)</b>	<b>F-Value</b>	<b>Significance</b>
Representation	3	1535	12.922	P=0.000

Bonferroni post-hoc tests revealed that there were significant differences between the four representations specified (Table 3.13). The normal (N) representation is significantly shorter than the formatting retained with contents removed (X) (p=<0.001). The X representation is significantly longer than the normal (N), unformatted (U) and unformatted with no contents were (UX) all (p<0.001). The unformatted (U) e-mails were shorter in duration than X e-mails (p=<0.001). The UX

<sup>28</sup> The identification mentioned is self-reported by the participants and not always correct (Tables 3.5 & 3.6).

e-mails were only significantly shorter than X ( $p < 0.001$ ). With regard to the temporal representations, the normal e-mails (considered as a baseline) were the shortest; unformatted with no content (UX) format were the next longest; unformatted with content (U), the third longest, formatted with no content (X) stimulated the longest scanpaths.

### 3.8.5.2 Scanpath Length

Scanpath length is calculated by adding the distances between the gaze samples (measure in pixels (px)) together. For search tasks involving mainly information, the best scanpath contains a direct route to the intended target area, with comparatively small fixation duration at the area of interest (Goldberg & Kotval, 1999, p. 638). Smaller scanpaths are interpreted so that the content is well laid out and simpler to detect, e.g., in text or a GUI. As described by (Goldberg & Kotval, 1999, p. 638) lengthy scanpaths indicate fewer incidences of resourceful scanning performance but temporal processing of information and searching cannot be classified separately unless equated with other metrics, such as fixation-based measures. Since the scanpaths are formed by computing the fixations and saccades, this allowed inferences to be drawn regarding the allocation of the user's 'attention', i.e., cognitive processing, to the stimuli (Goldberg & Kotval, 1999, p. 638). In other words, searching was far more 'intensive'.

Table 3.14: Mean scanpath lengths by block (px)

Block1	Block2	Block3	Block4
2960 px	1623 px	618 px	742 px

For each variable, a one-way ANOVA was conducted to assess scanpath lengths by blocks (Table 3.14), genre (Table 3.15 and 3.16) and representation (Table 3.17). There were significant differences between blocks 1 & 2 ( $p = .001$ ) and blocks 3 & 4 ( $p = .040$ ). The scanpath lengths in this case became spatially shorter between blocks 1 & 2 but the participants' scanpath lengths became longer from block 3 to 4. The differences in the scanpaths in Blocks 1 & 2 were significantly large (Table 3.14). Block 1 (mean=2960) was almost twice the size of Block 2 (mean=1623) from which it could be inferred that the image-searching processes became more efficient as the Blocks progressed.

Table 3.15: One-way ANOVA mean scanpath lengths by genre in pixels (px).

	Numerator (DF)	Denominator (DF)	F-Value	Significance
Genre	7	1535	63.988	$p = 0.000$

**Table 3.16: Bonferroni post-hoc comparison tests of Genres mean scanpath lengths**

<b>Genre</b>	<b>Lengths (px)</b>	<b>Longer</b>	<b>Significance</b>	<b>Shorter</b>	<b>Significance</b>
Call for papers (CFP)	2121	ITS Notice, Lib, Ord & Sem	p=<0.001		
Cinema (Cin)	2114	ITS Notice, Lib, Ord & Sem	p=<0.001		
Spam (Spm)	2424	ITS Notice, Lib, Ord & Sem	p=<0.001		
Newsletter (NL)	2506	ITS Notice, Lib, Ord & Sem	p=<0.001		
Orders (Ord)	575	CFP, Cin, NL and Spm	p=<0.001		
Information Technology Services (ITS) Notice	698			CFP, Cin, NL and Spm	p=<0.001
Seminar (Sem)	802	CFP, Cin, NL and Spm	p=<0.001		
Library (Lib)	646			CFP, Cin, NL and Spm	p=<0.001

The scanpath lengths (Tables 3.15 and 3.16) followed approximately the same trend as the durations. The Block 1 & 2 e-mails (Calls for Papers, Spam, Newsletters and Cinema) scanpath lengths were less efficient in scanning for features overall but the differences were statistically

insignificant between them, with the one exception of seminar e-mails. The scanpaths for this genre were statistically shorter (Table 3.16 and 3.17) than the entire block one e-mails. Blocks 3 & 4 (ITS, Library, Order and Seminar) e-mails were overall more efficient to search. The scanpath lengths/scanning behaviour of the Seminar e-mail was the least efficient, ITS was second least efficient, third was the Library e-mail and the least efficient of all was the Order. As the scanpaths were formed from computed fixations and saccades, the apportioning of attention to the particular e-mail genres can be extrapolated, i.e., the longer the scanpaths, the more attention is given to making the identification, and vice-versa.

**Table 3.17: One-way ANOVA mean scanpath lengths by representation in pixels.**

	<b>Numerator (DF)</b>	<b>Denominator (DF)</b>	<b>F-Value</b>	<b>Significance</b>
Representation	3	1535	6.909	p=0.000

Bonferroni post-hoc tests showed that there were significant differences between the different representations of e-mails (Table 3.17). The normal (1313 px) e-mails were statistically shorter ( $p < 0.001$ ) than the X (1822 px). The normal (N) e-mails were significantly longer than all other types of e-mail representations. N ( $p < 0.001$ ), U ( $p = 0.002$ ) and UX ( $p = 0.008$ ). The U (1380 px) e-mail scanpaths were significantly spatially shorter ( $p = 0.002$ ). The UX (1427 px) e-mails' scanpaths were significantly spatially shorter than the X ( $p = 0.008$ ). In the representations, the normal (N) scanpath lengths were significantly shorter in length than the formatted with no content (X) e-mails; the formatted with no content caused longer scanpath lengths than all the other representations. The unformatted and no content e-mails (UX) caused significantly shorter scanpath lengths than the formatted with no content (X).

This supports the hypothesis on the potential effect of structure, while searching and scanning for information, on a stimulus, such as an image or document.

### **3.9 Discussion & Summary of Findings**

#### **3.9.1 Timed-Response Measures, Fixation and Saccade Derived Data**

**RQ1. What are the relative contributions of form (structure) and purpose towards identifying genre in a timed-based response experimental format?** Clues that indicated the importance of form as well as purpose were abundant. A large proportion of the genres were identified correctly, and it may therefore be inferred that form (i.e., the structural features) is indeed important for the perception and identification of genre. The results showed quite clearly that form



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played a significant role in genre identification. According to the eye tracking data, there were many features which were deemed important for each genre from the sample collected (Table 3.3). This substantiates Watt (2009) and Toms & Campbell's (1999a) work, where they contended that the 'attributes' of a document's genre enable it to be specifically identified and showed that genre attributes play a significant role in the identification of documents.

**RQ2. Are two kinds (ecological and/or constructivist) of processes present in genre 'recognition' tasks?** The two perception processes were difficult to detect but some clues were found in the data collected, for example, when the participant was not aware of the genre type, he/she did not know what to expect in terms of attributes or layout nor did he/she have any previous knowledge to draw from. Therefore, if during the task, the genre was identified as a 'cinema' genre, it could be assumed that the e-mail had possibly afforded its purpose or, indeed, gained the reader's attention and/or directed the reader to the salient properties of the particular type. For example, the blocks of numeric values (layout and format features) *afforded* the information/action, e.g., the title of a movie, rating and list of times allowed the decision to be made regarding whether to go and watch a movie or not. These are created affordances, created partly because the human visual system is outstanding at pre-conscious processing. This is an accumulating evidence strategy, with people using features based on immediacy for attention and relevance, and building up evidence to a point where a decision can be made but, unlike constructivism, without cognition. Now, if the reader was fully familiar with a type of e-mail genre, again, cinema, this could lead to an 'expectation of purpose/form' with the result that the reader would compare knowledge expectation to visual attributes and thus recognise the purpose and form.

**RQ3. What oculographic methods do humans use when viewing and utilising the invariant layout cues, such as formatting features, that constitute genres? Are such features fixated upon and/or merely viewed with saccadic behaviour, such as regressions?** Different strategies for different representations of e-mail were noticed. When participants were shown a normal or normal with semantic content replaced representation, they used a circular scanning motion or indeed a 'cross' strategy which consisted of a left-right and then up/down behaviour but this was only detected when structure was left intact. The use of Microsoft Excel's XY scatter charts (Figure 3.7) made it possible to plot all the fixations and saccades recorded in the eye tracking viewpoint files, which were a good indicator of the useful features used by the participants. When introduced to the unformatted representations, the participants very often used the right side of the block of text in an up and down scanning pattern to identify the genre.

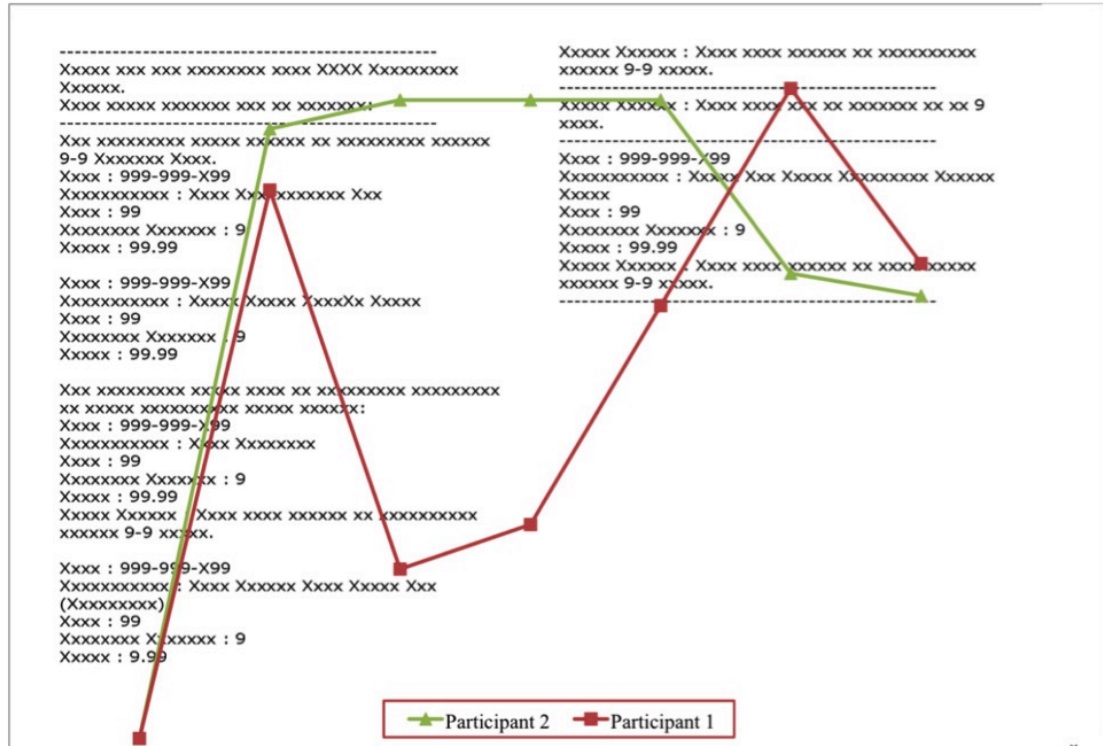


Figure 3.7: Screenshot from shows order e-mail with normal structure but no semantic content with fixations and saccades for participants 1-2 (data size reduced for reasons of clarity for the reader) plotted with Spreadsheet software.

**.RQ4. What are the relative contributions of form in the fixations during the identification of genres of e-mail? Are there instances of mutually dependent elements? How do the form features of a genre assist in text interpretation and use? Is format alone enough to identify texts in some instances? Do participants 'fixate upon' shapes/features of the layout of e-mail texts in four different representations (conditions 1-4) by predominantly using fixation ocular behaviour?** The participants fixated on blocks of text (paragraphs), emboldened and centred titles (e.g., Orders, Figures 3.7 & 3.8) and blocks of numeric (e.g., Cinema, Figure 3.9) and uppercase Xs on spam e-mails, of which there are many in the 'Nigerian letter' type.

There was as an interaction amongst the effects of the semantic content and formatting significantly in two conditions. N (condition 1) vs. U (condition 2) and N (condition 1) vs. X (condition 2) were both statistically different. The data showed that when comparing cognitive processing between N (condition 1) vs. U (condition 3), then U instigated more fixations, i.e., more scanning. Concerning N (condition 1) vs. X (condition 2), then X prompted many more fixations, again, indicating more scanning. This showed, in both cases, that there was an interaction amongst the effects of the semantic content and formatting, and although not all individual elements were statistically significant, there was a statistically significant interaction between the factors which indicated that both semantic content and formatting played a significant role in the classification of the e-mail

texts. Regarding the influence of the distinctive conditions on accuracy, the participants were mostly able to classify correctly, even when meaningful information was absent. The following effects were most noticeable:

- Formatting did have an effect on accuracy of classification, with significantly more mistakes made on unformatted e-mails in comparison with formatted examples (Mdn=55.5)  $z=-2.524$ ,  $p=0.012$ ,  $r=.51$ .
- Changing letters into 'X's and numerics into 9s had a significant effect on the accuracy of classification (Mdn=49.0)  $z=-2.371$ ,  $p=0.018$ ,  $r=.48$ .
- With all formatting removed, and letters changed to 'X's, participants performed well above coincidence when categorising messages (Mdn=49.0)  $z=-2.521$ ,  $p=0.012$ ,  $r=.51$ .

**RQ5. Is there any evidence of the “*Frame*” theory (Frow, 2006a, pp. 103-9) (see 2.2.6), Lorch’s “*Signaling Devices*” (Lorch, 1989) or the “*Landmarks*” (discussed in Heffron et al. (1996)) in user activities involving internal and external cues, while they are identifying the e-mails?**

The types of cues used by our participants have substantiated the ideas put forward by Frow (2006a, pp. 103-9) and also Genette (1997, p. 1). Particularly in the e-mails which consisted of structure with no content, the outer frame cues, i.e., paratextual information, were used because the participants perceived the shapes first, such as ‘chunks’ of texts like paragraphs. If the participants were then still uncertain they moved onto the internal cues, not the semantic content in this context, however, but structural cues, such as emboldened, and centralised titles, concentrations of numeric characters (replaced by 9s in orders and cinema e-mails) and many other instances of formatting and layout. In the unformatted e-mails, these behaviours were not recorded, but with one exception: the e-mails with a high concentration of numeric characters, such as orders and cinemas, were treated as internal cues for their genre identities.

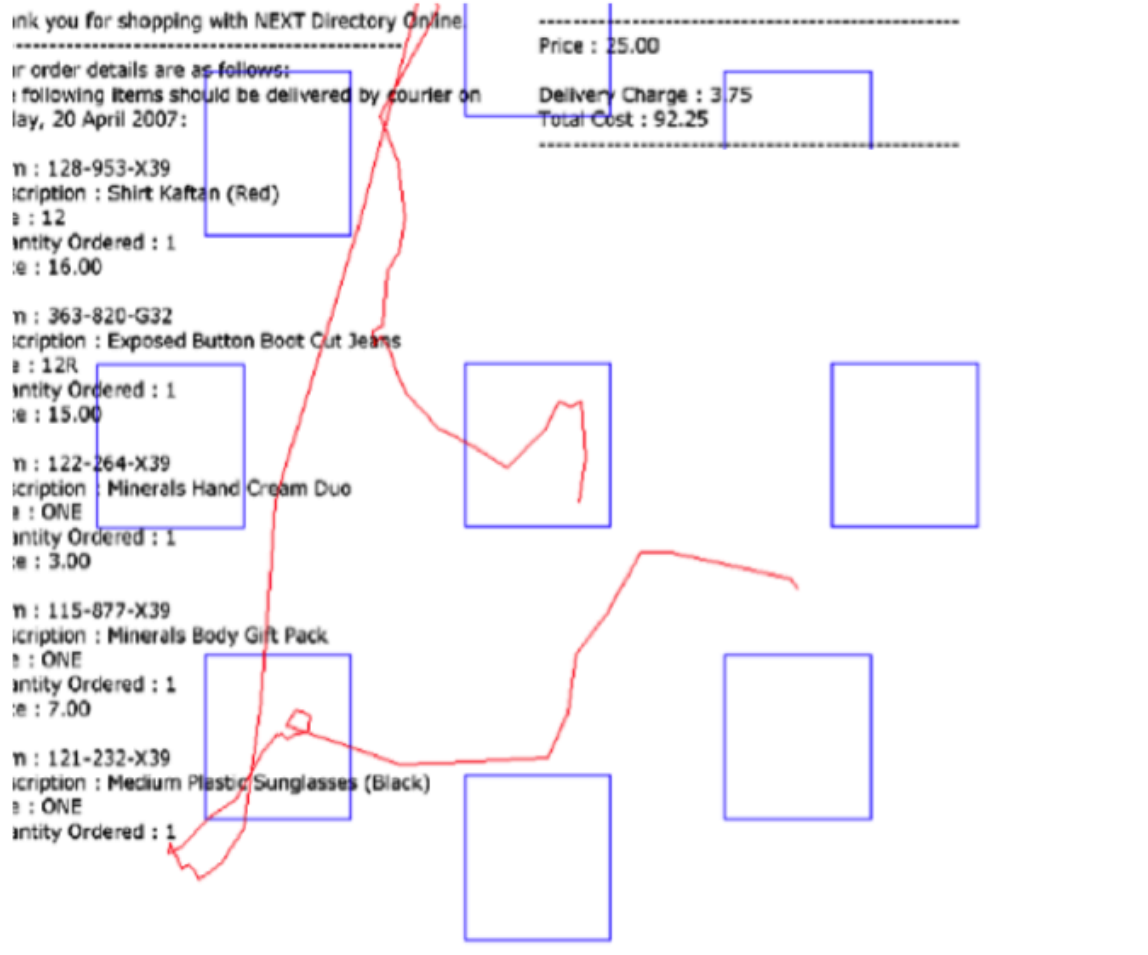


Figure 3.8: Screenshot shows participant 4 skimming some of the text on an original Orders e-mail until some information got his/her attention, such as the main title positioned at the top of the e-mail.

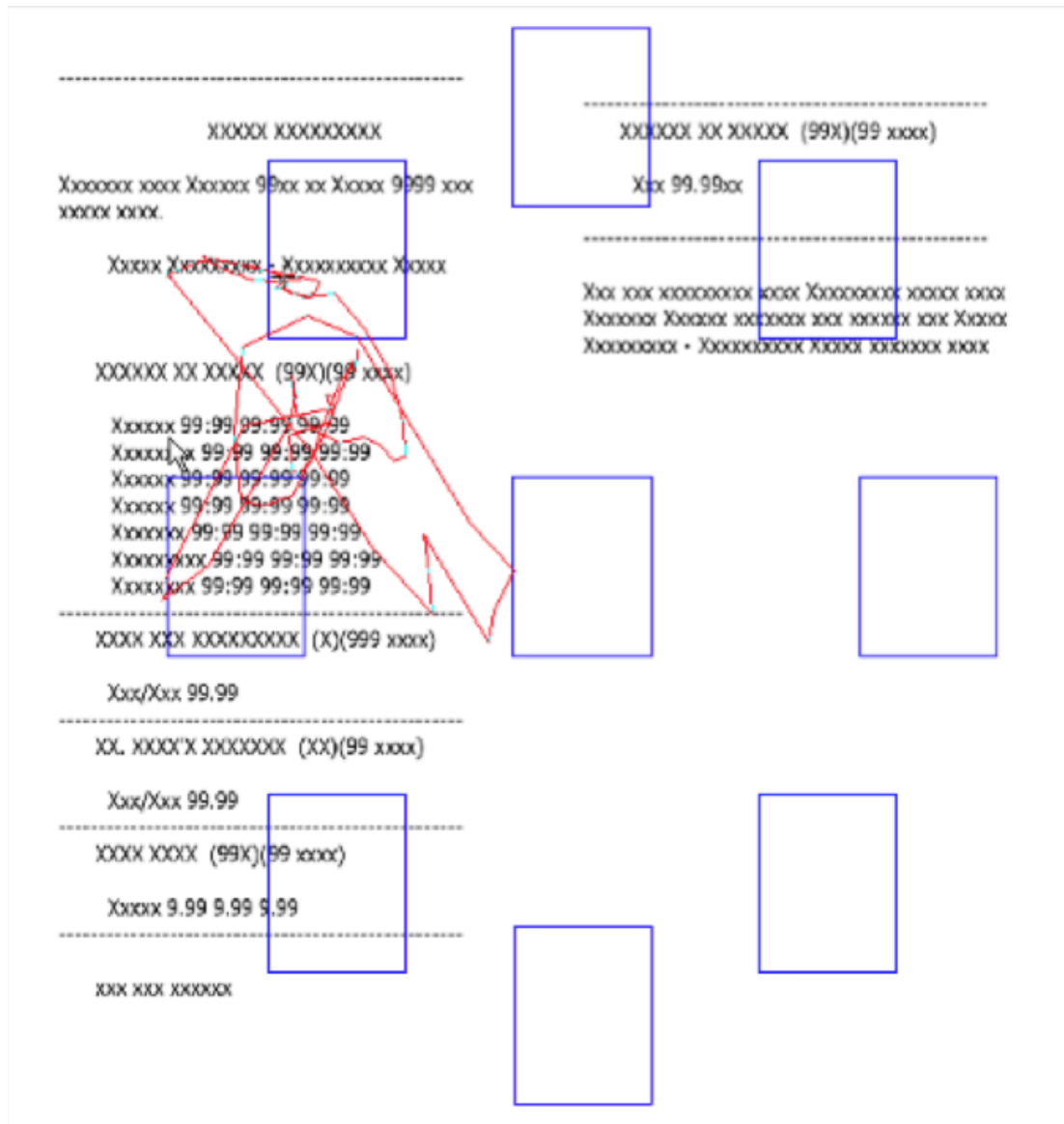


Figure 3.9: Screenshot Shows participant 7 viewing a Cinema e-mail -original structure with semantic information removed- in which the shape is skimmed vertically and the numeric information block is scanned in a 'circular' motion.

**RQ6. Are there instances of skimming and scanning behaviour, particularly in shapes of features of the layout of e-mail texts in four different structural representations?** By studying the data as described in Section 3.7 in the plotting of gaze data of e-mail representations, such as normal (N) and normal structure with no semantic content (X), there were many instances of genres and representations identified by the participants which contained instances of skimming - e.g., Figure 3.8, as detected using the methodology discussed in Section 3.2.4 - and scanning (Figure 3.8) as also detected by the methodology discussed in Section 3.2.4. Clues for research question five were extrapolated from the data, because, in some cases, the participants did indeed skim the shape of the texts in the formatted e-mail stimulus examples. When the e-mail text was heavily formatted

(centred), e.g., in calls for papers, or aligned left (seminars), the shape of the text, according to the eye tracker data, did seem to play an important role in the genre identification process (Figure 3.1). In contrast, when the text had all format removed, some participants also occasionally skimmed the shape of the large 'blob' of text, but this could mean that they were looking for semantic content/keywords.

### **3.9.2 Scanpath Derived Data**

**RQ7. What are the relative contributions of form in the scanpaths during the identification of genres of e-mail? Are there instances of mutually dependent elements?** How do the form features of a genre assist in text interpretation and use? As can be seen in Table 3.3 features, the participants themselves identified features of form, for example, main titles and sub-titles, emboldened text, blocks of content (text and numerical) typically justified. Numeric characters (especially in blocks) were also important, whether they were replaced or not. As regards interdependence, several genres were identified in form by the block shapes, in particular, seminars, calls for papers, and cinemas (which also contained blocks of numerics that were very helpful). The evidence in the data shown in Tables 3.6-3.10 indicates a higher level of fixations and the longest scanpaths for the e-mails only represented by form with no content. This indicates the steep rise in ocular behaviour that is produced in the participants when they are shown the e-mail stimuli. The structure effect also lessens from one block to the next block, e.g., the scanpaths shortened in length distinctly from blocks 1 and 2. The form features which exhibit the genres were thus very important for the interpretation and categorisation of the e-mails.

**RQ8. Do the lengths and durations (gaze point samples) of scanpaths differ significantly between each e-mail structural representation or genre?** The scanpath lengths are statistically longer in the scanpaths of the e-mails with no content replaced by Xs and 9s (X) but with structure intact. Cross-comparison with Table 3.6 revealed that the scanpaths for this representation were the longest overall (1822) dominated by fixations (mean count 8.09). The normal (N) e-mails had the lowest length scanpaths and the lowest number of mean fixations in the scanpaths which indicate a higher amount of saccadic behaviour. The unformatted e-mails with content (U) had a short scanpath length but the second highest mean count of 7.45 fixations. The unformatted with no content (UX) had the second longest scanpaths overall, but the majority were saccades rather than fixations (6.64). The scanpath durations for the genres calls for papers, cinema, newsletters and spam were significantly longer than the ITS, Library, orders and seminars. Cross-comparison with the e-mail genres (Table 3.6) revealed that the calls for papers, newsletters and spam had the

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highest level of fixations and longest scanpaths overall. This was not a surprise, since the participants were most familiar with these three genres, and it can therefore be deduced that these e-mails were recognised because of previous experience. The ITS, orders and seminar e-mails had very short scanpaths but also a low number of fixations, so the scanpaths were mainly formed from saccades. On the opposite side were the library e-mails which had the second shortest scanpaths in all eight genres, but a high number of fixations.

The scanpath durations for the formatted but no contents (X) e-mails were the longest along with the highest count of fixations; this indicates a higher level of cognitive processing. The unformatted (UX) e-mails had the second longest scanpaths and second largest number of fixations which again indicate that the users spent more time fixating during the scanpaths. The temporally shortest duration of scanpaths occurred during the normal e-mails with the lowest number of fixations. This indicates that the scanpath contains more saccades than fixations, especially if cross-referenced with saccades per second (Table 3.8).

The scanpaths durations for the genre e-mails call for papers, cinema, newsletters and spam were significantly longer than the ITS, Library, orders and seminars. Cross-comparison with the e-mail genres, as shown in saccades per second (Table 3.8) calls for papers, cinema, newsletters and spam revealed that although the calls for papers, spam and newsletters had the highest level of fixations and the longest scanpaths overall, the cinema and newsletters had a low number of fixations which indicates a low level of cognitive processing and more saccades. The two genres, call for papers and spam, were the most familiar to the participants, but it cannot be deduced that these e-mails were recognised because of previous experience. The ITS, orders and seminar e-mails had very short scanpaths but also a low number of fixations, so the scanpaths were mainly formed from saccades. On the opposite side, were the library e-mails which had the second shortest scanpaths of all the eight genres, but a high number of fixations.

### ***3.10 Chapter Summary***

This first user study provided valuable empirical evidence using fixation, saccade and two scanpath derived metrics which testified to the great significance of form during search and identification. Not only was form revealed as being important holistically but also the particular collection of texts were useful for showing the important structural features of form within the entire textual genre.

The results have shown how, in most cases, the structural formatting and layout cues from the texts appeared to make the participants employ quite intensive scanning behaviour in the course of which they matched what they were seeing with the information stored in their short term memories. As the experimental sessions continued, the scanpaths shortened, which seemed to indicate less cognitive processing and, at the same time, the 'affording' of the genre for identification. It should be noted that sometimes, in a few cases when there was a small amount of cognitive processing due to lack of fixations, there were also ocular behaviours that may be seen as indicative of the skimming of the structural aspects of the e-mails by the participants. Interestingly enough, however, the cross-referencing all the eye tracking data, such as fixation-derived metrics and the scanpath data in SPSS, did not reveal any particular patterns between the scanpath metrics and familiarity.

Finally, the results of the experiment also provided support for an important theory underlying this research, to the effect that structural information, such as format and layout, plays a very important role in human text categorisation and that the messages can even be categorised correctly with all words omitted.



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## Chapter 4A: Evolution of Wikipedia

### 4.1 Introduction

Social media on the WWW has rapidly become an exciting, and in some cases indispensable, method for the communication and rapid exchange of social information and knowledge. Communities of Practice now appear all over the web and amongst the multitudes of collaborative communities, Wikipedia has become an interesting and commonly used domain for genre analysis, especially in the context of enabling social interactivity and empowering the online community to access mainly accurate information. Literary evolutionary processes in Wikipedia (Tereszkiewicz, 2010) have enabled users to develop new and old variants of standardised information forms, such as lists and biographies.

In the previous chapter, Study One was introduced in which the structural features and layout of e-mails of organisational communication in a community of practice (university exchange) were thoroughly analysed. This chapter (Study Two) is divided into two parts (4a & 4b). Section 4a examines Wikipedia as a CoP and Section 4b reports user study two which again employs eye tracking.

Firstly, Section 4a examines the Community of Practice, that is, Wikipedia, in the context of the following three aims:

- To conduct a search and analysis exercise looking at the pages within the English version of Wikipedia in order to study the structural attributes of form;
- To examine new, evolving and interlinking articles e.g. biographies;
- To identify the usefulness of Wikipedia for a study evaluating structural features and tasks using genre.

Section 4.2 provides some background to the Wikipedia as an online encyclopaedia, the inner working of users, i.e., the hierarchy, and a lead into the purpose of the chapter. Section 4.3 discusses the kind of genres to be expected in Wikipedia, the discussion areas and a brief introduction to evolution. Section 4.4 introduces the research questions which have been identified. Section 4.5 presents the methodology employed to test the research questions and is divided into two parts: Section 4.5.1 explains why this specific approach was chosen and Section 4.5.2 gives the details of the search design. Section 4.6 considers whether Wikipedia is eligible to be considered a Community of Practice. Section 4.7 provides a case study of a biographical genre found in Wikipedia.

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The analysis is divided into 2 parts which are presented in Section 4.8: Section 4.8.1 examines the categorisation of Wikipedia genres; Section 4.7.2 analyses the attributes of features and layout. The penultimate section of this chapter (4.9), presents the conclusions that can be drawn from the analysis and, finally, Section 4.10 presents a summary of this chapter, to lead into Chapter 4b.

## **4.2 Background**

The Wikipedia Encyclopaedia, which first appeared in 2001, is growing and evolving day by day and has articles in more than 250 languages. Currently, the English version alone consists of more than 2.5 million articles and has more than eight million registered contributors (Ehmann et al., 2008).

Many literature reviews have been published that have tried to provide comprehensive descriptions of the popularity of Wikipedia for research Almeida et al. (2007); (Ayers, 2006; Nielsen, 2011; Okoli et al., 2012) and some of these involve genre analysis, for example, Elia (2006); Tereszkievicz (2010) and finally, Lanamäki & Päivärinta (2010), who looked at the Finnish version of Wikipedia. As Emigh & Herring (2005) pointed out, Wikipedia can offer extraordinary insights into how a community can democratically participate in creating forms or genres to show the meaning of an article. Collins et al. (2001) explained how there tend to be socially constructed communicative behaviours, namely genres, which emerge to improve the efficiency of the activities in a CoP and Dan O'Sullivan has described this "*community*" of "*Wikipedians*" in his book, *Wikipedia: a new community of practice?* (O'Sullivan, 2009, p. 85).

Wikipedia is an important and popular domain for accessing information about a huge range of information. Not only do individuals use it for reference, but many large organisations, such as the BBC News, use it for quick access to information. It is hard to avoid because no matter what is searched for in a search engine, such as Google, a related Wikipedia article will appear in the list of results to the query. The dynamic nature of Wikipedia has also contributed to former popular publications, such as Encarta and Encyclopaedia Britannica, being out of print<sup>29</sup>. Publishers changed their business models when they realised that not only was Wikipedia gaining a good reputation for accuracy among scholars but also that even when the books were freshly re-printed they were already out of date, unlike Wikipedia.

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<sup>29</sup>[http://www.pcworld.com/article/251796/has\\_wikipedia\\_beat\\_britannica\\_in\\_the\\_encyclopedia\\_battle.html](http://www.pcworld.com/article/251796/has_wikipedia_beat_britannica_in_the_encyclopedia_battle.html)

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Despite its popularity, Wikipedia does have its detractors; it is criticised for being inaccurate, possibly as a result of vandalism, although researchers are tackling this problem (Potthast et al., 2008b). Sometimes it is the object of satire: The Now Show (British comedy program) on BBC Radio Four has even used Wikipedia for some of its sketch material. At a higher level, there are many types of offshoots of Wikipedia, such as WikiBooks (Cookbooks, StudyGuide etc.), Wikizine, Portals and, of course, the rather controversial Wiki Leaks<sup>30</sup>. However, this study concentrates on the evolving types in 'Wikipedia The Free Encyclopaedia'. This Wikipedia operates in an editorial hierarchy of: "all", "users", "Autoconfirmed users", "Bots", "Administrators", "Bureaucrats", "Checkusers", "Stewards" and "Board Vote Administrators" with least permissible editing powers being assigned to "all" and "users" and the most "power" to "Stewards" and "Board Vote Administrators". For example, once an edit is submitted "live" by a least empowered editor, a modification is accepted/rejected by Stewards et al. Wikipedia contributors are allowed to edit each page and are given a toolbox of HTML functions to use for text formatting, linking files, adding photographs, inserting tables and so on. This could give rise to questions, such as, what is the point since the information is already available in books, but what happens if the sources are unaffordable to certain demographic regions? This is one of the obvious advantages of Wikipedia, as a tool for the dissemination of information which can be made available to people all over the world and can be accessed free, from a library, for example.

The purpose of this chapter is to describe an initial search study of the articles and to discover whether there is any evidence of evolutionary history in Wikipedia during which classical forms of genres are located, examined and recorded, such as biographies, lists and discographies. Another aim is to examine some other types of 'new' genres, their interlinkages, and how their attributes 'define' them by layout and with formatting.

### **4.3 *Wikipedian Genres***

Much like Kwaśnik & Crowston (2005), who described traditional genres that appear on the web, the Wikipedia community contains a wide array of forms:

1. Frequently Asked Questions (FAQ)
2. Lists, for example, Lists of People by Cause of Death (List of Lists) which contains a list of links to intriguing articles:
  - 2.1. List of fatalities from aviation accidents

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<sup>30</sup> <http://en.wikipedia.org/wiki/WikiLeaks>

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- 2.2. List of deaths through alcohol
  - 2.3. List of deaths from anorexia nervosa
  3. Timelines, such as Timelines of World War I<sup>31</sup>
  4. Events, such as Football World Cup event<sup>32</sup> or the Aberfan Disaster<sup>33</sup> which was an event, although it could arguably be categorised as a disaster. Since both of these have a before, during and aftermath, both are similar in structure.

New unique genres also appear, transform and evolve, much as Kwaśnik & Crowston (2005) pointed out. Sections 4.7 and onwards will be used to examine how some of these structural forms (or genres) evolve. Wikipedia as an 'encyclopaedia' is a genre in its own right, but for this chapter, there follows a closer look at the articles (sub-genres?), of which the forms are constantly evolving. The forms are a result of contributors employing certain devices or tools, such as formatting of text, lists, tables, imagery, captions and other formatting, then scrutinising suitable resources for accuracy, such as books, for amending and adding factual content with references.

Underlying each article in Wikipedia, there is also a discussion area (also known as Talk Pages) for users that re-enforces the potential understanding of the whole CoP aspect of this domain. For example, much of the current discussion on the General Motors Corporation (Figure 4.6) is focused on the likelihood of its demise as a result of the current financial crisis and debate about what content to include, and, in a completely different category, there is a lively discussion page related to a character meeting a sticky end in a soap opera 'cliff-hanger' episode. The participants involved in the soap opera 'biographical' discussion page were trying to decide whether to update the page to show the character as dead, possibly dead or fate unknown, in the lead up to the next episode, when all would be revealed<sup>34</sup>. According to the Wikipedia site, the purpose of the talk pages is to provide areas for editors to discuss changes to the linked article or project page. Also provided is a history starting from when the article was first created and up to the present day, as each amendment, no matter how big or small, is recorded. This small study is generally being used to examine the suitability of Wikipedia for an examination of structural forms in order to find out how structure is perceived and used, that is, the pertinence of purpose and form. The overall aims, at this stage, are to examine the suitability of Wikipedia and its constituent parts (discussion etc.) as a vehicle for demonstrating the CoP and evolutionary paradigm in this context for which a methodology has been

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<sup>31</sup> [http://en.wikipedia.org/wiki/Timeline\\_of\\_World\\_War\\_I](http://en.wikipedia.org/wiki/Timeline_of_World_War_I)

<sup>32</sup> [http://en.wikipedia.org/wiki/1966\\_FIFA\\_World\\_Cup](http://en.wikipedia.org/wiki/1966_FIFA_World_Cup)

<sup>33</sup> [http://en.wikipedia.org/wiki/Aberfan\\_disaster](http://en.wikipedia.org/wiki/Aberfan_disaster)

<sup>34</sup> [http://en.wikipedia.org/wiki/Talk:Danielle\\_Jones\\_%28EastEnders%29](http://en.wikipedia.org/wiki/Talk:Danielle_Jones_%28EastEnders%29)

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devised (Section 4.5). The ways in which several new and old types of structured articles have evolved are examined (see Figures 4.1-4.8), for example, discographies, lists (alphanumeric, bulleted and so on), musical groups/bands, footballers, etc. A small case study is also undertaken to show how a Wikipedia biographical article, on Spike Milligan, evolves. In order to fulfil the above-mentioned aims, several research questions were generated.

#### **4.4 Research Questions**

The research questions for this initial feasibility study were:

- RQ9. Is Wikipedia, as a community of practice (CoP), a suitable vehicle for demonstrating the evolution and development of genre?
- RQ10. Are Wikipedia articles consistently composed of a combination of purpose and form?
- RQ11. What are the constituent structural components of the articles in the Wikipedia domain?
- RQ12. How does a classical genre, such as Biography, evolve in this community? Are there any possible new genres?

#### **4.5 Method**

##### **4.5.1 Method background**

The Wikipedia articles became a main IR collection when they were used for the INEX in 2005 (Denoyer & Gallinari, 2007). Participation in the relevance judgements via the Daffodil Interactive IR system (Malik et al., 2006) provided an excellent opportunity to explore Wikipedia, however, the collection was only a snapshot and not the live version. While examining the topical relevance of organisations' submissions during the relevance judgements' phase of INEX 2005, particular layout and formatting techniques were being employed to help the perceiver to navigate the articles. This reinforced the idea that Wikipedia was, potentially, a suitable vehicle for studying the evolution or development of genre as a CoP and also for studying highly visual types of text with perceivable purpose and form.

##### **4.5.2 Search Design & Procedure**

The methodology for this study consists of several stages which tie in with the Ecology (Section 2.2.5), CoP (Section 2.2.3) and the thesis definition of purpose and form (Yates & Orlikowski, 1992, pp. 544-5). Creating Topics and performing the Relevance Judgements for the INEX 2005 Interactive track provided a good background and experience in creating short queries, all of which was useful for this small investigative study.

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The stages were:

1. Fifteen search queries (shown in Table 4.3, first column) input into the Wikipedia search engine, for example:
  - 1.1. REM (musical ensemble);
  - 1.2. Margaret Thatcher (former Prime Minister UK);
  - 1.3. General Motors (Car Manufacturer);
  - 1.4. Alex Ferguson (former manager of Manchester United Football Club);
  - 1.5. Spike Milligan (former comedian, poet, author, broadcaster)
  - 1.6. Ferrari (car manufacturer: supercars and Formula One)
2. Save to computer disk drive;
3. Examine the potential genres by purpose and form;
4. Look at how the articles are constructed and note if they lead to any other types of structure (Kwaśnik & Crowston, 2005), such as discography, FAQ, Biography, List and so on. Look at the articles, noting in particular whether:
  - 4.1. They are classical types of genre, such as Biography.
  - 4.2. The article is a NEW style of genre and/or has similarities with others.
  - 4.3. Mapping<sup>35</sup> conceptual associations/connected articles to the originally found article.
  - 4.4. Examine the underlying CoP to see whether the discussions (in articles) indicate the expected characteristics (Wenger, 2000).
  - 4.5. Label the article by genre.

#### **4.6 *Wikipedia: a Community of Practice?***

An examination of the related interactions on the discussions pages and edits of the articles mentioned above showed that Wikipedia does qualify as a CoP because it contains the three characteristics outlined by Wenger (2000): *"The Practice, The Community and The Domain"*. The editors involved demonstrate a commitment to the domain and also seem to value their collective competence and the chance to learn from each other. The members engage in joint activities, such as voting, interaction and discussion. The editors develop a large and shared repertoire of resources, such as stories, tools and ways of addressing recurring problems, a mechanism for this being that the editors actually practice democracy by initiating voting cycles to discuss the merits of carrying

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<sup>35</sup> Adapted from the described function in Ingwerson (1992).

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out an alteration to an article purpose<sup>36</sup>.

Section 2.2.5 previously described ecologies, CoPs (2.2.3) and the seminal work by Yates & Orlikowski (2002, p. 15) aided the identification of the ways in which articles are created and developed in Wikipedia. In addition, by referring to the history of the articles being made available, details of how and when the particular articles are/were produced, reproduced, supplanted and modified can be extrapolated. Although it could be argued that carrying out an analysis of the edit histories, discussion/talk pages would, instead of demonstrating genre evolution, simply suggest the supplementing of previous knowledge or thoroughness, this would be only a narrow-minded view of the genre evolution. The analysis of the edit histories and discussion clearly indicate a CoP implementing the division, merging, transformation and other evolutionary 'behaviours' of the articles by form in this very complex domain. Furthermore, as described in Section 4.6, with regard to questioning the suitability of Wikipedia, the editors involved demonstrate a commitment to the domain and also seem to value their collective competence and the opportunity to learn from each other.

#### ***4.7 Case Study: Biographical Genre***

The information retrieved from query twelve was used to examine closely an example of a 'classical' genre, that is, the biographical article, in this case about Spike Milligan, the celebrated and highly influential comedian and author who died in 2002. The purpose of the article is, obviously, to provide biographical information to the reader about Spike Milligan. As can be seen in the following Figures 4.1-4.3 and Table 4.1, the form of this web page article is continuously evolving and being transformed, much as Kwaśnik & Crowston (2005) described in their ecological metaphor of the fusion of form and purpose. As shown in Figure 4.1, the original article was first created on November 5, 2001; note the sparse and poorly organised information it contains.

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<sup>36</sup> 4Vote Proposal: <http://en.wikipedia.org/w/index.php?title=Talk:R.E.M.\discography\&oldid=94780788>

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Terence Alan “*Spike*” Milligan (1918-) ‘Irish’ comedian, novelist, poet, and member of the Goons. Spike Milligan has suffered from Bipolar Disorder for most of his life.

Comedy shows:

\*The Goon Show

\*Q8

**Books:**

\*Puckoon

\*Adolf Hitler, My Part in his Downfall

**Resources:**

\*<http://www.fireflycafe.org/spike/>

\*<http://directory.google.com/Top/Arts/Celebrities/M/Milligan,Spike/>

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Figure 4.1: Spike Milligan Wikipedia article containing only emboldened text formatting, basic bulleting \*. No really notable structuring, purpose or much content, dated 5 November 2001.

Spike Milligan	
	Image:Spike Milligan Muppet Show 1979.1.18.jpg Spike Milligan
<b>Born</b>	Terence Alan Milligan April 16, 1918 Ahmednagar, India
<b>Died</b>	February 27, 2002, age 83 Rye, East Sussex, England

Figure 4.2: ‘Information Box’ layout feature located in top-right of each biographical article which vary in size and detail. After seven years, approximately 487 different users have submitted edits to the Spike Milligan page with only ten editors submitting more than 10 edits per person. The community for this particular article is evidently quite large and still growing<sup>37</sup>, as can be seen in Table 4.1, and the article has evolved considerably in two-year stages (Figure 4.3, (Right Hand Side). Over this period of time, images were placed within the article. Eventually, the portrait picture in Figure 4.3 (after being in many different positions) ended up being positioned at top right in the same way that nearly all-main profile pictures now are. On the 26<sup>th</sup> November 2006, a table with the title Spike Milligan was created by a contributor. Since the screenshot was captured in early 2008, the biographical form in Figure 4.3 has yet again been transformed after much discussion by the editors involved. Not only has the contents table, positioned at top left been extended, but the table that encapsulates the name has also changed.

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<sup>37</sup> By November 2013 there were 804 users editing, 1,613 edits, with an average amount of 2.04 edits per user and roughly one edit every other day (c.f. [http://tools.wmflabs.org/xtools/articleinfo/index.php?article=Spike\\_Milligan&lang=en&wiki=wikipedia](http://tools.wmflabs.org/xtools/articleinfo/index.php?article=Spike_Milligan&lang=en&wiki=wikipedia)).



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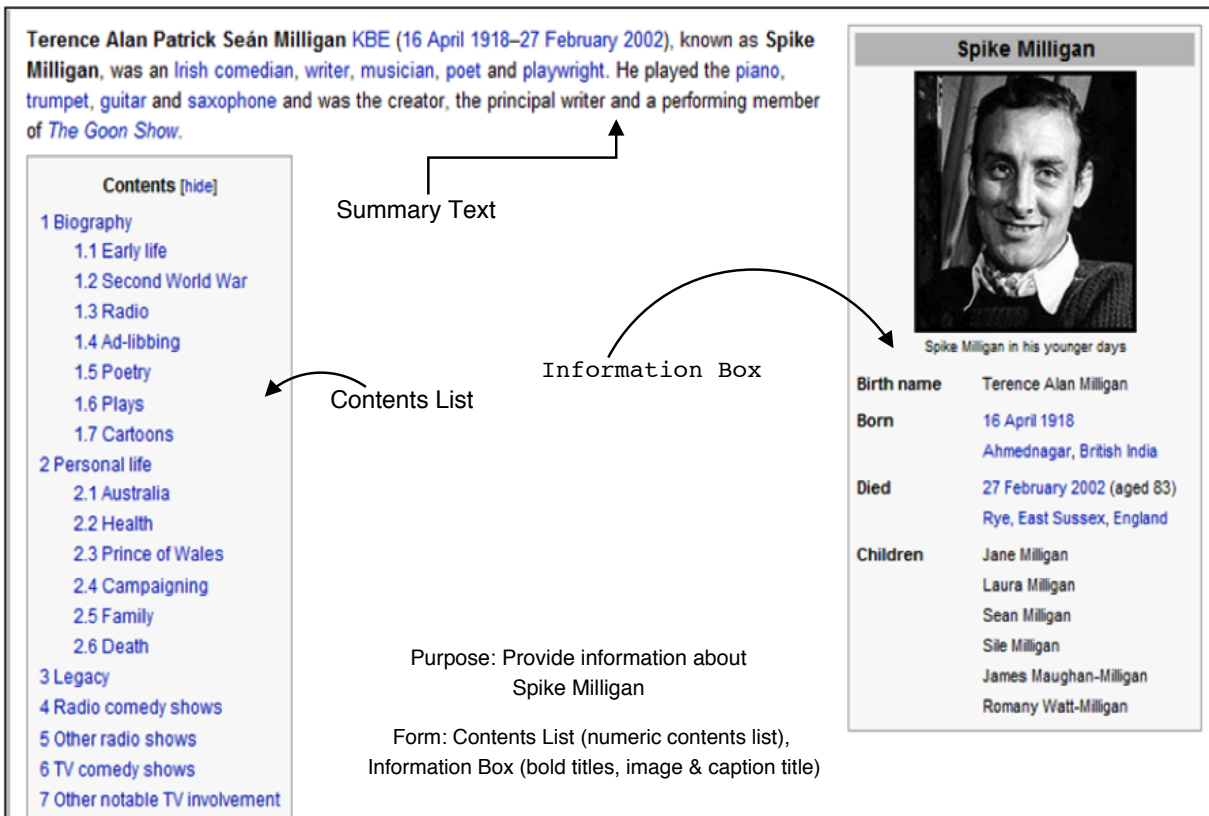
**Table 4.1: Spike Milligan biography article structure by contents table (positioned top left of each article).**

<b>November 2001</b>	<b>November 2004</b>	<b>November 2006</b>	<b>November 2008</b>
Comedy Shows:	* 1 Biography	* 1 Biography	* 1 Biography
* The Goon Show	* 2 Radio Comedy shows	* 2 Posthumously	o 1.1 Early life
* Q8	* 3 TV Comedy shows	* 3 Trivia	o 2nd World War
Books:	* 4 Theatre	* 4 Radio comedy shows	o 1.3 Radio
* Adolf Hitler, My Part in his Downfall	* 5 Movies	* 5 Other radio shows	o 1.4 Ad-libbing
* Puckoon	* 6 Books	* 6 TV comedy show	o 1.5 Poetry
	* 7 Quotations	* 7 Theatre	o 1.6 Plays
	* 8 External Links	* 8 Films	o 1.7 Cartoons
		* 9 Books	* 2 Personal life
			o 2.1 Australia
			o 2.2 Health
			o 2.3 Prince of Wales
			o 2.4 Campaigning
			o 2.5 Family
			o 2.6 Death
			* 3 Legacy
			* 4 Radio comedy shows
			* 5 Other radio shows
			* 6 TV comedy shows
			* 7 Other notable TV involvement
			* 8 Theatre
			* 9 Films
			* 10 Books
			* 11 Quotations
			* 12 External links
			* 13 References

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The information related to birth name, born, died and children has now changed to born, died, nationality, influences and those people on whom he arguably exerted an influence. The focus is now concentrated on the career instead of on the person, which is similar to a ‘Football Player’ or ‘Leader’ type of article, and is thus maybe moving towards forming another unique kind of genre which could be renamed ‘Artist’ or maybe ‘Comedian’.

Figure 4.3: Classical biographical genre from Wikipedia: Spike Milligan.



There could also possibly be overlaps with one of the new genres with classical attributes, such as Obituary (as Milligan has died) and Biography. Another possible issue which could be linked with the merging and overlapping of genres is the reaching of a consensus on what constitutes a type of genre in a community, in this case a biography. Recently, the Spike Milligan article has evolved to contain more professional, rather than personal biographical (a human life in its course) information, so it could now be argued that there should be two articles for the two contexts. The main elements shown in Figure 4.3, “Children”, has since been amended to show *Professional Influences* and the people on whom he exerted an influence instead of children, spouses (some time ago). Now, in August 2014, the space shows his *Children’s* names and *Notable works and roles*. The available ‘histories’ and underlying discussion area (Talk Page) do, of course, suggest this but the information is not conclusive. It is obvious that by operating as a community, the contributors have

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added and enhanced information that they deem important (in a hierarchy of importance) and have placed extra structural emphasis on the elements which are deemed most important about each article genre even if they do not always agree on these details. The Wikipedia editors have utilised a toolbox of HTML functions for formatting and embedding various media links, such as, video and photographs. The editors also seem to access unlikely sources to obtain information as indicated by one editor in the Talk page discussion: an un-named 'source' in the Daily Telegraph is cited as possessing a photograph of Spike Milligan's gravestone (for inclusion in the article) which is famous for the Gaelic inscription: "*I told you I was ill*".

## **4.8 Analysis**

### **4.8.1 Categorisation of Genres**

Some category examples of retrieved articles were:

- Biography
- List, including lists of lists by A-Z and Country Name by Alphabetical order
- Football club
- Stadium
- Motor vehicle manufacturer
- Political party
- Musical group
- Discography

Due to difficulties related to the quantity of articles being mapped, they were divided into categories of genre. The naming of article genres was done manually, such as football club, stadium or political party. However, classical articles, such as discography<sup>38</sup> and A-Z list<sup>39</sup> were already genre labelled by Wikipedia. As such, the descriptions which follow do not only present an account of what Wikipedia is doing (biographical evolution c.f. previous Section 4.7) but also of what is emerging from the analysis of Wikipedia (this Section and Section 4.8.2). Many Wikipedia pages have their own particular form and purposes. Conducting the search enabled the recording of the genre, relevant statistics and the purpose and form attributes (c.f. Table 4.3).

While searching for musical bands, the connected articles were mapped out (Figure 4.4). For example, other types of genres were linked to musical bands, most notably: discography, biography, musical group, and several types of lists, including a list of bands under the same record label, and a

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<sup>38</sup> [http://en.wikipedia.org/wiki/Muse\\_discography](http://en.wikipedia.org/wiki/Muse_discography)

<sup>39</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Iraqi\\_films](https://en.wikipedia.org/wiki/List_of_Iraqi_films)

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chronological list of Rock and Roll Hall of Fame inductees which is in two forms. One list type,<sup>40</sup> for reasons of clarity, has been restructured into a large five column table with the band information containing the year order, name, image of artist and year inducted and the second list type is in alphabetical order (c.f. Table 4.2). As can be seen in Figure 4.4, there are already classical genres, such as the list and A-Z index, but other, new ways of structuring information are also employed. The musical group, band members and discography contains a layout consisting of lists and tables, but some titles also show up consistently in different examples of musical groups (U2, Muse, etc.), discographies and band members which would only pertain to those actual types of pages for those purposes, such as weeks in the top 40, album name, weeks at number one and chart position.

It is also clear that, similarly to the evolutionary paradigms described in Section 2.2.5, some of these forms are still evolving, being modified and being supplanted. Some of the existing genres are actually evolving and outliving their usefulness and, in some circumstances, this is leading to their dividing into two types of genre, for example, the history of the articles for the rock band, REM, was comprehensively edited. Three years after the original band article first appeared, it had become too cumbersome because of all the detailed information that it contained, and could therefore be deemed to have outlived its relative effectiveness since the information had become more difficult to find. The REM page became too large because the list of the band's musical releases via different media, such as DVD, albums and singles, had grown, so that as a consequence a classical genre was brought into use, i.e., a discography<sup>41</sup>. As a result, the textual information was laid out more clearly for readers who were then able to filter through more quickly to the content they most needed. This 'ecological' action, it could be argued, can be of great help when an information search task is being carried out, since it obviates the need to categorise entire documents containing multiple genres.

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<sup>40</sup> [http://en.wikipedia.org/wiki/List\\_of\\_Rock\\_and\\_Roll\\_Hall\\_of\\_Fame\\_inductees](http://en.wikipedia.org/wiki/List_of_Rock_and_Roll_Hall_of_Fame_inductees)

<sup>41</sup> <http://en.wikipedia.org/w/index.php?title=Talk:R.E.M.discography&oldid=94780788>

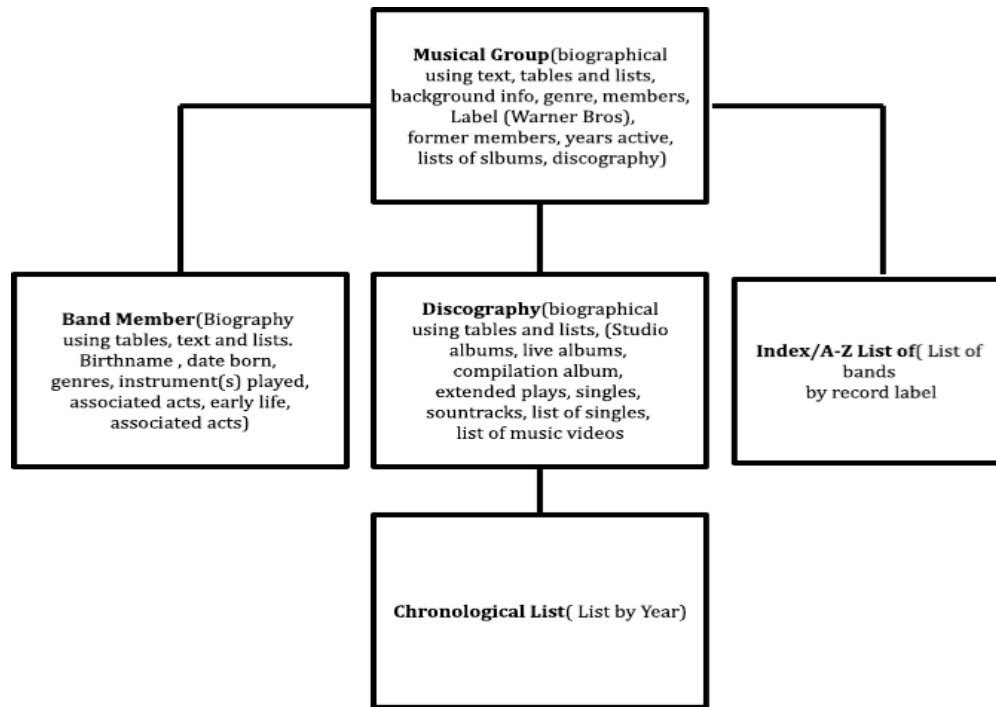


Figure 4.4: Band/Music Group example (see REM<sup>42</sup> for good example): visual format from Wikipedia  
**4.8.2 Analysis of the Attributes (constituent parts) of Genres in Wikipedia**

This aim of this section is to describe the main types of components (Table 4.2) and attributes located during the analysis of the genres located during the search query exercise. A description of the main titled sections and queries used to find the details from the retrieved results, such as ‘Article Genre, Statistics, Purpose and Form’ (Table 4.3) is shown, and is followed by Figures 4.3-4.5 which describe some of the retrieved articles and illustrate how they are conceptually linked.

**Table 4.2: Main components of Wikipedia articles and smaller components broken down**

Main components	Smaller components within main types
Sub Title	Plain, Bold, Italic
Contents Lists (CL) (Figures 4.5)	Title, Numeric, Content
Information Box (IB) (Figure 4.5)	Title, Banner Sub Title, Bullet List, Image, Image Text, Sub Title, Contents
Image Captions (IC)	Image, Text
Tables (Figure 5.1)	Header, Contents
References	Left Side, Right Side
Table Categories (TC) (Figure 5.2)	Banner (like Table Header but at bottom of page), Content (normally full of hyperlinks to other pages).
Summary Text (Figure 4.5)	Plain, Bold

<sup>42</sup> <http://en.wikipedia.org/wiki/R.E.M.>

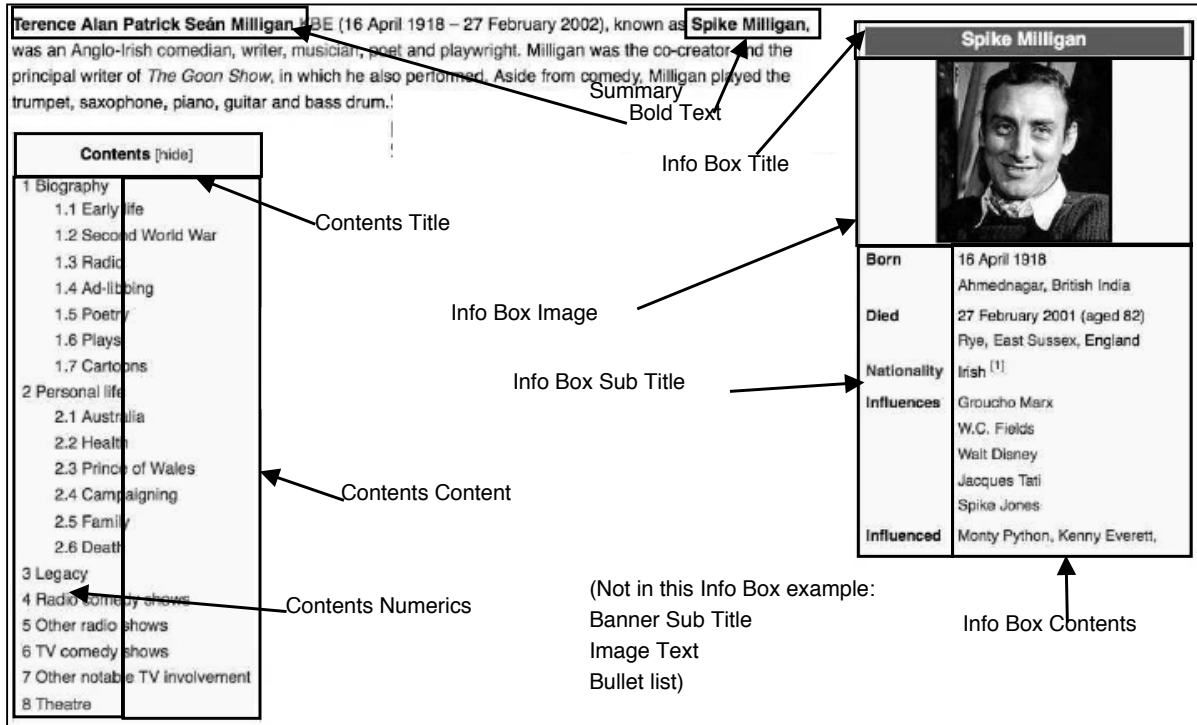


Figure 4.5: Classical biographical genre from Wikipedia: Spike Milligan showing main features at the top of each article

The main devices that are used in articles are listed in Table 4.2 and an example of each Contents List, Summary Text, Information Box and Bold Text is shown in Figure 4.5. Other features, such as, Sub Title and Main Title are self-explanatory, and examples of less obvious features are provided in Figures 4.1, 4.5, 5.1 and 5.2.

As shown in the diagram in Figure 4.5 and in the details in Table 4.3, automobile manufacturers, such as General Motors and Ford, had several different types of articles linked to the main article. At the top of the hierarchy, the articles tended to describe General Motors (GM) as an Organisation or Corporation (for example, British Petroleum and GM Corporation do have analogous structures and purposes) and display a particular layout that allowed the perceiver/reader to understand and find quickly the salient features pertaining to the Organisation/Automobile Manufacturer with its global reach.

Table 4.3: Queries and Article Genre, Statistics, Purpose and Form

Query	Genre	Stats (Date Created/ Amount of Editors/ Edits)	Attributes of Purpose (Themes, topics, discourse structure)	Attributes of Form (Structural features e.g titles, lists etc)
REM	Band/ Musical Group	1 February 2002/ 1067 editors/ 1564 edits	To biographically present the past and present members of the group, show their work output and list their achievements.	<b>INFO BOX TITLES/ HEADINGS:</b> Background information, Origin Genre(s), Years active Label(s), Associated acts, Website (URL), Former members. <b>MAIN TEXT HEADINGS:</b> Chronological History, URL(s)to listen/download radio one or more song samples, Summary of the Discography.
Napoleonic Wars	War	22 March 02/991 editors/23 61 edits	To provide a comprehensive article describing the prior cause, events during (battles etc) and aftermath of the war. Other things, such as, the belligerents.	<b>INFO BOX TITLES/ HEADINGS:</b> date, location, result. List of belligerents:- names of sides, List of commanders on each side, casualties and losses on each side in numerics. <b>MAIN TEXT HEADINGS</b> (title and years of stage): Lead up to start of war, major phases of war (battles etc), outcome, legacy and effects.
REM Discography	Discography	17 December 2005/145 editors /410 edits	To present and list the output produced by an entity such as musical artists. How they formed, what they produced and the latest news.	<b>INFO BOX TITLES/ HEADINGS:</b> Small summary table with type of release and amount e.g. album 5. <b>MAIN TEXT HEADINGS:</b> Tables. Each table by title such as Studio Albums, Singles etc with sub-titles such as Year, Album/Single Details, chart positions.
alternative rock bands)	A-Z index List of Bands by Genre	27 March 2004/832 editors/45 20 edits	To present a comprehensive alphabetically structured index	<b>INFO BOX TITLES/ HEADINGS:</b> Contents table: 0-9 · A B C D E F G H I J K L M N O P Q R S T U V

			of alternative musical groups throughout the world.	W X Y Z <b>MAIN TEXT HEADINGS:</b> Small summary. Index of alphabetical sections with list of band's name beginning with 0-9 to Z.
Nelson Mandela	Leader	7 yJune 2005/317 editors/10 53 edits	To present the biographical details of how and when a person became a leader in a political party, etc.,	<b>INFO BOX TITLES/ HEADINGS:</b> Title of office held, dates held position, Vice president, succeeded/proceeded by, born where and when, political party. <b>MAIN TEXT HEADINGS:</b> Early life, key moments in life and leadership
Aberdeen	City	5 February 2002/28 editors/22 34 edits	To detail the geographical, population and historical information pertaining to a particular city.	<b>INFO BOX TITLES/ HEADINGS:</b> Name of city, map with location, population, density, language spoken, location Council area, Lieutenancy area, Constituent country, Sovereign state, Post town, Postcode district Dialling code, Police/fire ambulance (name of service, European Parliament, UK Parliament Scottish Parliament. <b>MAIN TEXT HEADINGS:</b> Geography, demography, climate, Landmarks, transport, culture
Scarborough Athletic	Football Club	25 June 2007/68 editors/45 1 edits	To present current and historical information, including achievements, regarding a football /soccer team.	<b>INFO BOX TITLES/ HEADINGS:</b> image of coat of arms, Full name, Nickname(s), Founded, Ground (Capacity), Owner, Managing Director, League, Premier League. Images of club strip(shorts, socks and top). <b>MAIN TEXT HEADINGS:</b> Stadiums, Supporters, Table of honours, records, Table with list of current aquad players. Tables (with lists by name and years):



					coaching staff, key people, manager history, chairman history.
List of Newcastle United players	List of Football Players	11 February 2006/110 editors/357 edits	To present current (still playing) and historical information (now retired), including achievements, regarding a football /soccer player.		<b>INFO BOX TITLES/ HEADINGS:</b> None. <b>MAIN TEXT HEADINGS:</b> Large table with headings: Name Nationality, Position, <Club Name> career, appearances, Goal Table with list of first team captains (year and name)
list of bands by genre	List of Lists	10 December 2003/195 editors/340 edits	A comprehensive list of lists sorted by certain categories.		<b>INFO BOX TITLES/ HEADINGS:</b> None. <b>MAIN TEXT HEADINGS:</b> Title (By Genre, By Instrument) then list under each
Socialist Party of Ireland	Political Party	12 February 2004/92 editors/553 edits	Presents biographical information regarding a political party in a particular country or region in the world.		<b>INFO BOX TITLES/ HEADINGS:</b> Name, Logo, Founded, Leader, Headquarters, Political ideology, International Affiliation, European Affiliation European Parliament Group, Colours , Website. <b>MAIN TEXT HEADINGS:</b> Electoral history, Key policies, List of elected members (name, position, district)
General Motors	Automobile Manufacturer	25 February 2002/1772 editors/5233 edits	Presents information to the public regarding the general business structure and financial performance.		<b>INFO BOX TITLES/ HEADINGS:</b> Type, Founder(s) Area served,Key people, Industry,Products, Services, Revenue lecurrency (year), Operating income y (year), (year), Net income ncome y (year), Total assets ome y (year), ye, Total equity ▼ currency (year), Employees, (number) (year), Divisions, Subsidiaries,Website (url).. <b>MAIN TEXT HEADINGS:</b> History,

				Company Overview, Corporate Structure, Table listing open manufacturing plants, Table of Yearly Sales, List of brands/defunct brands,subsidiaries
Ferrari	F1 or Supercar manufacturer	28 October 2001/2910 editors/5814 edits	Presents information to the public regarding the general business structure and financial performance.	<b>INFO BOX TITLES/ HEADINGS:</b> Industry, Founder(s) Headquarters, Area served, Key people, Industry, Products, key people, Services, Revenue currency (year), Operating income y (year), (year), Net income ncome y (year), Total assets ome y (year), ye, Total equity ▼ currency (year), Employees, (number) (year), Divisions, Subsidiaries,Website (url). <b>MAIN TEXT HEADINGS:</b> History, Motorsport, Road cars,current models, supercars, identity, colour, coprorate affairs, technical partnerships, sales hostory, see also, references, notes, external links.
Spike Milligan	Entertainer, Poet, Comedian, Author, Broadcaster	26 <sup>th</sup> November 2006/521 editors/5011 edits	To present the biographical details of how and when the person was born, his life's achievements and subsequent death.	<b>INFO BOX TITLES/ HEADINGS:</b> Birth name, born (date/place), died (when/where), Children. <b>MAIN TEXT HEADINGS:</b> Biography, Personal life, legacy, radio comedy shows, other radio shows, TV comedy shows, other notable TV involvement
Alex Ferguson	Football, player, manager and director.	07 March 2002/2,374 editors/5,625 edits	To present the biographical details of how and when the person was born and his life's achievements.	<b>INFO BOX TITLES/ HEADINGS:</b> Personal information: full name , dob,pob,playing position. Senior career, national team, teams managed <b>MAIN TEXT</b>

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				<b>HEADINGS:</b> Early life, playing career, erly managerial career, Aberdeen, Manchester utd, Controversies, Legacy, Personal Life, Honours, Statistics, Notes, References, External Links.
Margaret Thatcher	Former Prime Minister of the UK	04 November 2001/3,189 editors/9, 333 edits	To present the biographical details of how and when the person was born and her life's achievements.	<b>INFO BOX TITLES/ HEADINGS:</b> In Office, Deputy, Preceded by, succeeded by. Leader of the opposition, in office, monarch, prime minister, preceded by, succeeded by, leader of the conservative party, in office, preceded by, succeeded by. Personal details, born, died, political party, spouses, children, alma mater, profession, religion, signatire. <b>MAIN TEXT HEADINGS:</b> Early life and education, early political career, prime minister (from:to) domestic affairs, foreign affairs, challenges to leadership, later life: post-commons,husband's death, final years. death, legacy, styles and titles, arms, see also References

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After submitting queries to Wikipedia for information on ‘General Motors’, two other related items of interest also appeared in the ranked list. First, there was one article entitled ‘A History of General Motors’<sup>43</sup> that resembled a timeline and described the history of the organisation from 1908 up to the present date – a kind of biographical discourse. Secondly and thirdly, respectively, on the list of search results were the list of ‘Automobile Industry by Country’<sup>44</sup> and an extremely specialised article giving a ‘List of GM Transmissions’<sup>45</sup>, both of which were very helpful ‘lists’ to aid filtering and navigation. This search showed the dynamic nature of Wikipedia, and also how the original GM article, which was created on the 25<sup>th</sup> February 2002, having outlived its use, was divided into other sub-genre articles, such as the ‘List of GM Transmissions’ that was created on the 4<sup>th</sup> January 2006.

The community of editors’ emphasis on the most important information related to each article, for example, see Figure 4.2 (and also Table 4.3), reflects their decision that the most important information for defining an organisation (such as General Motors) should be displayed in the information box (along with an image of the Organisation logo). This information is heavily formatted due to its prominence in the article, whereas the rest of the article is composed mainly of text, titles, tables, lists and other accumulated information devices, such as citations of a biographical nature in numerical list format that elaborate on this information. Wikipedia has many articles on specific organisations in the automobile industry, such as GM Corporation, British Leyland and Ferrari (Figure 4.6).

At the next level of the hierarchy, the first two organisations are more famed for producing consumer or family cars whilst the latter, Ferrari, produces Formula One™ or SuperCars (Figure 4.6), although this organisation could also be described as belonging to the first category of car suppliers if the high end of the car market is included. The Super Car and Family Car have their own individual forms, but also occasionally have overlapping attributes, such as an engine type like the V6, V8 or V10, which are helpfully displayed as a list in Wikipedia<sup>46</sup>.

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<sup>43</sup> [http://en.wikipedia.org/wiki/History\\_of\\_General\\_Motors](http://en.wikipedia.org/wiki/History_of_General_Motors)

<sup>44</sup> [http://en.wikipedia.org/wiki/Automotive\\_industry\\_by\\_country](http://en.wikipedia.org/wiki/Automotive_industry_by_country)

<sup>45</sup> [http://en.wikipedia.org/wiki/List\\_of\\_GM\\_transmissions](http://en.wikipedia.org/wiki/List_of_GM_transmissions)

<sup>46</sup> [http://en.wikipedia.org/wiki/List\\_of\\_Ferrari\\_engines](http://en.wikipedia.org/wiki/List_of_Ferrari_engines)

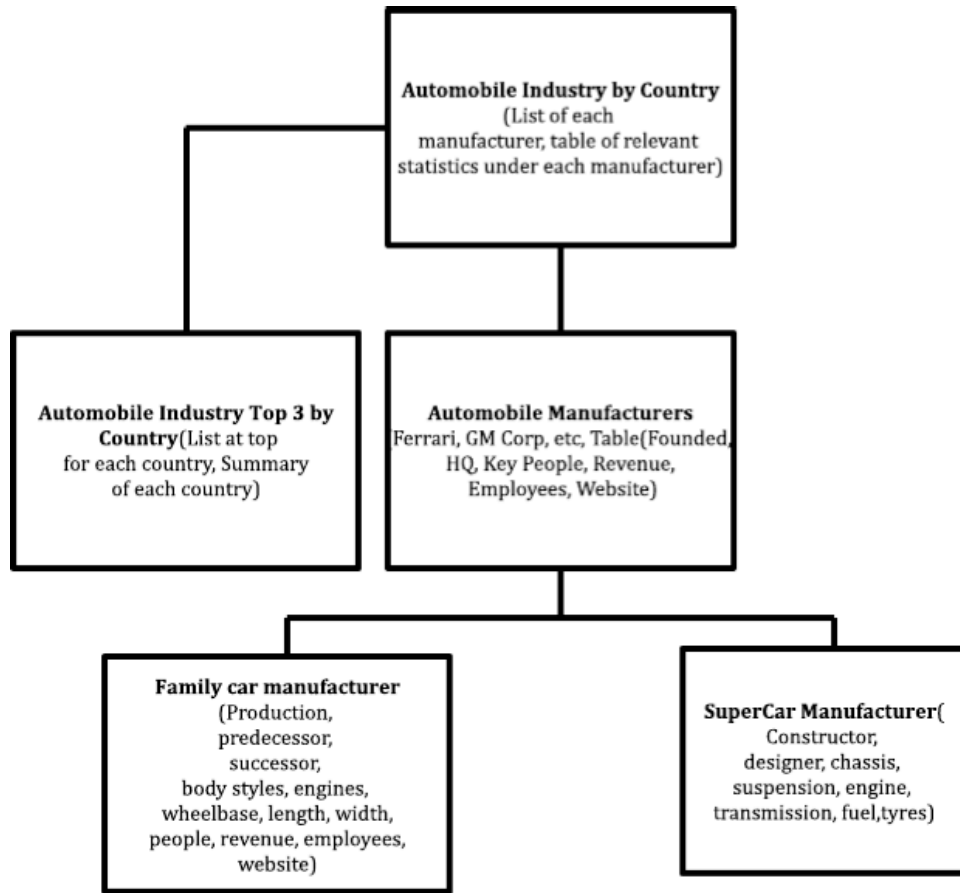


Figure 4.6: Small search for Automobile related Wikipedia articles and analysis of how they are structured and linked

During the analysis of the retrieved biographical articles, it was noted that several types of biography exist along with links to their genres. Another type of biographical sub-genre or, arguably, mixed genre was also found: Football Manager. This structured article also naturally led to football-player, team and ground, which also had links to county and country. The football team/club article seemed to be outliving its purpose and leading to the evolution of new genres, such as manager, ground and player. Figure 4.7 shows a typical hierarchy of articles for descriptions of clubs, such as Arsenal or Real Madrid, but for descriptions of smaller clubs, such as Scarborough Athletic, multiple genre articles are not required<sup>47</sup>. On the other hand, several football-related Wikipedia articles and the analysis of their structures and links are shown in Figure 4.7 and Table 4.3.

<sup>47</sup> [http://en.wikipedia.org/wiki/Scarborough\\_Athletic\\_F.C.](http://en.wikipedia.org/wiki/Scarborough_Athletic_F.C.)

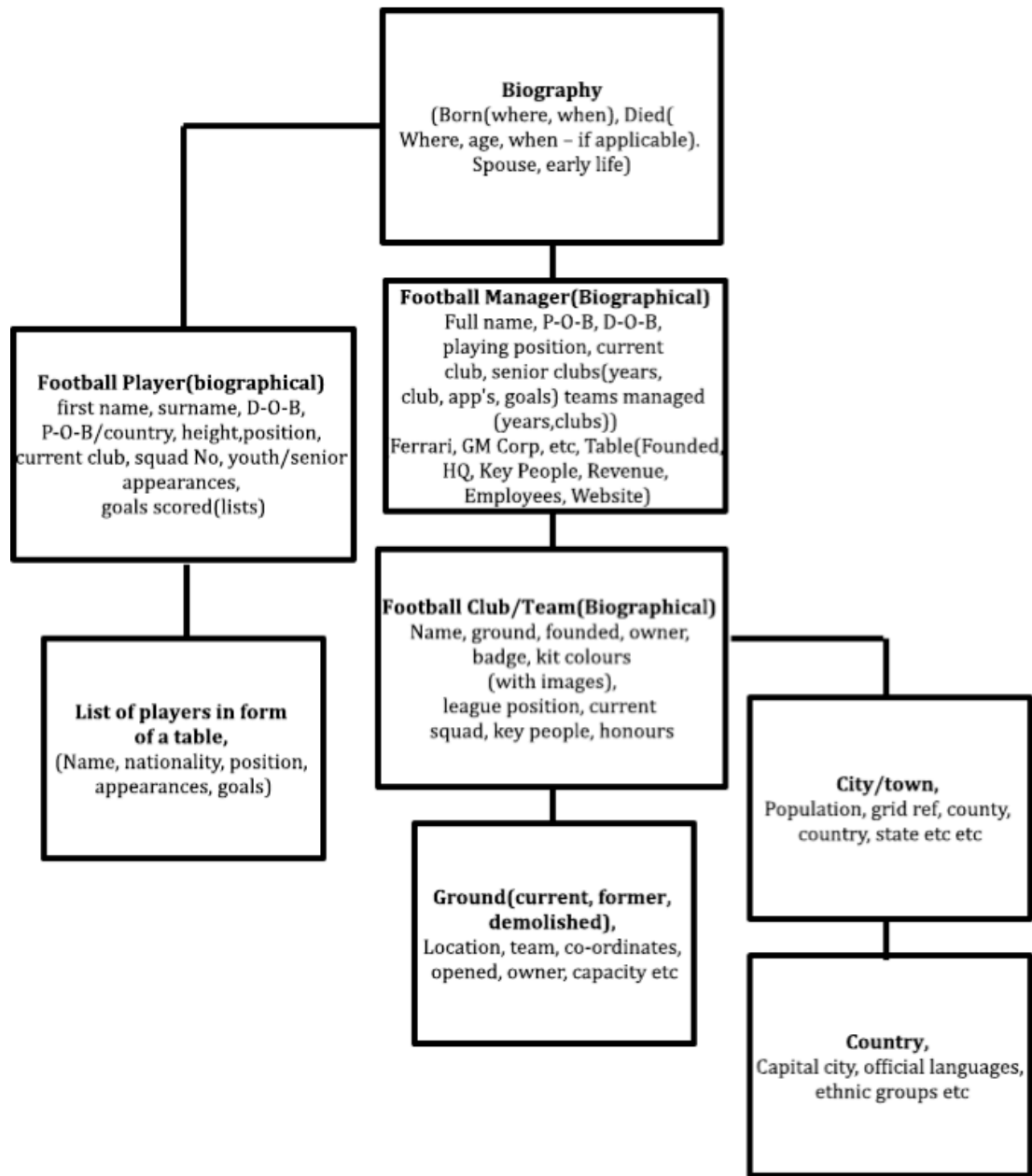


Figure 4.7: Search for football related Wikipedia articles and analysis of how they are structured and linked (see also Table 4.3).

As Figure 4.7 shows (Table 4.3 for more information), each genre category is defined by certain forms that have been created in this particular community. This raises the question of whether knowledge of genre leads to form, or form leads to genre in this context, i.e., how conscious are the editors of the forms that they are creating and/or modifying? Arguably, the ‘forms’ that are drilled into human beings from the early years of education onwards are linked to our ability to structure texts. The top boxes of Figures 4.7 and 4.8 contain a classical biographical article’s content and meet the criteria shown (Born (where, when), Died (where, when) and so on) but different types of biographical genre exist in Wikipedia that have many different sets of characteristics. For example,

Spike Milligan, Nelson Mandela, Alex Ferguson (Manchester United manager) and Napoleon, are some notable figures. Other than the sole biographical structures for Spike Milligan and Alex Ferguson, a different form existed for ex-President Nelson Mandela, and for Margaret Thatcher which, as can be seen in Figure 4.8, contains particular layout titles along with a biographical 'substance' in chronological order – this genre could be categorised as a Leader. Many kinds of genres that are represented by several types of form and purpose have been recorded during the search. Figures 4.1-4.8 and Tables 4.3 list most of these recorded types and show the specific structural properties (formatting, layout features) according to which, as contended in this thesis, they qualify to be categorised by form and purpose.

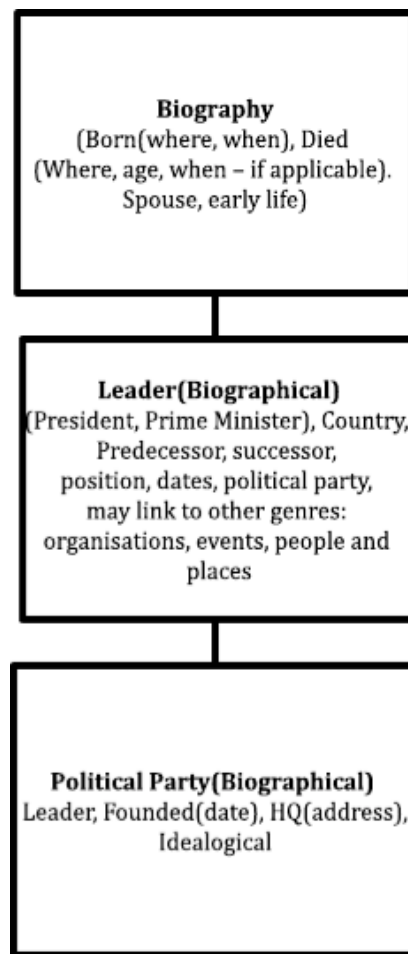


Figure 4.8: Search for notable people in history and analysis of how the main and related articles are structured and linked.

#### ***4.9 Conclusions of Wikipedia Exploration***

This section presents the conclusions drawn from the research on the Wikipedia domain that was conducted to ascertain the suitability of Wikipedia as a vehicle for genre research:

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- 1) RQ9. Is Wikipedia, as a community of practice (CoP), a suitable vehicle for demonstrating the evolution and development of genre?** Wikipedia is a suitably large and hierarchically structured CoP for showing how genres evolve over a scale of time. The structures, features and the evolution of a popular type of article, i.e., biography, can be examined although not all articles featured in Wikipedia are consistently well formed.
- 2) RQ10. Are Wikipedia articles consistently composed of a combination of purpose and form?** The viewed articles did contain a suitable amount of form (and purpose), with some distinct fusions of both, although some of the less formed articles did contain a very small amount of form. The less formed articles were generally on less popular topics, where there is little interest in the ‘community’ to develop the structure and a minimal amount of discussion in the metadata areas. Although many authors have found Wikipedia suitable (Almeida et al., 2007; Ayers, 2006; Black, 2008; Ehmann et al., 2008; Elia, 2006; Lanamäki & Päivärinta, 2010; Nielsen, 2011; O’Sullivan, 2009; Peoples, 2008; Potthast et al., 2008a; Tereszkievicz, 2010), in the context of this study, it was important to examine the Form of Wikipedia articles .
- 3) RQ11. What are the constituent structural components of the articles in the Wikipedia domain?** As shown in Figures 4.1-4.8, the constituent parts of the Wikipedia articles were identified from the major articles. The form components consist of large components made up of smaller parts. However, rather than just list the items and also to avoid duplication, c.f. Figures 4.4, 4.6 & 4.8 and Table 4.3 which have some clearly labelled descriptions of large and small components.
- 4) RQ12. How does a classical genre, such as Biography, evolve in this community? Are there any possible new genres?** Structures evolve in an almost ‘organic’ and ‘biological’, metaphorical and democratic discourse community. The tools available to any article editor affords a large amount of autonomy regarding the evolution of layout and the creation of new genres is arguably a very common occurrence. The articles related to a ‘Football Player’ or ‘Band Member’ could be construed as new sub-genres of biographies which relate to what they do either as individuals or collectively. With regard to the editing of articles to enable the evolutionary processes, although anyone with a login can submit information, update, or construct Wikipedia articles, there is a hierarchy of users with widely differing powers. Most alterations have to be agreed with and accepted by users and can be contested and/or rejected. The higher the ‘power’ granted to an editor then the less any updates are contested, even if they can still be ‘discussed’. Although the word ‘democracy’ is banded around with regard to all Wikipedia users being equal, the higher up in the hierarchy the users are, the more equal they



become<sup>48</sup>. This could result in some creative limitations being imposed on the editorial evolution of the articles and should be resisted as strongly as possible.

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<sup>48</sup><http://www.goodreads.com/quotes/6466-all-animals-are-equal-but-some-animals-are-more-equal>

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## Chapter 4B: User Study Two: Looking At Wikipedia Genres - The Use Of Structural Features During Search Tasks

### 4.10 Introduction

In the context of information interaction and processing, a modern eye tracker was used to record the ocular behaviour and strategies of participants in an academic community to show the ways in which they interact holistically with the layout of the main sections of Wikipedia pages, in multiple forms, during natural and realistic search tasks. In Wikipedia, naturally occurring structures, such as genres, offer rich pickings for participants and Wikis are important tools for researchers in the field of genre because they enable users to create their own community of practice for a project, such as Lucene<sup>49</sup> and personal promotion to construct textual forms for contextual purposes. One aim is to locate a set of features which still belong to the form (or structural) concept and to discover the most important aspects of the Wikipedia encyclopaedia articles, such as discographies and biographies, lists, lists of lists and so on. In the course of this study, the features and cues the participants found important during their tasks were examined.

### 4.11 Research Questions

The research questions devised for this user study were:

- RQ13. How 'useful' is form of a document type and does form afford efficiency during timed-tasks for sessions aimed at finding information to answer search task questions?
- RQ14. Where does the participant fixate in the first few seconds of viewing a Wikipedia article? For example, comparing the ocular behaviour between Wikipedia article features: Information Box (on right) and Contents List (on left).
- RQ15. Which structural (invariant) cues (signalling devices, landmarks and frames)/formatted features (Titles, Summary Texts, Information Boxes, Tables), if any, do participants identify by questionnaire or are identified using eye tracking metrics as being used for completing the information-searching task or for navigating textual information?
- RQ16. How 'useful' are whole article classical genres, such as lists (Figure 4.13), lists of lists, biographies (Figures 4.13 & 4.12) and which are the predominant features fixated upon

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<sup>49</sup> <http://wiki.apache.org/lucene-java/LuceneFAQ>

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during search tasks?

RQ17. Do/can participants skim (Figure 4.13) or scan (Figure 4.12) particular shapes of features (boxes) of the layout of Wikipedia article texts?

The measurements relating to the research questions are shown in 4.12.13.

## **4.12 Method**

### **4.12.1 Experimental design- overview**

A task-based observational, logged and questionnaire study was conducted using the online version of the English version of Wikipedia as it was in November 2011. An experimental design was used and 30 participants took part; each was paid £10. The starting point of each task for each participant was the main page of Wikipedia. Participants then had to input an initial search query of their own choice into the search engine provided by Wikipedia. In order to be able to enrich the types of data, record a wide range of genres and not exhaust the participants, it was decided to use a total of six tasks (Section 4.12.1.1). The first 15 participants were tested with tasks 1-3, and the subsequent 15 participants were allocated tasks 4-6. Prior to beginning the tasks, each subject was given a three-minute introduction to the eye tracker and a guidance sheet on what was to be expected. Each participant was shown the main page of Wikipedia and the location of the search engine box on the site. Each person was asked to sign a consent sheet before being calibrated to the system. The experimental setup of the evaluation was based on commonly used standards as detailed in previous task-based evaluations, such as Harper & Kelly (2006); White et al. (2006). The experimental procedures, such as time given for tasks and questionnaires, were based on the methods and the protocols used in previous interactive experiments (Dupont et al., 2010; Harper & Kelly, 2006; Kelly et al., 2008; Kelly et al., 2007; White et al., 2006; White et al., 2002).

#### **4.12.1.1 Simulated Situations**

A total of six simulated work tasks (c.f. Kelly (2009) for discussions of types of tasks) were constructed that were related to typical tasks to reflect similar participants' needs and were therefore representative of some of the most commonly submitted queries. The tasks were simulated in order to suggest that each participant was preparing to perform an evaluation of end-products task, such as creating an essay, etc., as shown in the examples in Kelly (2009), to reflect realistic participants' needs. A small interview on Survey Monkey was conducted which was circulated around a football chat forum, around the University of Strathclyde, family and friends by

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e-mail, and on the Facebook website. There were 53 respondents and they all recalled previous topics and tasks that they had used with Wikipedia. The pilot was performed using solely an indicative request task (Kelly, 2009) and, e.g., Elswailer & Ruthven (2007); White et al. (2002) but this type of task returned next to no useful data as the tasks were completed too quickly. As a result, the tasks were re-formulated using the format devised by Borlund (2003) and later discussed in Kelly (2009, p. 81) by giving each user a “*simulated work task situation and indicative request*” rather than just the latter. Together, as formulated by Borlund (2003); Borlund & Schneider (2010), they are collectively known as “*simulated situations*”. These type of simulated situations were also used in Elswailer & Ruthven (2007) and Kelly (2009) using realistic topical tasks (arguably realistic topics but not necessarily realistic tasks) supplied by the online survey. In order to get a good range of different types of participants and to avoid any bias in the selection procedure the experiment was advertised throughout the university campus and the first 30 people who replied were chosen.

To prevent task bias and learning effects, all simulated situations were allocated randomly by applying the three-by-three Latin square matrix for the first and second group of 15 participants. The simulated situations are as shown below. For clarity they are demarcated into their separate components. Plain text shows the simulated work task situation and each indicative request is italicised:

1. You are joining a debating society and need some notes to make a PowerPoint presentation on the first topic, which is: “Cannabis: Good or Bad?” Since being made illegal in the UK in 1928 and since the introduction of the 1971 Dangerous Drugs Act, the use of cannabis for medicinal reasons has been restricted. However, in recent years, some countries (for example, Austria) have legalised the smoking/ingesting of cannabis by certain patients for pain relief and other medicinal benefits. Thus, ‘medical cannabis’ has become a topic of hot debate. You want to understand the arguments for and against the use of marijuana for medical purposes. Therefore, you decide to do some preliminary research on this subject using Wikipedia. What are the possible health benefits and health problems that may entail from smoking/ingesting cannabis for medical reasons?
2. You have been tasked to write an essay on the Arab Spring which started to be reported in late 2010. The beginning of the so-called ‘Arab Spring’ led to a huge wave of demonstrations and uprisings in at least 17 countries that has resulted in many long-standing military regimes being overthrown and, in some cases, in civil war. Use Wikipedia to find out some useful information that you feel is appropriate and can be used later to form a basis for the

essay. For example, the countries involved and so on.

3. You are in the third year of a social studies degree and have been given coursework on the topic of 'Philanthropy'. On the 4<sup>th</sup> August 2010, thirty-eight US billionaire philanthropists pledged at least 50% of their wealth to charity through a campaign started by the investor, Warren Buffet, and the Microsoft founder, Bill Gates (BBC, 2010). Some of those who have signed the pledge include Michael Bloomberg and George Lucas. Many mentioned in 'The Giving Pledge' project are among the most influential people in the contemporary United States and debatably the world. Your coursework states that you have to carry out an investigation to find out who you think is the most influential philanthropist in the pledge group.
4. You are working for ITN news as an intern. There has been a major air crash at an international airport. The news editor wants you to search for background information on the previous top two worst air disasters in history, such as the numbers of fatalities, casualties and so on. She also wants to know the names of airlines with the best and worst safety records.
5. You are on work experience at the sports desk at The Guardian newspaper and have been asked by the editor to collect information on the two rival teams, Boca Juniors and River Plate, as they face each other in the Argentine Cup Final. Use Wikipedia to find out appropriate information about each club, such as the stadiums, star players and the managers of each team.
6. You are in the third year of a political studies' degree course and have been given coursework on studying the legislature in an African country. You decide to focus on Namibia. Collect information about the Parliament, National Council of Namibia, National Assembly and any other information you think is relevant to form the basis of your work.

#### **4.12.1.2 Independent variables**

An examination of the differences in genders, ages and nationalities was not really possible for this study as the genders were skewed two-one and the ages and nationalities were not sufficiently varied. There are three variables in this study: the Areas Of Interest (AOI) on the stimulus and the types of structures retrieved and used while the tasks were being carried out by the participants.

1. AOI: (Bullet Lists, Information Box (Figure 4.5 top right and Table 4.2), Contents List (Figure 4.5, top left and Table 4.2), References (Table 4.2), Main Title (Figure 4.5, top), Sub Title (Table 4.2), Tables (Figure 4.9 & 4.10), Image Captions (Table 4.2) and Summary Text

(Figure 4.5 text summary at top of article and Table 4.2). In Table 4.2, some of the features from 4.5 are broken down into smaller granularity. Also, see Table 4.2 for attributes of Form column.

2. The Structure versus Non-Structure condition was applied by adding AOIs to the non-structured areas of each article, for example, plain text.
3. Article type: represented in many ways for example, biography (Figure 4.5 & 5.3), list (Figure 5.5), list of lists, discography, football player, country and timeline.

Table Header

Candidate	Party	Votes	%
<a href="#">Hifikepunye Pohamba</a>	<a href="#">SWAPO</a>	611,241	75.25
<a href="#">Hidipo Hamutenya</a>	<a href="#">RDP</a>	88,840	10.91
<a href="#">Katutire Kaura</a>	<a href="#">Democratic Turnhalle Alliance</a>	24,188	2.98
<a href="#">Kuaima Riruako</a>	<a href="#">NUDO</a>	23,735	2.92
<a href="#">Justus Garoëb</a>	<a href="#">United Democratic Front</a>	19,258	2.37
<a href="#">Ignatius Shikwameni</a>	<a href="#">All People's Party</a>	9,981	1.23
<a href="#">Henry Mudge</a>	<a href="#">Republican Party</a>	9,425	1.16
<a href="#">Benjamin Ulenga</a>	<a href="#">Congress of Democrats</a>	5,812	0.72
<a href="#">Usutuaije Maamberua</a>	<a href="#">SWANU</a>	2,968	0.37
<a href="#">David Isaacs</a>	<a href="#">Democratic Party of Namibia</a>	1,859	0.23
<a href="#">Frans Goagoseb</a>	<a href="#">Namibian Democratic Movement for Change</a>	1,760	0.22
<a href="#">Attie Beukes</a>	<a href="#">Communist Party of Namibia</a>	1,005	0.12
Rejected ballots		12,363	1.52
Total (turnout )		812,233	100.00
Source: <a href="#">Electoral Commission of Namibia</a>			

Table Contents

Figure 4.9: Table-with Table Header and Table Contents outlined

Topics related to charity	
Main topics	Philanthropy · Acts · Tzedakah · Zakat · Sadaqah · Tithe · Altruism · Gift · Donation · Alternative giving · Youth philanthropy · Volunteering · Noblesse oblige
Organization types	Voluntary association · Nonprofit organization · Non-governmental organization · Registered charity, Charitable trust · Foundation · Private foundation · Charitable organization · Public-benefit nonprofit corporation · Mutual-benefit nonprofit corporation · Religious corporation
Additional topics	Charity Navigator · Charity badge · List of charitable foundations · List of wealthiest charitable foundations · Click-to-donate site · Halukka · Meshulach · Master of Nonprofit Organizations · Charity/thrift/rop shop · Telethon · Warm-glow giving

Categories: Philanthropy

**Figure 4.10: Table Categories-with Table Categories Header and Table Categories Contents outlined**

An example of the differences between footballer biography and biography are shown in Figure 4.7. A biography in Wikipedia typically centres on the person but can also evolve into what could be argued is a sub-genre. For example, the biography Figure 4.7, in the original form, centres on sections that describe the person's life story: birth, early life, later life, wife, siblings, and events leading to death. However, on the right of Figure 4.7 in the Information Box, the biography has been modified and oriented toward the profession of the person, in this case a football player. It is still a biography, but is now a biography that gives details of the person's professional life. This can be classed as a sub-genre of a biography; other sections could be added depending on the profession of the person, for example, the article about a football player provides the particular relevant tables and lists, such as teams, player transfers, goals scored, appearances for clubs, caps for the country, etc.

#### **4.12.1.3 Measurements**

The interactive measurements are cross-referenced with the research questions (RQs 13-17):

1. Mean fixation count per AOI (RQs 15, 16, 17)
2. Mean Visit Durations (Number of times AOI used) (RQs 15, 16)
3. Total visit (gaze) duration per AOI (RQs 15, 16)
4. Mean Visit count (RQs 15, 16)
5. Total Fixation Duration per AOI (RQs 15, 16)
6. Mean Fixation Duration (RQs 15, 16)
7. Number of articles per task (RQ 16)
8. Time to First Fixation for top of each article, for example, Figure 4.10 (RQ14)
9. Structure versus No Structure (RQ13)
10. Time taken for Task (RQ13)

#### **4.12.1.4 Ethics**

Due to the nature of the experiments, an ethics application for research involving human participants was completed (Appendix A1-2). This was for two main reasons:

1. **A safety issue arose from the exposure to infrared irradiance.** The manufacturers of the T-60, Tobii, assure users that exposure to these lesser than IR amounts are completely harmless in short term exposure. Tobii also describe the same safety ethos of there being no harm to participants. A total experiment length of around 60 minutes maximum for each participant results in negligible exposure and, in total, results in a lower exposure to radiation than anyone would encounter during the course of a normal day.
2. **The ethical issues involving the storage of user data for a set of experiments using eye tracking equipment and the questionnaires.** The Tobii T-60 Eye tracker is a combined monitor and eye tracker with the 'Professional' software suite built in. No web camera or other recording device was positioned to record the users in any other way. The recordings for the Tobii eye tracker are locked in an encrypted file which can only be opened by gaining access to the Tobii software with an active licence key. In addition to these extreme security measures, the faces of the participants were not recorded during the sessions so that no identifiable data became accessible. Financial inducements were offered to the 30 user study participants mainly because of the length of each search task, but also for lack of student volunteers. The experiments were conducted at the University of Strathclyde, which meant that colleagues were too far away to be recruited as volunteer participants. Only the experiment supervisor (thesis author) and his supervisors were able to access the data. All the hardcopies of the consent forms signed by the participants were stored in a locked cabinet. The user study presented in this chapter was approved by the Head of Department at the Computer and Information Sciences (CIS) department at the collaborating university, and ethical application paperwork was therefore not required.

#### **4.13 Participants**

Thirty participants were recruited and to avoid any bias, posters and e-mails to the entire university were sent out. The first 30 respondents who replied were recruited. The participants were aged between 18 and 42, with a mean age of 23.5. In terms of genre, 18 were male and 12, female. All 30 of the participants used a computer and accessed the web every day. They were PhD (five), post-doc (one), MSc/MA (eight) or undergraduate (16) students working in a variety of fields, such as law, history, computer science and psychology. The definition of normal computer use for the participants was: for administration tasks, such as paying bills, education tasks, browsing for leisure, hobbies, shopping, e-mails, assignments, health, finance, social networking, current affairs on the news, watching movies and communicating with friends. Over 75% simply said: 'Work'. All



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participants stated that they used the web on a daily basis. Nearly half (13) the participants stated that they used online encyclopaedias every day; nine, once or twice a week and eight, once or twice a month. When asked which types of online encyclopaedias, 26 said Wikipedia, and a small number of participants (two) said they used many other types of encyclopaedias, such as Investopedia, Encyclopaedia Britannica, Collins and Uncyclopedia. Encyclopaedic books were only used by 12 participants. Regarding Wikis, nine participants stated that they had used Wiki styled websites in connection with a hobby or coursework. Of the 30 participants, 16 had never contributed content to a Wiki site. Those who had, used them for coursework (three), football (two), knitting, travel, public library, legal history, article on Greek Tragedy, Solar Arc<sup>50</sup> and TV Series, such as a soap opera. Familiarity with Wikis ranged from: Very Familiar (two), Quite Familiar (one), Neither/Nor (six), Not Really Familiar (six) and Not At All (15) which was a surprising result given number of participants who stated that they had used them. Familiarity with Wikipedia ranged from: Very Familiar (16), Quite Familiar (11) and Neither/Nor (three) which, again, was a surprising result given the feedback from the participants regarding normal usage, contributions to articles and the previous statistic of frequency of use of Wikipedia. Of the 30 subjects, 28 stated that they do not entirely trust Wikipedia and, interestingly enough, 25 would not feel comfortable citing it as a source - which means that three do not trust Wikipedia, but may cite it anyway!

#### ***4.14 Data Capture & Apparatus***

##### ***4.14.1 Apparatus***

The apparatus used in this study was the T-60 model manufactured by Tobii systems. The T-60 allows a 60Hz data-sampling rate, which is ample for information seeking studies. The eye tracker is integrated within a 17" TFT monitor, so that intrusion on the participant is negated. Unlike the Arrington Viewpoint used for study one in Chapter 3 the Tobii system grants users a large amount of head freedom (44 x 22 x 30 cm) and allows them to behave naturally in front of the computer screen at a distance of 64cm, in contrast to the previously used hardware (the Arrington Viewpoint system) which required users to keep their heads completely still. Studies of substantial length and intricate design can be implemented to collect data of accuracy, with a minimal drift of less than 0.3 degrees. It is also a binocular tracking system, whereas the Arrington Viewpoint system is monocular.

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<sup>50</sup> <http://alabe.com/solararc.html>

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The Tobii provides two filters (with inbuilt smoothing algorithms) used for the fixation data but, unfortunately, to get to the saccadic data it has to be exported for manual analysis. Firstly, there is the ClearView fixation algorithm which is based on the I-VT (Velocity-Threshold Identification fixation filter) described in Salvucci & Goldberg (2000) and secondly, the Tobii Fixation Filter is a classification algorithm created by Olsson (2007). There is also the option of having no filter set, so that only raw data is recorded, but this is not advisable because it allows too much noise in the data. As described in Tobii Technology AB (2010, p. 77) the 'ClearView Fixation Filter' calculates the fixations by using a threshold value: anything which exceeds the threshold is a fixation. The Tobii Fixation Filter is very similar to the I-VT implementation by detecting fast changes in the gaze point using a 'sliding window averaging method'. With the assumption of saccades between two different fixations, the subsequent distinctions are used:

- when a segment of the signal is of constant or slowly changing mean value due to drift, it is classified as a single fixation
- an abrupt change in the signal indicates the eyes have moved to another fixation location.

At the time of conducting the study, the version of the Tobii Professional software was 2.2.7, whereas at the time of writing, the version was 3.2.1 (with another available algorithm built-in, but this will not be discussed here since it does not fall within the scope of this study). The Tobii Fixation Filter was chosen for two reasons: firstly, the algorithm was highly recommended by Tobii as default and the technical specialist who sold the hardware and software explained that if the ClearView threshold is wrongly set, then data can be excluded which was intended to be kept. Secondly, the Tobii Fixation Filter also interpolates any data which is missing.

#### **4.14.2 Data Types**

Four main kinds of data were recorded for the experiment - eye gaze data, questionnaires, timings and search task data.

1. Three kinds of questionnaires were used - an entry questionnaire (Appendix B3), a post-search task (one questionnaire was completed after each task (Appendix B4)) and an exit questionnaire (Appendix B5). The Tobii software records large quantities of types of data, such as logging, gaze plots and heat maps.
2. Logging - including fixations, pupil dilations, queries, mouse clicks, screenshots, video playback, URL, titles of webpages, timestamps, and x/y location of the eye. Saccadic and scan path data is not available at present from the Tobii software automatically (apart from visually in gaze plots and heat maps), because it requires time-consuming manual sorting

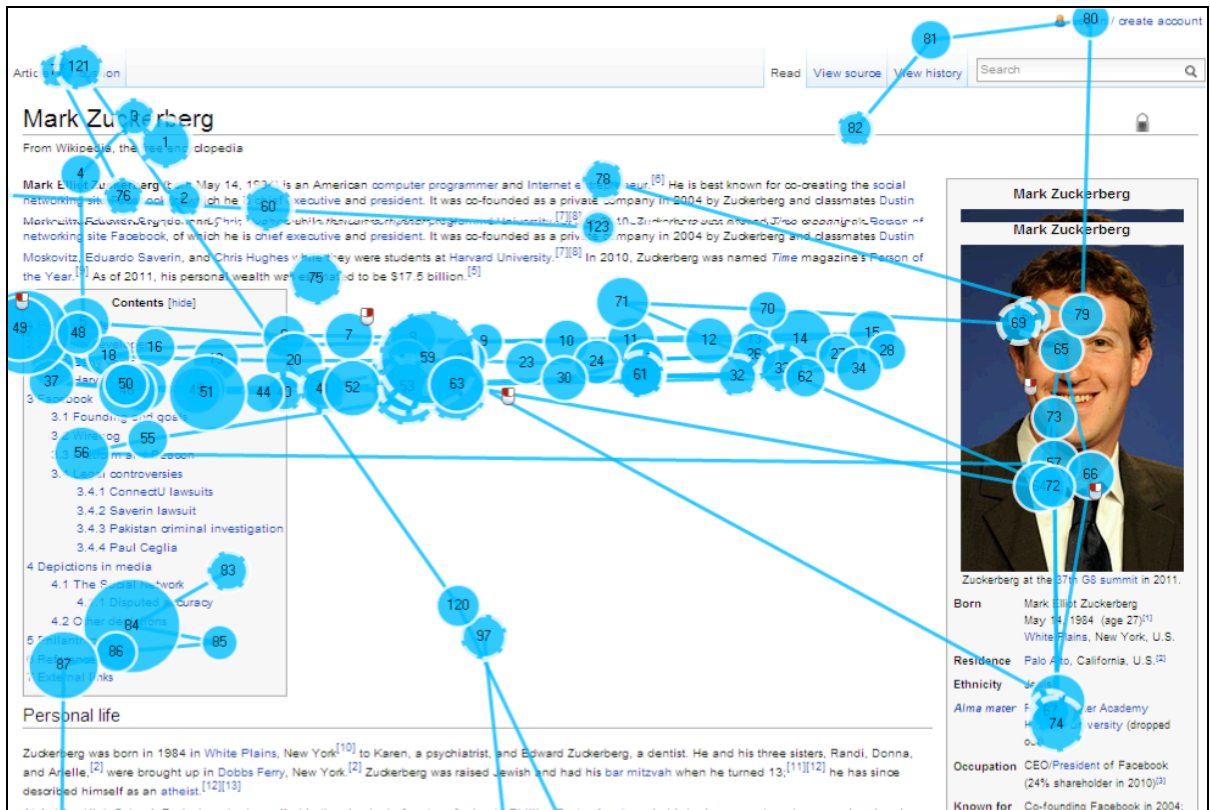
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from the logs, but this will be analysed in future work.

3. Gaze plots (Figure 4.11–4.13) - visualise the movement sequence and position of fixations and saccades on the stimulus. The size of the fixation indicates the fixation duration whereas the number on the fixation 'dot' represents the order in which the fixation occurs in the scan path. Gaze plots can be used to illustrate the gaze activity of one or many subjects over the eye tracking session. Unfortunately, the saccadic and pupil data was unobtainable from the database. Unlike the Viewpoint data which is stored in log files for access at any time (and created at the time of data capture), the Tobii system requires the users to output the data when needed from the User Interface. However, problems have been experienced when trying to output the log data, which is the only way to access these types of information due to software exceptions. The software licence with Tobii expired in Autumn 2013 so there is no way of accessing System Support to help to resolve the problem at this time.
4. Timings - Times (in Seconds) that each participant took for each task. The times are cross-compared with the ocular data and questionnaire responses to try to highlight any relationships, for example, between Task Clear and Time Taken.

All the questionnaire data and eye tracking data was merged into one large SPSS file to enable full comparison. By cross-referencing all the data and conducting a comprehensive analysis of the participants' behaviour, the research questions, as listed in Section 4.11, were tested. The task data saved by the 30 participants consisted of whole Wikipedia web pages and text which were copy-pasted within Word files (extracted from articles).

The three types of questionnaires used the psychometric five-point Likert scales and were based on templates used previously (Liu et al., 2010). The purpose of the entry questionnaire was the recording of demographic information, such as age, web experience and encyclopaedia use. The second questionnaire, filled in by the participant after completing each of the three tasks, was to record the participant experiences, semantic differentials, and evaluation of the task. The exit questionnaire was to compare and contrast the three tasks and search completion results that the subjects had just attempted to carry out.



**Figure 4.11: Gaze plots example from Mark Zuckerberg biographical article. The dots are fixations, larger dots mean greater fixation durations and the lines between the fixations are saccades.**

## 4.15 Materials

### 4.15.1 Corpus

Wikipedia has become an interesting and now commonly used domain for research (Almeida et al., 2007; Ehmann et al., 2008; Hu et al., 2009) and also for genre analysis (Emigh & Herring, 2005; Stvilia et al., 2005; Sushmita et al., 2010), especially in the context of enabling social interactivity and empowering of the online community. Literary evolutionary processes in Wikipedia have enabled users to develop new and old variants of standardised information forms, that is, genres. In the context of information interaction and processing, the studying of the ocular behaviour and strategies of participants in an academic community will show the ways in which they interact holistically with the layout of the main sections of Wikipedia pages, in multiple forms, during natural and realistic search tasks. In Wikipedia, naturally occurring structures, such as genres, offer rich pickings for participants and Wikis are important tools for researchers in the field of genre because they enable a community of practice to construct textual forms for contextual purposes.

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#### **4.16 Procedure**

The study was conducted on a one-to-one basis, but the observer did not intervene unless it was necessary to resolve a problem with the eye tracker. The procedure was as follows:

1. Briefing, instructions, tasking overview, ethics and consent
2. Entry questionnaire
3. Search tasks (repeated three times):
  - a. Allocated search task -- Save web file(s) to folder or relevant selected text to Word file - then complete Task Questionnaire
4. Exit questionnaire & Debrief

##### **4.16.1 Briefing and Instructions, Tasking overview and Debrief**

###### **4.16.1.1 Briefing and Instructions**

On arrival, in the room where the experiment was to take place, each participant was briefed and asked to read the ethics form (Appendix B1). If the participant agreed to continue, the participant was asked to sign a form confirming as much and reminded that he/she was free to leave at any time (Appendix B2). Once the ethical formalities were complete, the participant was handed a form describing the experiment and then matched up to the equipment, which was altered each time to suit the height of the participant. A pre-experimental calibration was performed to test whether the participant could be detected with the Tobii T-60 accurately, otherwise the pre-experiment briefing and first questionnaire would have been a pointless exercise. Fortunately, the T-60 had different optional tools in the software, unlike the Arrington in Chapter 3, to test whether the participants were being detected with ease and accuracy. Once calibration was confirmed to an acceptable standard, the participant was briefed for the task.

###### **4.16.1.2 Tasking overview**

Firstly, each participant was asked to fill out an opening questionnaire which collected demographic information (data in Section 4.13 and questionnaires in (Appendix B3-B5)).

Each participant was allocated the simulated situations (tasks) listed in Section 4.12.1.1 (Appendix B6) (using Latin Square three-by-three) and asked to search Wikipedia, (strictly only Wikipedia, but on two occasions, participants failed to comply), while the eye tracking system recorded the search task sessions and which areas of interest (AOIs) of the Wikipedia pages were used. Once the task had been started, Internet Explorer launched

automatically set to the Wikipedia homepage for each task. Each participant was instructed to use only the Wikipedia search engine and not the search toolbar in the Internet Explorer (IE) browser<sup>51</sup>.

#### **4.16.1.3 Debrief**

Immediately after the eye tracking recording was completed, the participants were debriefed and required to fill out a post-experiment questionnaire (Appendix B5) to document any of their discoveries (also c.f. Section 4.16.1.3 debrief).

### **4.17 Results & Analysis One: Important Features**

#### **4.17.1 Visit Count and Mean Visit Durations per AOI**

The AOI visit count (Table 4.4) starts as soon as a participant first fixates on an AOI, and ends when the participant fixates outside the current AOI. Any number of fixations can occur during a visit. Whenever a participant fixates on text outside the AOI, and then subsequently returns to the AOI, this is added as the beginning of another visit. These are therefore important for study sample, for retrieving relevant information on the tasks. A one-way repeated-measures ANOVA was used to assess mean visit count per AOI and revealed a main effect of  $F(1,325) = 265.28, p < .001$ <sup>52</sup> (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). Bonferroni post-hoc tests revealed that:

- Sub Title were gazed at most in the visit counts. Sub Title versus Image Captions, Tables, Main Title, References, Numeric List and Table Categories ( $p < .001$ ) apart from Information Box ( $p = .042$ ) and Bullet Lists ( $p < 0.05$ ), but differences between Contents Lists and Summary Text were insignificant.
- The Contents Lists was gazed at significantly more than Main Title, References, Numeric List and Table Categories (all  $p < .001$ ).
- Summary Text was significantly more important than the Main Title, References and Table Categories (all  $p < .001$ ).
- The Information Box was gazed at less than Sub Title ( $p = .042$ ) and more than Numeric List ( $p = .033$ ) and Table Categories ( $p = .006$ ).
- The Bullet Lists were gazed at less than Sub Title  $p < 0.05$  and more than Table Categories

<sup>51</sup> The Tobii system currently restricts the user to using IE8, as it is the only browser object in the SDK.

<sup>52</sup> A fixed-level  $P$  value of .001 means that the disparity between the groups was attributed only 1 time out of 1,000 to chance.  $P$  would be 1 time out of 10,000!

( $p=.013$ ).

- Image Captions were significantly less gazed at than Sub Title ( $p<.001$ ) but no more significantly gazed at than any other feature.
- The Tables were less significantly gazed at than Sub Title ( $p<.001$ ).
- The Main Title was gazed at less than the Sub Title, Contents List and Summary Text (all  $p<.001$ ).

In this study, the structural features that were most used by the participants to navigate around the articles were, firstly, the Sub Title and, secondly, the Contents List. The way in which the participants used these features suggests that they were used as signalling devices: after visiting the Contents List to find the Sub Title, the participants scrolled down through the text until they reached the relevant section of text. These results help to answer RQ13, with regard to the usefulness of form; RQ14, with regard to the use of formatted features; RQ14, with regard to the usefulness of the Contents List box shape; RQ15, with regard to the features that were most used, such as Sub Title. In this case, the Sub Title and Contents Lists were most visited and used as a mix of signalling devices and landmarks. The Summary Text was the third most visited feature, which suggests that it was used for judging the relevance of the article.

**Table 4.4: visit (gaze) count and mean visit durations per AOI across all tasks**

AOI	Mean Visit Count	Mean Visit Durations
Sub Title	63.33	0.74
Contents Lists	52.09	1.04
Summary Text	45.64	0.90
Information Box	36.22	1.36
Bullet Lists	34.48	1.26
Image Captions	29.47	0.99
Tables	27.61	1.91
Main Title	14.53	0.42
References	13.48	1.53
Numeric List	11.57	1.72
Table Categories	3.95	0.84

Visit (gaze) duration (Table 4.4) is the sum of the duration of each fixation within a visit or, put simply, the duration of each individual visit within the AOI group in seconds. It is occasionally used as a metric of the dissemination of a participant's attention amongst the AOIs. Sometimes this metric is confused due to the number of words in an AOI, as it takes more fixations to process the

text. This does not seem to be the case here, since the summary text, which contains the AOI with the largest passages of text in the AOIs, only recorded a mean duration of 0.90 seconds, which ranks fairly low. A one-way repeated-measures ANOVA was used to assess mean visit duration per AOI and revealed a main effect of  $F(1,325) = 6.923$ ,  $p < .001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). Bonferroni post-hoc tests revealed that, according to the sample summarised in Table 4.4, the participants found:

- The Sub Title were more time engaging than the Main Title ( $p < .001$ ) but less than the Table Categories ( $p < .001$ ).
- The visit durations between the Contents Lists were more time engaging than the Main Title and Table Categories ( $p < .001$ ) but less than the References and Numeric List ( $p = .032$ ).
- The Summary Text significantly more time engaging than the Main Title ( $p = .005$ ) and Table Categories ( $p = .002$ ).
- The Information Box was fixated upon longer than the Contents Lists, Summary Text and the Main Title  $p < .001$ .
- Bullet Lists were looked at significantly more than the Main Title ( $p = .003$ ) and Table Categories ( $p < .001$ ).
- References and Numeric List had longer durations than the Contents Lists ( $p = .032$ ).
- The durations between Table Categories were significant ( $p < .001$ ).

The statistical results (the mean Visit Durations for the Information Box, the Contents List, the Summary Text, and Main Title) show that when the articles were first viewed, the visit to the Information Box lasted the longest. This partially answers RQ14, at this point, because when most articles were first viewed, the visit duration to the AOI was the longest. The answers to RQ13 and RQ15 are also found here: the statistics showed that the structural features in all the areas allowed the efficient navigation of the content. The statistical results also revealed the importance of the Information Box, Contents List, Summary Text, Bullet Lists, Numeric List and Table Categories, with regard to the most useful shapes, features, signals and landmarks of the layout (RQ16).

#### **4.17.2 Total Visit (gaze) Duration and Fixation Count per AOI**

The total visit (gaze) duration (Table 4.5) is defined in this context as the duration of all visits within an AOI group even when a user has regressed to the AOI. A one-way repeated-measures ANOVA was used to assess mean total gaze duration per AOI and revealed a main effect of  $F(1,325) = 265.28$ ,  $p < .001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). Bonferroni post-hoc tests revealed:



- Sub Title had effect longer more than Main Title, References, Numeric List and Table Categories (all  $p < .001$ ) and longer than Bullet Lists and Image Captions also ( $p = .036$ ).
- Contents Lists and Summary Text were gazed at longer than Main Title, References, Numeric List and Table Categories ( $p < .001$ ).
- The Information Box was important for longer than the Main Title ( $p = .003$ ), References ( $p < 0.05$ ), Numeric List and Table Categories ( $p < .001$ ).
- In total, the Bullet Lists were deemed more important than the Main Title ( $p < 0.05$ ), References ( $p = 0.38$ ), Main Title ( $p = .010$ ) and the Table Categories ( $p < .001$ ).
- The Table had more effect than Main Title ( $p = .010$ ), Numeric List ( $p = .003$ ) and Table Categories ( $p = .003$ ).
- The Image Captions were deemed insignificant compared to Main Title ( $p = .010$ ), Numeric List and Table Categories ( $p < .001$ ).
- The Main Title had less effect than the Sub Title ( $p < .001$ ), Contents List ( $p < .001$ ), Summary Text ( $p = .002$ ), Information Box ( $p = .003$ ), and Tables ( $p = .010$ ).
- The References had less effect than Sub Title and Contents List, both  $p < .001$ , Summary Text ( $p = .032$ ) and Information Box ( $p < 0.05$ ).
- The Numeric List was more effective than the Image Captions. However, the Numeric List features did have less effect than Sub Title ( $p < .001$ ), Contents Lists ( $p < .001$ ), Summary Text ( $p < .001$ ), Table ( $p = .003$ ) and Bullet Lists ( $p = .038$ ).
- Table Categories were statistically less effectual than Sub Title, Contents Lists, Information Box and Summary Text ( $p < .001$ ). Bullet Lists and Tables were also less effectual ( $p = .028$ ) and ( $p = .003$ ) respectively.

The analysis of the visits metric showed how many times the topographical features, such as Sub Title, Main Title, Numeric List and Table Categories were visited (and re-visited). This may mean that the features of the Wikipedia pages are not only noticeable but that the features are also returned to for further navigation around the text. Sub-Titles were shown to be the most important signalling devices (RQ15). However, compared with the previous metric, Mean Visit Duration (Table 4.5), no single feature was visited more than any other. This was even the case at the top of each article, with regard to the Information Box, Main Title, Contents List and Summary Text (RQ14). Conversely, on many occasions, out of all the listing devices and information presentation layouts, the visits to the Tables lasted the longest. The statistics also showed that the Main Title visit durations were shorter than all the others (RQ16).

Nevertheless, for this metric, no single feature was outstanding for navigational purposes; the statistics showed that they were all generally important features for the overall navigation of the articles (RQ13 & 15).

**Table 4.5: Total gaze duration in seconds and mean fixation counts per AOI**

<b>AOI</b>	<b>Total Visit (gaze) Duration (seconds)</b>	<b>Mean Fixation Counts</b>
Bullet Lists	43.37	46.81
Summary Text	41.17	62.72
References	20.57	31.18
Main Title	6.17	19.53
Sub Title	46.83	71.32
Information Box	49.29	61.08
Tables	52.80	44.45
Image Captions	29.25	41.84
Numeric List	19.9	42.07
Contents Lists	54.42	52.60
Table Categories	3.33	11.50

The counts of fixations on a specific AOI is indicative of the noticeability of the area in question and the cognitive activity of a participant in accomplishing the task.

A one-way repeated-measures ANOVA was used to assess mean fixation count per AOI and showed a main effect of  $F(1,325) = 24.197, p < .001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). Bonferroni post-hoc tests were conducted on the Mean fixation count AOIs and the following was discovered:

- The Sub Title were more noticeable than the Main Title ( $p < .001$ ), Table Categories ( $p = .001$ ), Numeric List ( $p < .001$ ), References ( $p < .001$ ), Image Captions ( $p = .001$ ), Table ( $p = .001$ ) and Bullet Lists ( $p = .009$ ).
- The Contents Lists is less noticeable than the Main Title ( $p < .001$ ), References ( $p = .001$ ), Numeric List ( $p < .001$ ) and Table Categories ( $p < .001$ ).
- The Summary Text is more noticeable than Main Title ( $p < .001$ ), Table Categories ( $p < .001$ ) and References ( $p = .014$ ).
- The Information Box is less noticeable than the Table Categories only ( $p < 0.05$ ). The

Information Box is less effective than Sub Title ( $p=.009$ ) but more than Main Title ( $p=.001$ ), References ( $p=.014$ ) and Table Categories ( $p<.001$ ).

- Bullet Lists are less noticeable than Sub Title ( $p<.001$ ) and more noticeable than Main Title ( $p=.039$ ) and Table Categories ( $p=.002$ ).
- Image Captions and Tables were statistically more effective than Table Categories ( $p=.023$ ) but less than Sub Title ( $p=.001$ ).
- Main Title were less noticeable than Sub Title, Contents Lists, Summary Text ( $p<.001$ ), Information Box ( $p=.001$ ) and Bullet Lists ( $p=0.39$ ).
- References were statistically third least effective and Table Categories the absolute least as shown in Table 4.5.

If the tops of the articles are not taken into account, the Sub Title had the most cognitive fixations which shows that they were being used as signalling devices for navigation (RQ13 and RQ15) It could be argued that the prominence of the AOI Summary Text (text encapsulated in one or more formatted textual paragraphs) mean fixation counts in Table 4.5 was due to the amount of text which featured in the captions: some participants were reading the text, which would lead to many more fixations, but also leads to cognitive effort, which helps to answer RQ13, RQ14 and RQ15 (fixations of features and shapes, fixating in the first seconds of the viewing of an article and features used for IS tasks, such as Summary Text, etc., respectively). The careful and painstaking analysis of each article with the Summary Text AOIs revealed that there were only a few occasions when the text was actually heavily fixated on due to reading; this was the case for participants 1, 21 and 27 who, taken together, scored a mean of 74.45 fixations. In other words, the large mean amount of fixations was not due to extensive reading but to the actual scanning of the text to look for relevant information. The ocular behaviours described in Chapter 2 (Section 2.9.3) showed whether skimming or scanning was utilised to determine the behaviour in the Summary Texts. This helped to determine the scanning behaviour, rather than skimming, in these instances (RQ17).

#### **4.17.3 Time to First Fixations at top of Articles**

**Table 4.6: Time to First Fixations in seconds. Four AOIs at top of article**

<b>AOI</b>	<b>Time to First Fixations in Seconds (AOI at top of all relevant pages)</b>
Summary Text	28.90
Main Title	58.29
Contents Lists	15.77
Information Box	19.53

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The data in Table 4.6 was analysed to answer the research question RQ14, i.e., ‘*Where does the participant fixate in the first few seconds of viewing a Wikipedia article?*’ Four AOIs were setup on the articles which contained the four layout features (AOI column in Table 4.6). The total means are displayed on the right of Table 4.6 but the full data was analysed. A one-way repeated-measures ANOVA was used  $F(3,124) = 1.903, p < .001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). Bonferroni post-hoc tests revealed from the sample summarised in Table 4.6 that:

- The participants fixated on the Contents List faster than Summary Text ( $p = .023$ ), Main Title ( $p < .001$ ) and Information Box ( $p = .039$ ).
- The Information Box was fixated on faster than the Summary Text ( $p = .011$ ) and Main Title ( $p < .001$ ).
- The Summary Text was fixated on faster than the Main Title ( $p < .001$ ).

According to a statistical examination of the AOIs data in Table 4.6, the Contents List was fixated on first in most cases (all the articles). The second most important feature fixated on first was the Information Box and the third most important, the Summary Text. The most surprising result was that the Main Title was the least noticeable or looked at. This could be construed as meaning that it is considered unimportant, maybe that the Wikipedia search facility is considered trustworthy or that the Main Title is skimmed. It seems, according to the data, that the majority of participants consult the Contents List and then look for information in the Information Box. The Contents List at the top of articles was predominantly the first and therefore the most important feature for determining relevance in the first few seconds of exposure (RQ14). As shown in Table 4.4 this showed that the participants, in this case, were using the Contents List as a signaling device to search if there were relevant Sub Title later on opposed to browsing the whole article for an answer (RQ15).

A further in-depth analysis of lower level finer-grained features was deemed appropriate to build on the current findings. For example, what are the most commonly fixated features when a user is using an article (Figure 4.4) after the previous large AOIs are split into smaller AOIs? On looking at the Information Boxes, are the emboldened titles used more than the actual content, or the sub titles? In a Contents List, which part is most commonly used? How much attention, if any, do participants pay to the alphabetised label positioned above each section of text?

Visual analysis of smaller grained features, such as Hyperlinks, would also be interesting to look at in more depth, but a line was drawn here because, for such a feature, a more sophisticated eye tracker with a higher gaze rate than the available 60Hz would be required. The next Sections, 4.17.4 & 4.17.5, all tackle the problem of looking at finer grained features.

#### ***4.17.4 Mean Fixation (gaze) Duration, Fixation Count and Total Fixation Duration per AOI for Finer Grained Features in all Articles***

A one-way repeated-measures ANOVA was used to assess mean fixation duration per AOI (Table 4.7) and showed a main effect of  $F(30, 985) = 8.963, p < .0001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). Bonferroni post-hoc tests were conducted on the means for fixation duration (Table B.1).

Many observations were made during the analysis of the Fixation Durations of the Bonferroni post hoc tests and means shown in Table 4.7:

- In terms of the Sub Title, there were no statistical differences between the three types, i.e., Bold, Italic and Plain. The participants used them but, cognitively, there were no observable differences.
- In terms of the Contents List, there were no statistical differences between the three areas, i.e., Title, Numeric and Content. The participants used them and they were important but, cognitively, there were no observable differences between the three.
- In terms of the Information Box, there were no statistical differences between the seven areas, i.e., Title, Banner Sub Title, Bullet List, Image, Image Text, Sub Title and Contents, among the samples. All 30 participants used them all and they were important but, cognitively, there were no observable differences.
- In terms of the Summary Text, there were no statistical differences between the two types, i.e., Bold and Plain.
- In terms of the Bullet Lists, there were statistical differences between the three areas, i.e., Small, Paragraph Right and Left. The smaller Bullet Lists were fixated on longer than the Paragraph Counterparts (Left and Right sides) ( $p < .0001$ ). Numeric List are also compared below.
- In terms of the Image Captions, there were no statistical differences between the two areas, i.e., Image Caption Image and Image Caption Text.
- In terms of the Table Categories and the Tables, there were two areas in each; Table

Categories with Banner and Content and the Table with a Header and Contents. Only the Table Contents were significantly viewed for longer than Table Categories Banner ( $p=.026$ ) out of all the Table AOIs.

- Next, the numeric lists types were evaluated. The References (left and Right side) and Numeric List all are similarly structured so analysed together. None of these types were fixated on longer than the other statistically. However, when compared to the Bullet List types there are some interesting statistics. The small in text Bullet Lists fixations are longer than Numeric List and References Right, ( $p<.0001$  and  $p<.005$  respectively) so from this sample it could be concluded they are more prominent throughout the retrieved sample of articles or a more popular type with the participants.
- The Quotations (Centred and Boxed) were not significant at all.

The fixation durations provided a mixed bag of results but mostly the comparison of similar types provided fewer indications of differences in cognitive effort between them.

**Table 4.7: AOI mean fixation (gaze) duration, mean fixation count and total fixation duration**

<b>AOI</b>	<b>Mean Fixation (gaze) Duration</b>	<b>Mean Fixation Count</b>	<b>Total Fixation Duration per AOI</b>
<b>Sub Title:</b>			
Plain	0.36	47.03	16.87
Bold	0.33	49.47	16.17
Italic	0.34	17.15	5.77
<b>Contents List:</b>			
Title	0.34	27.65	9.54
Numeric	0.37	84.78	31.77
Content	0.32	78.56	25.1
<b>Summary Text:</b>			
Plain	0.33	243.06	85.82
Bold	0.29	9.04	12.25
<b>Information Box:</b>			
Title	0.42	4.42	1.88
Banner Sub Title	0.48	5.72	2.78
Bullet List	0.50	25.12	12.61
Image	0.36	31.53	11.47

Image Text	0.40	5.75	2.28
Sub Title	0.42	24.45	10.32
Contents	0.44	39.97	17.54
<b>Bullet List:</b>			
Small	0.38	145.84	55.94
Paragraph Right	0.32	32.45	10.30
Paragraph Left	0.33	26.5	8.83
<b>Image Captions:</b>			
Image	0.34	82.13	27.84
Text	0.36	18.68	6.67
<b>Tables:</b>			
Header	0.36	19.34	7.91
Contents	0.30	117.78	47.62
Main Title	0.29	39.53	11.32
<b>References:</b>			
Left Side	0.36	47.61	17.25
Right Side	0.35	22.24	7.68
Numeric List	0.40	53.07	21
<b>Table Categories:</b>			
Banner	0.29	10.38	3.01
Content	0.33	7.68	2.53
<b>Quotations:</b>			
Centred	0.32	17.11	5.51
Boxed	0.23	3	0.69
Menu Bar	0.29	28.09	12.64
Search Box	0.39	29.18	12.71
Wikipedia Icon			

The features that were most and least prominent are shown in Table B.2. The fixation counts are defined in this context. The counts of fixations on a specific AOI are indicative of the noticeability of the area in question and the cognitive activity of a participant in accomplishing the task. A one-way repeated-measures ANOVA was used to assess mean fixation counts per AOI (Table 4.7) and showed a main effect of  $F(30, 985) = 19.876, p < .0001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance).

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Many observations were made during the analysis of the Fixation Counts of the Bonferroni post hoc tests and means shown in Table 4.7:

- In terms of the Sub Title, there were no statistical differences between the three types, i.e., Bold, Italic and Plain. The participants used them but, cognitively, there were no observable differences.
- In terms of the Contents List, there were no statistical differences between the three areas, i.e., Title, Numeric and Content. The participants used them and they were important but, cognitively, no single one of the three was more important than any other.
- In terms of the Information Box, there were no statistical differences between the seven areas, i.e., Title, Banner Sub Title, Bullet List, Image, Image Text, Sub Title and Contents from the samples. All 30 participants used them all and they were important but, cognitively, there were no outstanding differences between the seven areas of the Information Box.
- In terms of the Summary Text, there were statistical differences between the two types, i.e., Bold and Plain. The plain version was more noticeable and registered far more fixation counts than the bold version ( $p < .0001$ ).
- In terms of the Bullet Lists, there were statistical differences between the three areas, i.e., Small, Paragraph Right and Left. The Bullet List Paragraph Left and Right had fewer fixation counts than the Bullet Lists Small ( $p < .0001$ ). Numeric List are also compared below.
- In terms of the Image Captions, there were no statistical differences between the two areas, i.e., Image Caption Image and Image Caption Text.
- In terms of the Table Categories and the Tables, there were two areas in each; Table Categories with Banner and Content and the Table with a Header and Contents. Only the Table Contents were significantly viewed for longer than the Table Categories Banner ( $p = .026$ ) out of all the Table AOIs.
- The Table Header had fewer fixations than the Table Contents ( $p < .0001$ ) since the participants tended to use the headers to determine the relevance of the contents. The Table Contents Banner registered more fixation counts than the other Tabular areas ( $p < .0001$ ) which reversed the trend of the Table Header/Contents. The TC Banner may have been more noticeable due to the colouring than the standard plain Table Header and this might explain why it was viewed on more occasions.
- Next, the numeric lists types were evaluated. The References (Left and Right sides) and Numeric List are all similarly structured and were therefore analysed together. The statistical results showed that none of these types had more or fewer fixations than any



other. A comparison with the Bullet List types, unlike the fixation durations, did not yield any interesting statistical results.

- The Quotations (Centred and Boxed) were not significant at all.

It could be concluded that, statistically, in the retrieved sample of articles, none of the features are used more prominently than others.

A one-way repeated-measures ANOVA was used to assess Total Fixation Duration per AOI (Table 4.7) and showed a main effect of  $F(30, 985) = 16.303, p < .0001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). The Total Fixation Duration measures the sum of the duration for the entire amount of the recorded fixations within the setup AOIs and then computes the averages. The post hoc tests are shown in Appendix Table B.3. However, to summarise, many observations were made during the analysis of the Total Fixation Durations of the Bonferroni post hoc tests and means shown in Table 4.7:

- In terms of the Sub Title, there were no statistical differences between the three types, i.e., Bold, Italic and Plain. The participants used them but, cognitively, there were no observable differences.
- In terms of the Contents List, there were no statistical differences between the three areas of this area, i.e., Title, Numeric and Content. The participants used them and they were important but, cognitively, there were no observable differences between the three.
- In terms of the Information Box, there were no statistical differences between the seven areas, i.e., Title, Banner Sub Title, Bullet List, Image, Image Text, Sub Title and Contents from the samples. All 30 participants used them all and they were important but, cognitively, there were no observable differences between the seven areas of the Information Box.
- In terms of the Summary Text, there were some statistical differences between the two types, i.e., Bold and Plain. The Summary Text Plain had a greater number of Total Fixation Durations than the Summary Text Bold ( $p < .0001$ ).
- In terms of the Bullet Lists, there were some statistical differences between the three areas, i.e., Small, Paragraph Right and Left. The total fixation period of the smaller Bullet Lists were longer than the Paragraph Counterparts (Left and Right sides) ( $p < .0001$ ). The Left and Right Bullet Lists were not significantly different. The Numeric List is also compared below.
- In terms of the Image Captions, there were no statistical differences between the two areas, i.e., Image Caption Image and Image Caption Text.
- In terms of the Table Categories and the Tables, there were two areas in each; Table

Categories with Banner and Content and the Table with a Header and Contents.

Table Contents had longer fixation duration in total than the Table Headers ( $p < .0001$ ). A comparison of the differing Table types showed that only the Table Contents were significantly viewed longer than the Table Categories Banner and the Table Categories Box ( $p < .0001$ ) out of all the Table AOIs.

- Next, the numeric lists types were evaluated. The References (Left and Right side) and Numeric List are all similarly structured and were therefore analysed together. None of these types were fixated on longer than any other statistically. However, when compared with the Bullet List types, there are some interesting statistical results. The small in-text Bullet Lists fixations were longer, in total, than the Numeric List and the References Right and Left, ( $p < .0001$ ), and it could therefore be concluded from this sample that they are more prominent throughout the retrieved sample of articles or a more popular type with the participants for use in navigation.
- The Quotations (Centred and Boxed) were not significant at all.

The fixation durations, fixation counts and total fixation durations (Table 4.7) provided a mixed bag of results overall, but the more finely grained comparison of similar types using the metrics indicated fewer differences in cognitive effort between them. For example, the fixation durations showed that there were no differences, when evaluating the lower level features of the Information Box, Contents List, etc. However, this does not mean that they were unimportant for the tasks; when analysed alongside the results in Sections 4.17.1-4.17.3 and 4.17.5, the results showed that the features in the Information Box, Contents List, etc. were being used cognitively as if "*The whole is greater than the sum of its parts*" (Aristotle, 1984) or synergic. It was expected that there would be marked differences between the features that are viewed upon first interaction with an article, but as shown in this section, this seemed not to be the case. However, there were instances of some smaller features being fixated on more and for longer, for example, all the Sub Title were fixated on for longer than the Table Categories Banner, the Summary Text Bold, the Bullet List Paragraphs and so on. These results are displayed in Appendix B7.

With regard to the set of fixation results in this section and the research questions, RQ16 (which are the predominant features fixated upon during search tasks?) and RQ15 (formatted features (Titles, Summary Texts, Information Boxes, Tables), there were no particular statistical conclusions that could be drawn from the smaller sets of features. This does not mean that they were not used

(as will be shown in Section 4.17.5) but rather that the large feature AOIs, when separated into smaller groups, were simply not as important in a cognitive context.

#### ***4.17.5 Mean Visit Count, Mean Visit Durations and Total Visit Durations per AOI for Finer Grained Features in all Articles***

The AOI visit count (Table 4.8) starts as soon as a participant first fixates on an AOI, and ends when the participant fixates outside the current AOI. Any number of fixations can occur during a visit. Whenever a participant fixates on text outside the AOI, and then subsequently returns to the AOI, this is added as the beginning of another visit. These are therefore important for our sample, for retrieving relevant information on the tasks. Visit (gaze) duration (Table 4.8) is the mean duration of each fixation within a visit or, put simply, the duration of each individual visit within the AOI group in seconds. It is occasionally used as a metric of the dissemination of a participant's attention amongst the AOIs. The total visit duration is defined in this context as the duration of all visits within an AOI group even when a user has regressed to the AOI. The Total Visit Duration is calculated by finding the average of the total sum of all the durations of each fixation within a visit (Table 4.8).

A one-way repeated-measures ANOVA was used to assess Mean Visit Counts per AOI and showed a main effect of  $F(30,985) = 13.253$ ,  $p < .0001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). The post hoc tests are shown in Appendix B7, Table B.4.

However, to summarise many observations were made during the analysis of the Mean Visit Counts of the Bonferroni post hoc tests and means shown in Table 4.8:

- In terms of the Sub Title, there were statistical differences between the three types, i.e., Bold, Italic and Plain. The participants visited them but, cognitively, there were no observable differences. The Sub Title Plain was visited more than Italic ( $p = .002$ ) and Bold ( $p = .008$ ) and the Sub Title Bold was visited fewer times than Italic ( $p = .008$ ).
- In terms of the Contents List, there were statistical differences between the three areas of this area, i.e., Title, Numeric and Content. The Contents Title was visited fewer times than Numeric ( $p < .001$ ) and Content ( $p < .0001$ ). All instances of the Contents Content were visited more than all other Contents features ( $p < .0001$ ), except for Contents Numeric (not significant).
- In terms of the Information Box, there were statistical differences between the seven areas,

i.e., Title, Banner Sub Title, Bullet List, Image, Image Text, Sub Title and Contents from the samples. All 30 participants used them all and they were important but, cognitively, there were observable differences between the seven areas of the Information Box. The Information Box Title was visited fewer times than the Information Box Content ( $p=.010$ ), the Information Box Banner Sub Title ( $p<.006$ ), and the Information Box Image Text ( $p=.028$ ). The Information Box Contents was visited more than the Title, Banner Sub Title and Image Text.

- In terms of the Summary Text, there were no statistical differences between the two types, i.e., Bold and Plain. The Summary Text Plain visit duration was not longer than the Summary Text Bold.
- In terms of the Bullet Lists, there were statistical differences between the three areas, i.e., Small Paragraph Right and Left. The smaller Bullet Lists were visited more in total than the Paragraph (Left and Right sides) Counterparts ( $p<.0001$ ). Numeric List are also compared below.
- In terms of the Image Captions, there were statistical differences between the two areas, i.e., Image and Caption Text. The Image Caption Image was visited more than the Image Caption Text ( $p=.011$ ).
- In terms of the Table Categories and the Tables there were two areas in each; the Table Categories with Banner and Content and the Table with a Header and Contents. The Table AOIs had no significant differences.
- Next, the numeric lists types were evaluated. The References (left and Right side) and Numeric List are all similarly structured and were therefore analysed together. None of these types was visited more than any other statistically. However, when compared with the Bullet List types, there were some interesting statistical results. The small in-text Bullet Lists visits are longer than the Numeric List and References Right and Left ( $p<.0001$ ).
- The Quotations (Centred and Boxed) were not significant at all.

It could be concluded that, statistically, in the retrieved sample of articles, none of the features are used more prominently than others.

The Mean Visit Counts metrics post hoc tests produced different outcomes compared with those in Section 4.17.5. The separate AOI features were visited quite extensively in comparison with the fixations. Many of the same signal topographical features of different types were visited, e.g., Sub Title Plain vs. Italic and Bold (RQ15 formatting), Contents List and Information Box sub types, which

provided the answer to RQ16 with regard to the features used. With regard to the smaller form features, they helped the participants find information more efficiently and with more ease (RQ13).

**Table 4.8: AOI visit (gaze) count, mean visit durations and total visit durations**

<b>AOI</b>	<b>Mean Visit Count</b>	<b>Mean Visit Duration</b>	<b>Total Visit Duration</b>
<b>Sub Title:</b>			
Plain	31.38	0.56	17.45
Bold	30	0.56	16.65
Italic	11.53	0.51	5.84
<b>Contents List:</b>			
Title	14.77	0.68	10.03
Numeric	34.59	1.09	37.55
Content	37.06	0.84	31.11
<b>Summary Text:</b>			
Plain	38.12	1.44	85.82
Bold	7.52	0.37	2.76
<b>Information Box:</b>			
Title	3.46	0.59	2.06
Banner Sub	4.17	0.67	2.78
Title			
Bullet List	11.29	1.15	12.94
Image	16.63	0.75	12.41
Image Text	4.43	0.53	2.33
Sub Title	16.76	0.64	10.32
Contents	21.77	0.84	18.37
<b>Bullet List:</b>			
Small	32.03	2.06	65.82
Paragraph Right	6.55	1.64	10.76
Paragraph Left	5.94	1.59	9.44
<b>Image Captions:</b>			
Image	29.35	1.07	31.42
Text	10.61	0.63	6.71
<b>Tables:</b>			
Header	10.89	0.77	8.36

Contents	19.41	3.1	60.25
Main Title	14.53	0.42	15.57
<b>References:</b>			
Left Side	11.43	1.81	20.68
Right Side	7.24	1.18	8.58
Numeric List	8.64	3.9	33.73
<b>Table Categories:</b>			
Banner	3.92	0.79	3.11
Content	4.16	0.62	2.56
<b>Quotations:</b>			
Centred	7.89	0.73	5.73
Boxed	1	0.69	0.69
Menu Bar	18.96	0.96	18.19
Search Box	13	1.86	24.14
Wikipedia Icon	5.62	0.64	3.61

A one-way repeated-measures ANOVA was used to assess Mean Visit Durations per AOI and showed a main effect of  $F(30,985) = 14.550$ ,  $p < .0001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). The post hoc tests, unfortunately, showed nothing to report in terms of statistical differences between the smaller AOIs, and are therefore not shown.

A one-way repeated-measures ANOVA was used to assess Total Visit Durations per AOI and showed a main effect of  $F(30, 985) = 14.561$ ,  $p < .0001$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). Unlike the Visit Durations, the post hoc tests showed some significant differences between the AOIs (The post hoc tests are show in Appendix B7, Table B.5). However, to summarise many observations were made during the examination of the Total Visit Durations of the Bonferroni post hoc tests and means shown in Table 4.8:

- In terms of the Sub Title, there were no statistical differences between the three types, i.e., Bold, Italic and Plain. The participants visited them but, cognitively, there were no observable differences.
- In terms of the Contents List, there were no statistical differences between the three areas of

this area, i.e., Title, Numeric and Content. The participants used them and they were important but, cognitively, there were no observable differences between the three.

- In terms of the Information Box, there were statistical differences between the seven areas, i.e., Title, Banner Sub Title, Bullet List, Image, Image Text, Sub Title and Contents from the samples. All 30 participants used them all and they were important but, cognitively, there were no observable differences between the seven areas of the Information Box.
- In terms of the Summary Text, there were statistical differences between the two types, i.e., Bold and Plain. The Summary Text Plain was visited longer than the Summary Text Bold ( $p < .0001$ ).
- In terms of the Bullet Lists, there were statistical differences between the three areas, i.e., Small, Paragraph Right and Left. The smaller Bullet Lists had shorter visit durations than the Paragraph Counterparts (Left and Right sides) ( $p < .0001$ ). Numeric List is also compared below.
- In terms of the Image Captions, there were no statistical differences between the two areas, i.e., Image and Caption Text.
- In terms of the Table Categories and the Tables, there were two areas in each; Table Categories with Banner and Content and the Table with a Header and Contents. The Table Head visit durations were shorter than the Contents and TC Banner and Contents (Box) ( $p < .0001$ ).
- Next, the numeric lists types were evaluated. The References (Left and Right side) and Numeric List are all similarly structured and were therefore analysed together. None of the visit durations for these types were longer or shorter than any other statistically. However, a comparison with the Bullet List types revealed some interesting statistics. The small in-text Bullet Lists visit durations were longer than the Numeric List and References Right and Left, ( $p < .0001$ ) and it could therefore be concluded that, statistically, in the retrieved sample of articles, these features are used more prominently than the others.
- The Quotations (Centred and Boxed) were not significant at all.

Much like the fixation durations, the visit duration metrics post hoc tests did not produce much that could be used for analytical purposes, compared with Section 4.17.5. The results regarding the visit durations were not very informative, but the RQ13 (form useful) was used to find information, and form helped the participants to find the information efficiently (RQ13). The separate AOI features visit durations were a mixed bag. Many of the same signal topographical features (RQ15) of different types were visited but only the Summary Text Plain was, statistically, visited more times

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than the Summary Text Bold, small sections of the Tables and Bullet/Numeric List (RQ15 features used).

#### **4.17.6 Summary**

The previous Section, 4.17.1-4.17.5, was structured to holistically examine and analyse the most shallow and then slightly more finely grained and dominant features used by the participants during the tracking of their eye movements. The features analysis highlighted the most important features which also helped to identify the ocular behaviours employed by the participants.

- 1. Structural (invariant) cues/formatting features identified by eye tracking.** The participants reported that the Sub-Titles, Tables (headers), Contents Lists (title), Information Boxes (image caption and sub-titles) and Hyperlinks (not measured using this specific eye tracker due to its low refresh rate) were used during the task. Quantitatively, the eye tracker corroborated the information reported by the participants, i.e. that the Sub Title, Tables, Contents Lists and Information Boxes were of substantial importance during the search tasks. As might be expected, there were occasions when participants did not report the usefulness of some formatting features but the gaze data suggested otherwise, for example, in the case of the bullet lists.
- 2. Shapes/signalling devices or landmarks.** The shapes of features, such as Information Boxes, are important signalling devices and are used together with some landmark clues. For example, a biographical Information Box containing terms such as, Born, Died and Name, is quite informative in the context of making decisions on relevance when searching for a biographical article. According to the fixation and gaze data, the most common visited and fixated signalling devices were the Contents Lists, Table Categories, References and Information Boxes. Again, this result is partially shown in Figure 4.11, with regard to the Contents List and Information Box. In this case, the shapes (signalling devices) are extremely helpful and natural for the participants to navigate between.

The Sections 4.17.1-4.17.5 helped to positively (and statistically) answer RQ13 (form useful), RQ13 (form relates to efficiency of search), RQ15 (structural/formatting features), RQ15 (participants 'fixate upon' shapes/features/signs of the layout of Wikipedia articles) and RQ16 (features predominately used, such as Main Title, sub-titles, information boxes, lists, references).



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Nevertheless, after completion of the first analysis by features, it was decided that further work was required in the context of exploring the data by analysing the six tasks (simulated situations) as shown below, in Section 4.18.

#### ***4.18 Results & Analysis Two: Tasks and Biographies***

This section provides an analysis of each task, and a deeper analysis of typical genres in terms of the biographical and list articles which were retrieved. In addition, a statistical analysis of the gaze data between the AOIs on structure versus AOIs over non-structured areas, such as plain text, allows a direct comparison between the two groups to discover which are the most important. As Cole et al. (2010) states it is highly plausible and effective to detect the types of information task from eye movements and gaze patterns.

A further in-depth analysis of biographical features is deemed appropriate to build on the current findings. For example, what are the most commonly fixated features when a user is introduced to a biographical article (Figures 4.11/4.12)? This follows on from the Evolutionary work in Chapter 4a.

Overall, the 30 participants made 396 queries in total (mean of 13.2 each over the whole experiment) over six tasks (mean of 2.2 queries per task) and 332 articles in total were retrieved (Table 4.9). Many errors were made in Wikipedia search engine queries due to the mistyping of words and, as a result, some of the articles recorded by the eye-tracking data had to be discarded because they were Wikipedia error pages which forward the user to a search error page to refine the query and category pages, etc. Only 270, therefore, could be used for the analysis (126 articles were from direct query results from the Wikipedia, whilst the remaining 144 were retrieved through browsing). In addition, some articles did not have any recorded ocular behaviour because they were not viewed by the participants. Many other retrieved media were images that were accidentally clicked on by the participant while viewing an image, but these will be useful for future research on the ways in which people interact with images on Wikipedia as well as with the small image and captions text. Other discarded contents are listed in Table 4.9, as 'non-useful articles'. A breakdown of the entire experiment is shown in Tables 4.9-4.16.

As discussed in Kelly (2009, p. 72), participants were provided with standard collections (Wikipedia online in this case) tasks (simulated work task situation and each indicative request), and then asked to search and make the final Relevance Judgements (RJ) themselves.

Table 4.9: Articles retrieved in tasks

Articles	Number
Total articles	332
Articles used in analysis	270
Non-useful articles	162
*Wikipedia search results pages	110
*Image pages	18
*Wikipedia query error pages	22
*External web page	1
*Wikimedia	3
*Google search page	1
*Talk page	1

However, to ensure clarity, relevance judgements (Table 4.10) that were evaluated by the experimenters are shown. The RJ may differ if cross-compared with the participants, but by looking at the post task and post experiment questionnaires (Tables 4.16-4.22) they are most likely to be very similar to those in Table 4.10.

Table 4.10: Articles retrieved in entire study and during all tasks used in analysis

Article Types	Number
Relevant	181 (mean 30.17 SD =1.90 per task)
Non-relevant	89 (mean 15 SD = 1.45 per task)
Biographies (footballers, philanthropists and politicians)	119
Lists	41
Football clubs/stadiums	7
Football stadiums	5
Events	11(air crashes)
Category	5
Timelines (civil war/demonstrations/uprisings, e.g., Timeline of 2011 Libyan Civil War)	18
Country/city	7/5
Definition: circa, colo, airline, demonstration, executive, jasmine revolution, judiciary, marijuana. Disambiguation: philanthropy, spring)	10
Other misc. articles	42

Before the resulting tables are shown and the results discussed, it does of course have to be acknowledged that a higher number of fixations and mean visit counts<sup>53</sup> to AOIs and so on, may arise due to feature distribution. 'Feature distribution' refers to the fact that, in some pages, there may be fewer occurrences of AOI structured features, or that some features might be visited more frequently because there are more of those features, for example, more plain text AOIs than structured text AOIs (e.g., Sub Title). The lack of format or structure in some of the pages being searched by participants may lead to the recording of fewer fixations or mean visit counts to AOIs which subsequently skews the data, i.e., leads to the conclusion that structure is less important in these pages than non-structure. This could occur in the case of entire pages that contained only plain unformatted text, because it could lead to unequal proportions of non-structure AOIs vs. structured text AOIs. This is of minimal significance in the case of this study, which involved limited data and 30 participants; for a study involving a large number of users, however, it would certainly be an important issue.

#### 4.18.1 Analysis by Tasks

Table 4.11 shows the number of articles retrieved during the six tasks by all participants and the times taken per task and per page. A separate t-test was conducted to investigate the effect of the different tasks and time taken (in seconds), and the results showed that this did significantly increase response time ( $t = 13.083$ ,  $n = 90$ ,  $p = 0.00$ ).

**Table 4.11: Number of articles retrieved per task, time taken and mean time each page searched**

<b>Task Name</b>	<b>Number of Articles</b>	<b>Mean Time Taken Per Task (MM:SS)</b>	<b>Mean Time Per Page (seconds)</b>
1 (cannabis)	26	08:35	19
2 (arab spring)	30	09:37	19
3 (philanthropy)	80	10:42	8
4 (aircrash)	40	08:29	12.7
5 (football)	53	06:01	6.8
6 (namibia)	41	04:10	6

As shown in Table 4.11, the least amount of time taken was in the Namibia task, which is not surprising since these pages had the least amount of information (possibly no intensive cognitive activity) but were satisfactorily structurally formed. However, one factor could be the type of

<sup>53</sup> Mean visit counts are calculated by the visits over the whole of each page of which each is divided into AOIs created from areas of structural features or neutral areas, i.e., plain text. To calculate the Visit Counts a one-way repeated-measures ANOVA was used to assess Mean Visit Count per AOI divided into users ( $F(30,985)$ ).

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request. The indicative request was of a vague nature, i.e., *“Collect information about,... and any other information you think is relevant to form the basis of your work”*. In this case, the task was mainly subjective and the participant was left to judge whether the relevant information had been successfully retrieved. The information to be searched for was not really specified, this could lead to a lack of intensive searching (Tables 4.12 & 4.13).

In the Arab Spring task, the pages are long with large tables of data, so the timings are expected. The indicative request was again not so specific *“Use Wikipedia to find out some useful information that you feel is appropriate and can be used later to form a basis for the essay. For example, the countries involved and so on”*.

This, again, left the participants to their own subjective decision-making and did not necessitate their looking for any specific answers as such. Despite the low number of articles available on the Arab Spring, since it was concentrated in a small geographical region, the participants spent the second greatest amount of time searching while carrying out this task, and the eye tracking data shows some intensive information processing and seeking, although without indicating gaze activity (4.12 & 4.13).

The Philanthropy task, for which the majority of searched pages were biographical, were on average searched for eight seconds per page. This could be indicative of very well-formed pages, especially since the biographies of these millionaires/billionaires are generally likely to be constantly updated, comprehensive and well structured. Many of these individuals employ a PR company to manage their profile pages<sup>54</sup> and, as such, these ‘lobbyist editors’ become part of the Wikipedia community, a development which is frowned upon by Wikipedia as being unethical<sup>55</sup>. Eighty articles were retrieved and this task took the longest time for the participants on average, due to the indicative request being quite specific and thus requiring more searching: *“Your coursework states that you have to carry out an investigation to find out who you think is the most influential philanthropist in the pledge group.”*

The indicative request for the Aircrash task was: *“The news editor wants you to search for background information on the previous top two worst air disasters in history, such as the numbers of fatalities, casualties and so on. She also wants to know the names of airlines with the best and worst safety records”*.

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<sup>54</sup> <http://www.prweek.com/article/1074122/fixer-cleans-wikipedia-entries-senior-business-figures>

<sup>55</sup> <http://www.bbc.co.uk/news/technology-16084861>

This was quite a specific task that required the participants to actually locate particular information, and the results shown in Table 4.12 indicate the cognitive effort used to search for the information. Some of the specific information was, however, available in lists and well laid out Information Boxes.

The South American Football task was a fairly simple but specific information search task: “*Use Wikipedia to find out appropriate information about each club, such as the stadiums, star players and the managers of each team*”. The participants took the second shortest amount of time per article and page so, perhaps because of the specificity and the unique layouts of the football articles. In addition, because the task asked for information about only two teams, once the main articles had been found the other information, for example, on stadiums, was directly linked.

The indicative request for the Cannabis task was “*You want to understand the arguments for and against the use of marijuana for medical purposes. Therefore, you decide to do some preliminary research on this subject using Wikipedia. What are the possible health benefits and health problems that may entail from smoking/ingesting cannabis for medical reasons?*”

For this task, not so many articles on cannabis were available in English Wikipedia, but those that were available were overloaded with information, which resulted in fewer structural devices being used to display the information. This required more intensive searching and longer search times during which the participants had to find quite specific information (Tables 4.11-4.13).

**Table 4.12: Resulting metric measurements structure versus no structure per task (means)**

<b>Task (amount of users for each task n=15)</b>	<b>Fixation Duration Structure</b>	<b>Fixation Duration No Structure</b>	<b>Fixation Counts Structure</b>	<b>Fixation Counts No Structure</b>	<b>Visit Duration Structure</b>	<b>Visit Duration No Structure</b>
1 (cannabis)	44.13	45.80	40.87	66.97	20.77	67.50
2 (arab spring)	48.23	52.20	51.97	60.40	59.63	55.80
3 (philanthropy)	33.73	47.90	45.13	40.17	47.37	51.57
4 (aircrash)	49.90	55.17	55.70	53.30	43.77	47.90
5 (football)	51.80	41.37	45.90	30.67	52.77	29.90
6 (Namibia)	45.20	30.57	33.43	21.50	48.70	20.33

The significance tests between tasks in Tables 4.12 & 4.13 showed no statistical differences between tasks one-six, taking into account all the metrics means of all the users. However, when comparing the structure versus no structure means (Table 4.12 and 4.13) within each task, there

were significant differences. Each of the following  $P$  or  $F$  values is indicative of statistically significant differences between the conditions attributed to the structured part of the eye tracking metric and not to chance).

- **Task 1 Cannabis:**

- For Visit Duration Structure Visit Duration No Structure a separate t-test was conducted; to investigate the results showed that the participant's visit duration times No Structure was highest using a Repeated Measures ANOVA  $F(1, 14) = 9.229, p = 0.09$ .
- Additionally Total Visit Duration No Structure was higher than Structure  $F(1,14) = 5.799, p = .030$ .

One explanation for this could be that the users spent more time looking outside structured AOIs because they were looking for specific answers, such as a keyword, or were confused by the large amounts of plain text in the layout in some cases. Nevertheless, the data still indicates that the structure was an important factor.

- **Task 2 Arab Spring:**

- Fixation Counts Structure were statistically fewer than Fixation Counts No Structure  $F(1, 14) = 10.705, p = .06$ ,
- Visit Duration Structure was longer than Visit Duration No Structure  $F(1,14) = 52.045, p <.0001$
- Total Visit Duration Structure shorter overall than Total Visit Duration No Structure  $F(1, 14) = 21.497, p <.0001$ .

According to the data Fixation Counts, Visit Durations and Total Visit Duration Structure were intense, and task timings (Table 4.12) indicated much information seeking within the AOIs, but not so much cognitive activity. The articles were large, in this task, and this suggests more 'cognitive suppression during search'.

- **Task 3 Philanthropy:**

- Fixation Counts Structure were statistically more than Fixation Counts No Structure  $F(1, 14) = 11.454, p = 0.04$
- Visit Duration Structure was shorter than Visit Duration No Structure  $F(1,14) = 47.208, p <.0001$
- Visit Counts of Structure were more than Visit Counts No Structure  $F(1,14) = 21.025, p$

<.0001

- Total Visit Duration Structure were longer than the no structure counterpart  $F(1,14) = 12.938, p = 0.03$ .

Over all the metrics in this task, the structured AOIs were used far more than the non-structured AOIs. Although there were more fixation counts in these areas, the visit durations were shorter, which indicates that the participants were able to understand the meaning of the content in the structured AOIs and therefore did not have to study them intensively. In the non-structured areas, the participants fixated intensively and more.

• **Task 4 Air Crash:**

- Fixation Counts Structure were statistically more than Fixation Counts No Structure  $F(1,14) = 33.103, p <.0001$
- Visit Duration No Structure was shorter than Visit Duration Structure  $F(1,14) = 65.652, p <.0001$
- Visit Counts of Structure were more than Visit Counts No Structure  $F(1,14) = 22.260, p <.0001$
- Total Visit Duration Structure was longer overall than Total Visit Duration No Structure  $F(1,14) = 39.907, p <.0001$ .

During this task, there were more fixations and visits within the structured AOIs. However, the durations of the visits into the structured areas were much shorter, which suggests that information was easier to extrapolate from the AOIs than from the structured features but that, cognitively, the task was intensive.

• **Task 5 South American Football:**

- Fixation Duration Structure was longer than Fixation Duration No Structure  $F(1,14) = 6.714, p = 0.21$
- Fixation Counts Structure was more than Fixation Counts No Structure  $F(1,14) = 18.012, p = 0.01$
- Visit Duration Structure was longer than Visit Duration No Structure  $F(1,14) = 13.225, p = 0.03$
- Visit Counts of Structure were more than Visit Counts No Structure  $F(1,14) = 16.792, p = 0.01$
- Total Visit Duration Structure was much longer overall than Total Visit Duration No

Structure  $F(1, 14) = 32.350, p < .0001$ .

During Task five, the times indicated this was the easiest task for the participants, but the eye tracking data indicated that all the gaze data metrics were more intensive in the structured areas and that the information was easier to find.

- **Task (6) Namibia** All the following metrics of the Structural means for this task were longer or more:
  - Fixation Duration Structure  $F(1, 14) = 22.018, p < .0001$ ,
  - Fixation Counts Structure  $F(1, 14) = 22.334, p < .0001$
  - Visit Duration Structure  $F(1, 14) = 18.716, p = 0.01$
  - Visit Counts of Structure  $F(1, 14) = 15.872, p = 0.01$
  - Total Visit Duration Structure  $F(1, 14) = 24.265, p < .0001$ .

**Table 4.13: Resulting metric measurements structure versus no structure per task (means)**

Task (amount of users for each task n=15)	Total Visit Duration Structure	Total Visit Duration No Structure	Visit Count Structure	Visit Count No Structure
1	38.07	67.07	52.27	64.30
2	51.17	61.97	46.13	63.73
3	44.77	40.33	43.03	36.13
4	53.73	52.60	54.43	54.20
5	50.60	30.30	44.63	32.27
6	34.67	20.73	32.50	22.37

Each of the  $F$  values for Task six is indicative of statistically significant differences between the conditions (structure & non-structure) attributed to the structured AOI using each eye tracking metric and not attributed to chance. The task was of a vague nature and took less time than any of the other five tasks, but smaller amounts of eye tracking data were collected from the participants although they still mainly concentrated on the structured text rather than on the non-structured text.

#### **4.18.2 Analysis by Biography**

##### **4.18.2.1 Time to First Fixations at top of biographies**

This section is divided into several parts which all look at the ways in which biographical articles (Figure 4.12) are fixated upon when they are first visualised. Firstly, the means for the biographical articles will be shown using the Time to First Fixation (TtFF) at an AOI for major areas. Secondly,



there is a breakdown of the main areas to see how they are perceived holistically, and then as smaller parts using TtFF. Thirdly, the Structured vs. Non Structured analysis will be shown.

Table 4.14: Time to First Fixations in seconds. Seven major structure AOIs at top of article from all users.

AOI (AOI at top of article)	Time to First Fixations (seconds)
Bold Text	7.75
Summary Text	4.93
Main Title	12.64
Search Box	62.29
Wikipedia icon	23.44
Contents Lists	8.29
Information Box	28.68

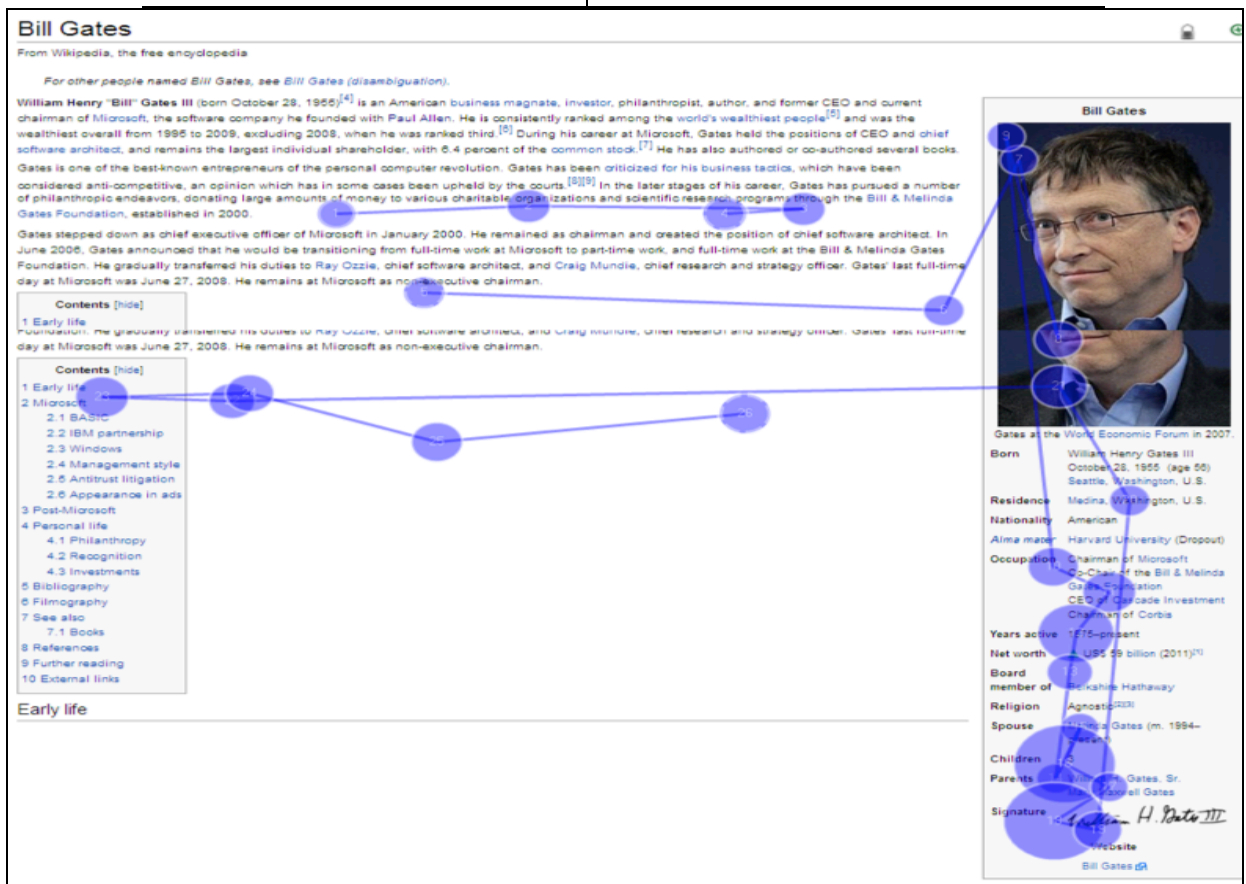


Figure 4.12: Snippet of Wikipedia article: Bill gates biographical article being scanned (gaze plots in purple).

A one-way repeated-measures ANOVA was used to assess mean TtFF per AOI (Table 4.15) for each user and revealed a main effect of  $F(1, 9) = 10.899, p = .009$  (statistically significant differences between the AOI groups are attributed to the structured feature and not to chance). Bonferroni post-hoc tests revealed that:

- Bold Text vs. Search Box and Information Box ( $p=.001$ ) TtFF was significant ( $p=.038$ ).
- The Summary Text TtFF was quickly looked at compared to the Information Box ( $p=.010$ ).
- The Main Title area was fixated upon faster than both the Search Box ( $p=.019$ ) and the Information Box ( $p=.010$ ).
- The Bold Text ( $p=.038$ ), Main Title ( $p=.019$ ) and Wikipedia Icon ( $p<.0001$ ) was perceived significantly faster than the Search Box.
- Between the major AOIs at the top of the screen the Contents List was looked at significantly faster than the Information Box ( $p=.006$ ).
- The Information Box was looked at less quickly than Bold Text ( $p=.001$ ), Summary Text ( $p=.010$ ), Main Title ( $p=.010$ ) and the Contents List ( $p=.006$ ).
- Interestingly the Wikipedia Icon on the page was looked at faster than the Search Box ( $p<.000$ ).

The least important area was the Search Box, then the Information Box. Judging the most important is difficult, since not one feature is faster than all the others. However, the results tend to show that the Contents List was important.

Table 4.15: Time to First Fixations in seconds. Fourteen AOIs at top of article with two major AOIs broken down into small area groups from all users.

AOI	Time to First Fixations (AOI at top of article) (seconds)
<b>Main Title</b>	12.64
<b>Contents List:</b>	
Title	8.22
Numeric	13.40
Content	11.22
<b>Information Box:</b>	
Title	13.05
Banner Sub Title	9.91
Image	12.06
Image Text	59.22
Sub Title	15.01
Content	17.15
<b>Search Box</b>	62.29
<b>Wikipedia Icon</b>	23.44
<b>Summary:</b>	
Plain Text	3.06
Bold Text	9.72

This Table 4.15 was to test which of **all** features were mostly fixated upon first as soon as a

biographical article was retrieved by each user during a task. In Table 4.15, the more quickly each AOI was fixated upon, the more noticeable it is presumed to be. In contrast to Section 4.18.1, in this section, the Information Box (IB) and Contents Box (CB) were broken down into smaller groups to see which was the most dominant area perceived during the tasks. The bold text commonly appeared within the Summary area. However, not only did the Summary plain text appear in almost every article where the bold text did not, but also there was far more plain text than bold text in the articles that both appeared. Both of these findings, obviously, may be explained by feature distribution.

A one-way repeated-measures ANOVA was used to assess TtFF per AOI for each user and revealed a main effect of  $F(1, 13) = 18.078, p < .001$  (statistically significant differences between the AOI groups are attributed to the structured AOI and not to chance). Bonferroni post-hoc tests, however, revealed very limited (though complex) results:

- Summary Bold Text was visited quicker significantly than the IB Image Text only ( $p = .036$ ).
- CL Content faster than IB Image Text ( $p = .014$ ).
- The Title in the CL was less noticeable vs. IB Image Text ( $p = .007$ ) but the plain text in the Summary it was significantly slower to be fixated upon ( $p = .006$ ).
- The Content Numeric was not looked at faster than any other feature statistically.
- The IB Image was fixated upon faster than the IB Image Text ( $p = .002$ ).
- IB Title and IB Content were both looked at significantly faster than the IB Image Text ( $p = .005$ ).
- IB Content was significantly faster than Search Box ( $p = .049$ ) and IB Image Text ( $p = .005$ ).
- IB Banner Sub Title was looked upon quicker than IB Image Text ( $p = .012$ ) and Search Box ( $p = .020$ ).
- The IB Image Text was looked at slower (significantly) than nearly all apart from Content Numeric and search Box.
- Main Title was faster than IB Image Text ( $p = .003$ ) and Search Box ( $p = .043$ ).
- Search Box was looked up faster than the Wikipedia Icon ( $p < .001$ ) and two others mentioned above.

There was no overall discernible feature from the list above and Table 4.15, but the broken down segments of the Information Box were fixated upon many times and therefore have to be deemed important. Lastly, for all the Biographical articles, it was necessary to be thorough and examine the

TtFF examining the structure vs. no structure. A t-test was conducted to investigate the effect of fixations on structure and not on structured text, for example, not within the AOIs, i.e., plain text and whitespace, and the results showed that the participants' first fixation times did significantly increase compared with looking at the AOIs ( $t = 2.142$ ,  $n = 30$ ,  $p = 0.03$ ). This pointed towards the participants' having to look more closely at the plain text rather than at the formatted areas. It could be surmised that the participants were drawn more quickly to the formatted AOIs than to the plain text or whitespace.

#### 4.18.3 Analysis by Lists



Figure 4.13: Snippet of article: List of deaths by death toll being skimmed (gaze plots in light blue).

Looking over all the 270 articles retrieved (relevant and non-relevant articles), 41 of in total were Lists or Lists of Lists (Table 4.10 & Figure 4.13). Traditionally, Lists are a very well known and popular everyday genre, so it is worth looking at how they are perceived in an ocular sense. As laid out in RQ16, which parts of the lists are looked at and how important are the numerical blocks or bold sub-titles?

**Table 4.16: Metrics showing mean times for participants' behaviour on AOIs for list articles**

<b>AOI</b>	<b>Time to First Fixations</b>	<b>Fixation Durations</b>	<b>Visit Durations</b>	<b>Visit Counts</b>	<b>Total Fixations Durations</b>
Main Title	18.61	.2346	.3622	1.59	.7397
Summary	9.46	.2377	.7082	3.62	3.04
Contents List	12.41	.3360	.6383	2.66	1.81
Table Categories	4.68	.1026	.1670	.4038	.2156
Information Box	11.07	.2225	.2106	.8222	.4264
Bullet List	19.72	.2885	.4606	1.20	.7944
Tables	28.94	.2650	.7122	2.42	2.79
References	14.96	.1763	.3194	.7115	.6521
Numeric List/Block	49.26	.2270	1.0402	2.02	4.06
Sub Title	37.89	.3217	0.3217	1.90	1.0411
Image Caption	26.94	.2949	.5978	2.90	1.7416

#### **4.18.3.1 Time to First Fixation**

A one-way ANOVA was used to assess TtFF per AOI for each user and revealed a main effect of F (10, 285) = 3.487,  $p < .0001$  (statistically significant differences between the AOI groups are attributed to the structured AOI and not to chance in Table 4.16). Bonferroni post-hoc tests were again utilised to test for effects between AOIs. As the Bullet Lists and Numeric List/Blocks were the most prominent, it was important, throughout these articles, to identify the most important: Bullet List or Numeric List? It was also necessary to find out which were looked at first at the beginning of the List articles (this can be used to answer RQ16).

Firstly, the Bullet Lists were viewed statistically faster than Numeric List overall ( $p = .004$ ). The participants therefore cognitively navigated through more bullet-type lists than numeric-type lists in the 41 articles. Secondly, overall, at the top of the articles, the only statistically significant difference between all the means pertained to the Summary Box rather than to the Contents List, Information Box and Main Title.

1. The Main Title was statistically looked upon faster than all other AOIs (although only just): Contents List and Information Box ( $p = .042$ ).
2. The Summary was statistically faster than Contents List ( $p = .010$ ) and the Information Box ( $p = .005$ )

3. The Contents List was faster than Information Box ( $p=.001$ ).

#### **4.18.3.2 Fixation Durations**

A one-way ANOVA was used to assess Fixation Durations per AOI for each user and revealed a main effect of  $F(10, 285) = 2.696, p=.004$  (statistically significant difference between AOI groups in Table 4.16). Bonferroni post-hoc tests were again utilised to test for effects between AOIs. In the fixation durations, there were hardly any statistical differences between the AOIs regarding the metric, apart from all AOIs having significantly longer fixation durations than Table Categories.

#### **4.18.3.3 Visit Durations**

A one-way ANOVA was used to assess Visit Durations per AOI for each user and revealed a main effect of  $F(10, 285) = 5.866, p<.0001$  (statistically significant difference between AOI groups in Table 4.16). Bonferroni post-hoc tests were again utilised to test for effects between AOIs. The Bullet Lists visit durations were statistically more in comparison to Numeric List ( $p<.0001$ ). At the top of the articles, the Contents Lists' visit durations were longer than Information Boxes ( $p=.005$ ). The Information Box durations were shorter than Contents ( $p=.005$ ) and Summary ( $p=.001$ ). The Main Title were shorter than the Summary Text ( $p=.022$ ).

#### **4.18.3.4 Visit Counts**

A one-way ANOVA was used to assess Visit Counts per AOI for each user and revealed a main effect of  $F(10, 285) = 8.172, p<.0001$  (statistically significant difference between AOI groups in Table 4.16). Bonferroni post-hoc tests were again utilised to test for effects between AOIs. The Bullet Lists were visited on average less than Numeric List, so they were either not noticed or not of use/interest ( $p<.0001$ ). At the top of the article, the Contents List visits were more than Information Boxes ( $p=.001$ ) and Main Title ( $p=.048$ ). The Summary visits were on average more than Information Boxes ( $p<.0001$ ) and Main Title ( $p<.0001$ ).

#### **4.18.3.5 Total Fixations Durations**

A one-way ANOVA was used to assess Visit Counts per AOI for each user and revealed a main effect of  $F(10, 285) = 9.368, p<.0001$  (statistically significant difference between AOI groups in Table 4.16). Bonferroni post-hoc tests were again utilised to test for effects between AOIs. The Numeric List were, in total, significantly viewed longer than all but one AOI (Tables  $p=.032$ , all others  $p<.0001$ );, namely Summary. This may indicate that the participants were using them to navigate down the article in order to differentiate between list items. The Contents Lists were

fixated, in total, more than Information Boxes ( $p=.016$ ), Summary ( $p=.032$ ) and Main Title ( $p=.032$ ). Summary durations were longer compared to Information Box ( $p<.0001$ ) and Main Title ( $p<.0001$ ).

#### 4.19 Debrief and Tasks Statistics

##### 4.19.1 Post Tasks' Questionnaire

The Post Task questionnaire shown in B4 was used to show how each user found the tasks overall (Table 4.17). The majority of the users (mean=4.60) found the task Absolutely Clear. The 30 participants rated the ease of the tasks between 'Quite Easy' to 'Completely Easy'. The tasks were mostly familiar in nature and the participants stated: "*I believe I have succeeded in my performance of the task*". They succeeded in around 90% of 90 tasks in total (Table 4.17). The participants were then asked a two-part question: "*What are the things that helped your performance?*"

Overall, the participants stated that their understanding of the tasks was well above average, they said that they were given enough time to complete the tasks and found the tasks appropriate. The participants stated that they generally knew what was relevant to the tasks (just above average).

Table 4.17: Post task descriptive statistics for part 1 'Task' section on post task questionnaire

Task (n=15 per task)	Mean Statistics
Task Unclear: Clear (1-5) Unclear	4.60
Task Ease: Easy (1-5) Difficult	1.50
Task Familiarity: Unfamiliar (1-5) Familiar	4.11
Task Succeeded: Disagreed (1-5) Agreed	4.10
Task Understood: Disagreed (1-5) Agreed	4.56
Enough Time for Effective Search Disagreed (1-5) Agreed	4.58

To ensure a thorough analysis, the data shown in Table 4.16 and Table 4.17 was cross compared with the eye tracking data and to highlight any effects. Regarding the clarity of the tasks, the only statistical differences pertained to fixation durations.

##### 4.19.1.1 Task Clear/Unclear

A one-way ANOVA was used to assess task clear/unclear for each user (Table 4.16), fixation durations and five Likert scaled questionnaire conditions and revealed a main effect of  $F(4, 89) = 4.993$ ,  $p=.001$  (statistically significant difference between AOI groups). Bonferroni post-hoc tests were utilised to examine the correlations with the reported qualitative Task Clear/Unclear variables

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and the quantitative eye tracking variable. In other words, when participants reported a lack of clarity, this was perceivable in the ocular data.

The following fixation durations were, statistically, significantly longer temporally. Unclear were temporally longer than Quite Unclear ( $p=.001$ ); Quite Unclear fixation durations were temporally longer vs. Clear ( $p<.0001$ ) and Quite Clear ( $p<.0001$ ). The fixation durations of Quite Clear were longer than Quite Unclear ( $p<.0001$ ). This was interesting since it showed, in some instances, that the participants fixated longer on webpages while searching for information when they were not sure about the requirements of the task. The experience was therefore cognitively intense in terms of focus.

Using a one-way ANOVA, there were no statistical differences when compared with time-taken in seconds.

#### **4.19.1.2 Task Ease/Difficult**

The Task Ease component of (Table 4.16) showed did not show any statistical differences during the cross-comparison with eye tracking data. Bonferroni post-hoc tests were utilised to study the correlations with the reported qualitative Task Ease/Difficult variables and the quantitative eye tracking variable. In other words, when participants reported Difficulty or Ease, this was not perceivable in the ocular data. Using a one-way ANOVA, there were no statistical differences when compared with time-taken in seconds.

#### **4.19.1.3 Task familiar/unfamiliar**

As in Study One, familiarity was analysed statistically, but in this study, there were differences to the previous analysis described in Section 3.8, Table 3.2. A one-way ANOVA was used to assess task familiar/unfamiliar using psychometric five Likert scaled questionnaire conditions for each user, fixation counts and revealed a main effect of  $F(4, 89) = 2.074$ ,  $p<.0001$  (statistically significant difference between AOI groups in Table 4.17). Bonferroni post-hoc tests were utilised to study the correlations with the reported qualitative Task Familiar/Unfamiliar variables and the quantitative eye tracking variable. In other words, when participants reported a lack of Familiarity/Unfamiliarity, this was perceivable in the ocular data. The Bonferroni post-hoc tests revealed higher fixation count differences; Quite Unfamiliar higher count than Unfamiliar ( $p=.027$ ), Quite Familiar ( $p=.040$ ) higher count than Familiar ( $p=.020$ ). Unfamiliar had more fixation counts than Quite Unfamiliar ( $p=.027$ ). Familiar had considerably more fixations than Unfamiliar ( $p=.020$ ). The results indicated that the less familiar the task was (with regard to previous experience), the fewer fixations occurred throughout the tasks. In other words, cognitive effort was increased when



the task was deemed familiar. Using a one-way ANOVA, there were no statistical differences when compared with time-taken in seconds.

#### **4.19.1.4 Task Succeeded: Agreed/Disagreed**

The Task Succeeded (Table 4.17) showed no statistical differences during the cross-comparison with eye tracking data. Using a one-way ANOVA, there were statistical differences when comparing Task Succeeded and Time taken in Seconds  $F(4, 89) = 3.215, p=.002$ . The cross-comparison showed that the more the task was deemed a success by a participant, the longer was the duration of the task.

#### **4.19.1.5 Task Understood: Agreed/Disagreed**

The Task Understood (Table 4.17) showed no statistical differences during the cross-comparison with eye tracking data. Using a one-way ANOVA, there were statistical differences when comparing Task Understood and Time taken in Seconds  $F(4, 89) = 5.570, p<.0001$ , i.e., the less time the task took, the better the task was understood.

#### **4.19.1.6 Task Enough Time: Agreed/Disagreed**

The Task Enough Time (Table 4.17) showed no statistical differences during the cross-comparison with eye tracking data. Using a one-way ANOVA, there were statistical differences when comparing Task Enough Time and Time taken in Seconds  $F(4, 89) = 12.333, p<.0001$ , i.e., there was a correlation between the two metrics, since the amount of time taken was proportionate to the participants' statement with regard to having enough time for the task. The following Topic Related and Task Appropriate (Table 4.18) are replies to the request for information regarding: "*the answers(s) I have received from the results for this task are:*"

Table 4.18: Post task descriptive statistics part 2 'Retrieved Answer's section on post task questionnaire

<b>Task (n=15 per task)</b>	<b>Mean Statistics</b>
Topic Related: Relevant (1-5) Not Relevant	1.43
Task inappropriate: Inappropriate (1-5) Appropriate	4.44
Idea of Relevance: (Not at All (1)-Vague (3)-Clear (5))	4.53
Satisfied with Search Results (Very (5)-Somewhat (3)-Not at All (1))	4.53

Using a one-way ANOVA, there were no statistical differences when comparing Topic Related and Satisfied with Search with time-taken in seconds. However, when comparing Task Appropriate/Inappropriate and Idea of Relevance, there were statistically significant differences:  $F(4, 89) = 3.336, p=.001$  and  $F(4, 89) = 2.074, p<.0001$  respectively. Firstly, when the task was

deemed appropriate, the task took less time and secondly, the clearer the task, the shorter was the time taken.

The small survey reported in Table 4.19 indicated how useful the participants found the structural layout of Wikipedia with regard to helping them carry out the tasks. The percentages certainly support the data in the tables regarding the usefulness of the structural layout in helping the participants complete the tasks.

**Table 4.19: Was structure useful?**

<b>Structure Useful</b>	<b>Percentile</b>
Completely useful	56.3%
Quite useful	26%
Not useful	17.7%

#### **4.19.2 Exit Questionnaire & Structural Features Used?**

The exit questionnaire for the participants was divided into two parts. Firstly, “*Tasks and Information Needs*” and secondly, “*Search Experience*”. The participants replies to the question “*to what extent did you find the tasks similar to other searching tasks you typically perform*” (Table 4.20) were recorded.

**Table 4.20: Post task descriptive statistics for exit questionnaire**

<b>Task (n=15 per task)</b>	<b>Mean Statistics</b>
Task 1-15: Similarity: Not at All (1-5) Completely	4.28
Task 16-30: Similarity: Not at All (1-5) Completely	4.47

**Table 4.21: Post task descriptive statistics for exit questionnaire task evaluation**

<b>Tasks Info (n=15 per task)</b>	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>	<b>T5</b>	<b>T6</b>
Which of the tasks did you find easier to understand? (Rank 1-3; 1 being best and 3 being worst).	2.07	1.80	2.20	1.35	2.12	2.00
Which of the tasks did you think helped you to know what kind of documents you were looking for from the result? (Rank 1-3; 3 being best and 1 being worst)	1.67	2.20	2.13	1.47	2.18	2.00

Tables 4.21 and 4.22 show the answers to Tasks and Information Needs from the questionnaire (Appendix B5). The participants were asked for their opinion (Table 4.22) on the search experiences, in particular, *“how satisfied were you with the search experiences and how satisfied were you with the retrieved answers?”*

**Table 4.22: Post task descriptive statistics for exit questionnaire search experience (means). Fifteen participants for each task asked to rank best to worst (1-3) search experience and results retrieved from allocated 3 tasks.**

<b>SEARCH EXPERIENCE (Rank 1-5; Satisfaction=1-not at all; 5= completely) n=15 per task</b>	<b>Task1</b>	<b>Task2</b>	<b>Task3</b>	<b>Task4</b>	<b>Task5</b>	<b>Task6</b>
Search Experience	4.00	4.40	3.87	4.00	3.59	4.65
Results	4.20	4.20	3.67	4.06	3.60	4.06

The comments below were written by the participants in reply to the question: *“Do you have any further comments or suggestions about the entire search experience?”*:

1. *“I enjoy the structure of the pages so finding relevant information was easy”*
2. *“Layout was very useful and helpful”*
3. *“Use of boxes to highlight key facts was helpful to finding information”*
4. *“Wikipedia makes searching very easy as the layout of every page is simple to work with and they all have very useful structures. By providing reference/footnote links it makes the site more reliable”.*

The participants identified the following features as important although some, e.g., hyperlinks were not feasibly marked as AOI due to the sheer quantity. This would, of course, be possible but only by examining the hundreds of pages of data logging files. This will be future work. The feature number is in brackets:

Sub Title (24), Contents Lists (21), Links (18), Tables (18), Information Box (top right (12)), Whole articles (10), References (nine), Main Title (eight), Jumping to Paragraphs and Sections (eight), Indices (six), Bullet Lists (four), Emboldened text (three), Index (three). The feature analysis led to some interesting findings, for example, only four participants highlighted bullet lists as important but the gaze data suggested otherwise.

#### **4.19.3 Questionnaire Post Experiment Remarks**

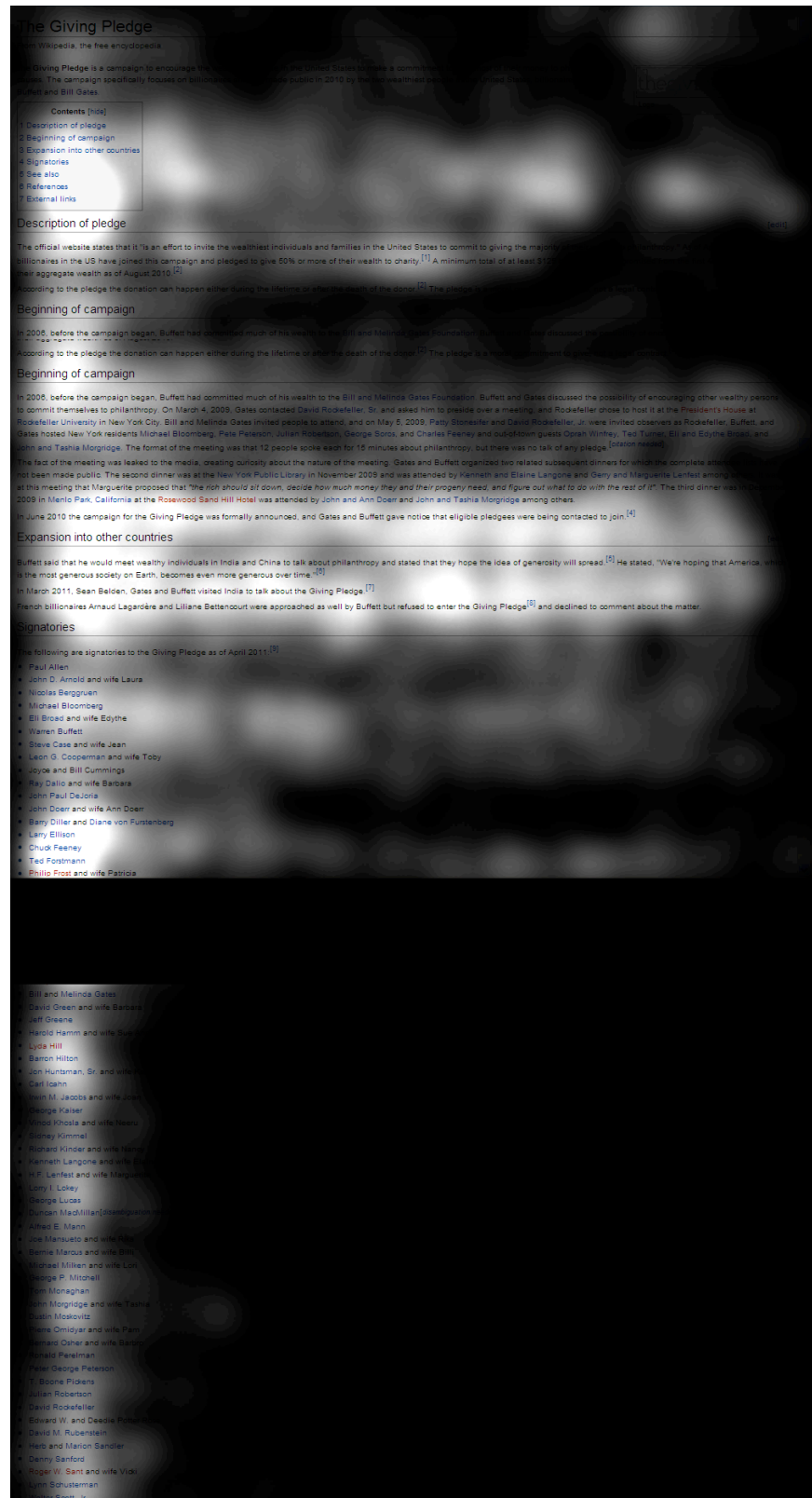
Although there was a wide range of comments about whole article searching, the majority (18) participants said that they started by forming an initial query and then browsing through the article links in the article web. Twelve people said that they preferred to search for lists or lists of lists to act as a starting point, particularly for tasks two, three and four. Regarding task two, ‘The Arab Spring’ participants searched for a ‘list of countries involved’ and for task four, the participants

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searched for a 'list of air crashes', 'list of worst air crashes' and 'list of best safety records in airlines'. During task four, participants submitted queries, such as 'List of Philanthropists Giving Pledge'.

#### **4.20 Discussion of Research Questions' Findings**

**RQ13. How 'useful' is form of a document type and does form afford efficiency during timed-tasks for sessions aimed at finding information to answer search task questions?** As shown in the descriptions of the analysis of the eye tracking data (Feature and Task) and questionnaires in previous sections, form was vital to success in the task and this is supported by the results obtained from comparing the non-structured text with the structured text. All the search strategies employed by the 30 participants involved navigation by using the salient features and areas such as Contents Lists and Information Boxes. There was minimal query input (2.2 per user per task) and no other strategies were employed, such as, searching the pages via keywords using the 'Control+F' (Find) function or similar. An examination of the timed data (Table 5.9) and the strategies used to search the articles for relevant documents revealed that form features were essential to locate relevant information. In most cases, the decisions of relevance were made using the Information Box, Contents List or Summary Text (Figures 4.14 and 4.16-4.18). As described in Section 4.18.1, other factors have to be acknowledged, such as the type of indicative request, but the form of the pages was just as vitally important. According to the data, the sub titles were most commonly used (Figures 4.17 and 4.18). In addition, the Contents Lists, and Summary Text at the top of most articles drew the most attention (Figures 4.17 and 4.18). The other AOIs were utilised by the participants in certain articles in preference to other articles, depending on the tasks, but this would require a much deeper evaluation. The references were used in many cases (Figure 4.19) but statistically were not that important.



**Figure 4.14: Task Philanthropy ‘The Giving Pledge’.** Fixation Counts Gaze Opacity map (the more bright white the more it was gazed at) shows where all relevant participants fixated the most over the whole of the article. The participants gazed and navigated from top to bottom on the left side using the Main Title, Contents List (most prominent), Sub Title then Bullet Lists.

**RQ14. Where does the participant fixate in the first few seconds of viewing a Wikipedia article? For example, comparing the ocular behaviour between Wikipedia article features: Information Box (on right) and Contents List (on left).** The data indicates that the most important AOI for the participants in the first few seconds of exposure to the Wikipedia articles is, firstly, the Contents Lists on the left of the article and, secondly, the Information Box (for example, Figures 4.3, 4.11 and 4.12). Thirdly, although the ocular behaviour was possibly skewed on occasion with the Summary Text data, due to the amount of textual content, i.e., more fixations through reading, it did indicate higher prominence. However, even taking this into account, the data reveals that it was still important over the different metrics examined. In those first few seconds, the structural aspects are very important and, as Toms suggests, can act as textual affordances: the unique shapes may trigger the user's mental model and this interpretation of the shape (or frames) might lead the user to develop a set of expectations about the article before he/she reads the semantic content.

The screenshot shows the Wikipedia article for "Cannabis (drug)". A Gaze Opacity map is overlaid on the page, with the brightest white areas indicating where participants fixated most. The most prominent areas are the Contents List on the left and the Information Box on the right. The main text of the article is dimmed, indicating lower fixation counts.

**Contents [hide]**

- Effects
  - Classification
  - Medical use
  - Long-term effects
- Forms
  - Unprocessed
  - Processed
    - Kief
    - Hashish
    - Hash oil
    - Residue (resin)
- Routes of administration
- Mechanism of action
- Potency
  - Adulterants
- Detection of use
- Gateway drug theory
- History
- Legal status
- Price
- Truth serum
- Breeding and cultivation
- In arts and literature
- See also
- Footnotes
- Citations

**Scientific classification**

Kingdom:	Plantae
Phylum:	Magnoliophyta
Class:	Magnoliopsida
Order:	Rosales
Family:	Cannabaceae
Genus:	Cannabis
Species:	<i>C. sativa</i>

**Binomial name**

*Cannabis sativa* L.<sup>[1]</sup>  
*Cannabis indica* Lam. (putative)<sup>[1]</sup>

**Figure 4.15: Task Cannabis. Fixation Counts Gaze Opacity map (the more bright white the more it was gazed at) shows where all 15 participants looked at at the top of the article in those first few seconds. The Contents List was most important for this article according to the Gaze Opacity.**

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**RQ15. Which formatting features do participants identify by questionnaire and eye tracking metrics as being used for completing the information-searching task or for navigating textual information?** During the questionnaire sessions, the participants identified the Sub Title (24), Tables (18), Contents Lists (21), Information Boxes (12) and Hyperlinks (18) as the most used during the task. During this experiment, it was not possible to apply AOIs to every hyperlink in the Wikipedia pages retrieved, so there is no ocular data to record this. The data recorded by the eye tracker reinforces the recollection by the participants of the importance of the Sub Title, Tables, Contents Lists and Information Boxes during the search tasks. There are, on occasion, indications of differences between the information obtained from the participants and that obtained from the gaze data, for example, where the participants do not confirm the usefulness of formatting features but the gaze data suggests otherwise, c.f. the bullet lists. According to the fixation and gaze data, the most commonly visited and fixated upon areas were the Contents Lists (Figures 4.11-4.12), Table Categories, References (Figure 4.20) and Information Boxes (Figure 4.12). Again, this finding is partially shown in Figures 4.18 & 4.19, concerning the Contents Lists and Information Box. The shapes are extremely helpful and natural for the participants to navigate between. Figures 4.18-4.20 both show the fixation counts and durations on the Giving Pledge article and show the navigation using the Contents List, Sub Title and Lists.

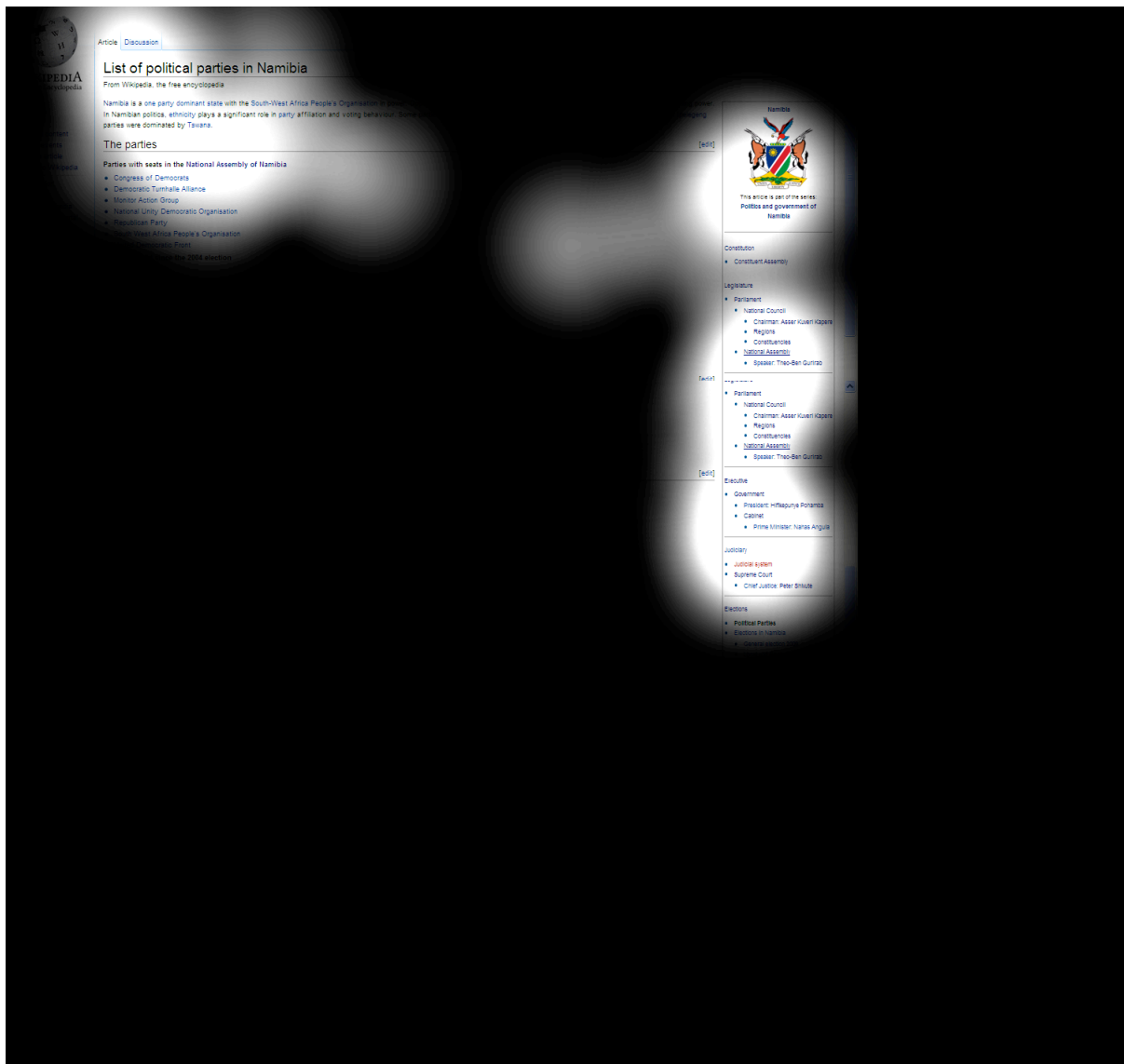
**RQ16. How ‘useful’ are whole article classical genres, such as lists (Figure 4.13), lists of lists, biographies (Figures 4.11 & 4.12) and which are the predominant features fixated upon during search tasks?** The analysis of the articles searched and saved by the participants on the desktop, which were deemed relevant and not relevant during the tasks, showed that the majority of the articles that the participants used were of a biographical nature (119) and different types of lists (41) which accounts for most of the Wikipedia pages retrieved during the tasks.



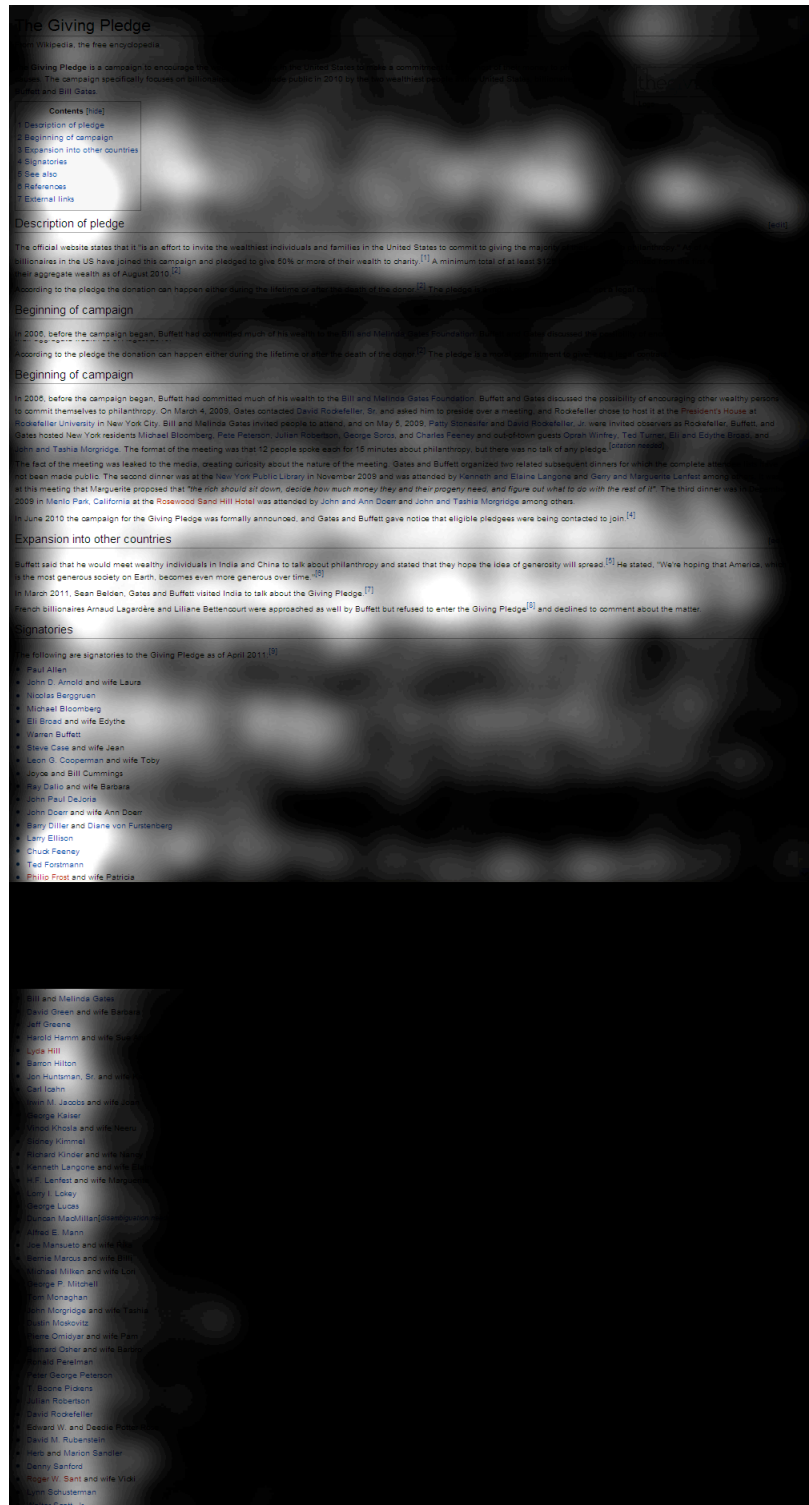
**Figure 4.16: Task Arab Spring. Fixation Duration Heatmap (the more red shown indicates a heavily gazed area) displays areas of interest for all participants who viewed this page. It shows the Table, Bullet List, Main Title and Image Caption were viewed but the left column of the Table, Bullet List and Image were viewed mostly.**

**RQ17. Do/can participants skim (Figure 5.5) or scan (Figure 5.4) particular shapes of features (boxes) of the layout of Wikipedia article texts?** The analysis of the data searched by the participants revealed instances of both ocular behaviours. With regard to skimming, the participants preferred this technique during searches amongst very long documents. For example, the article regarding the Arab Spring is long, so most users skimmed the pages to assess its relevance to the task. In addition, skimming from the Contents Lists, Main Title and Information Box was common practice while interacting with the articles, and the participants would also 'skim and scroll' down the articles looking for relevant information pertaining to their tasks. Scanning was a more common behaviour during this experiment, for example, the article on Mark Zuckerberg (Figure 4.11) was scanned quite extensively by one specific participant looking for evidence of 'philanthropy'. Long lists in this experiment that were divided by a large amount of Sub Title (Figure 4.13) were scanned regularly during searches for keywords or phrases to match the task. A comparison of the saccadic and fixation data will be carried out to substantiate these findings in the immediate future.

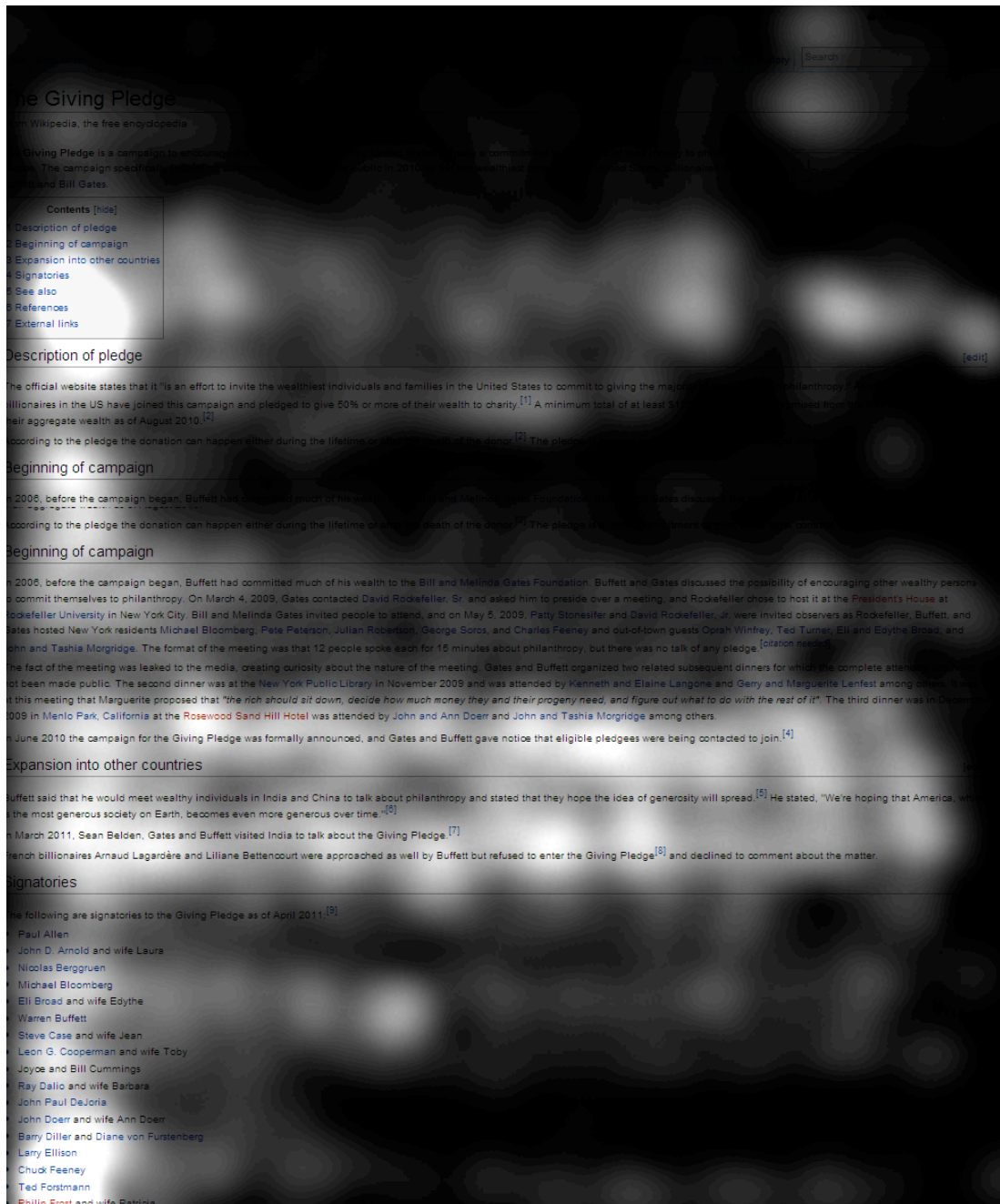




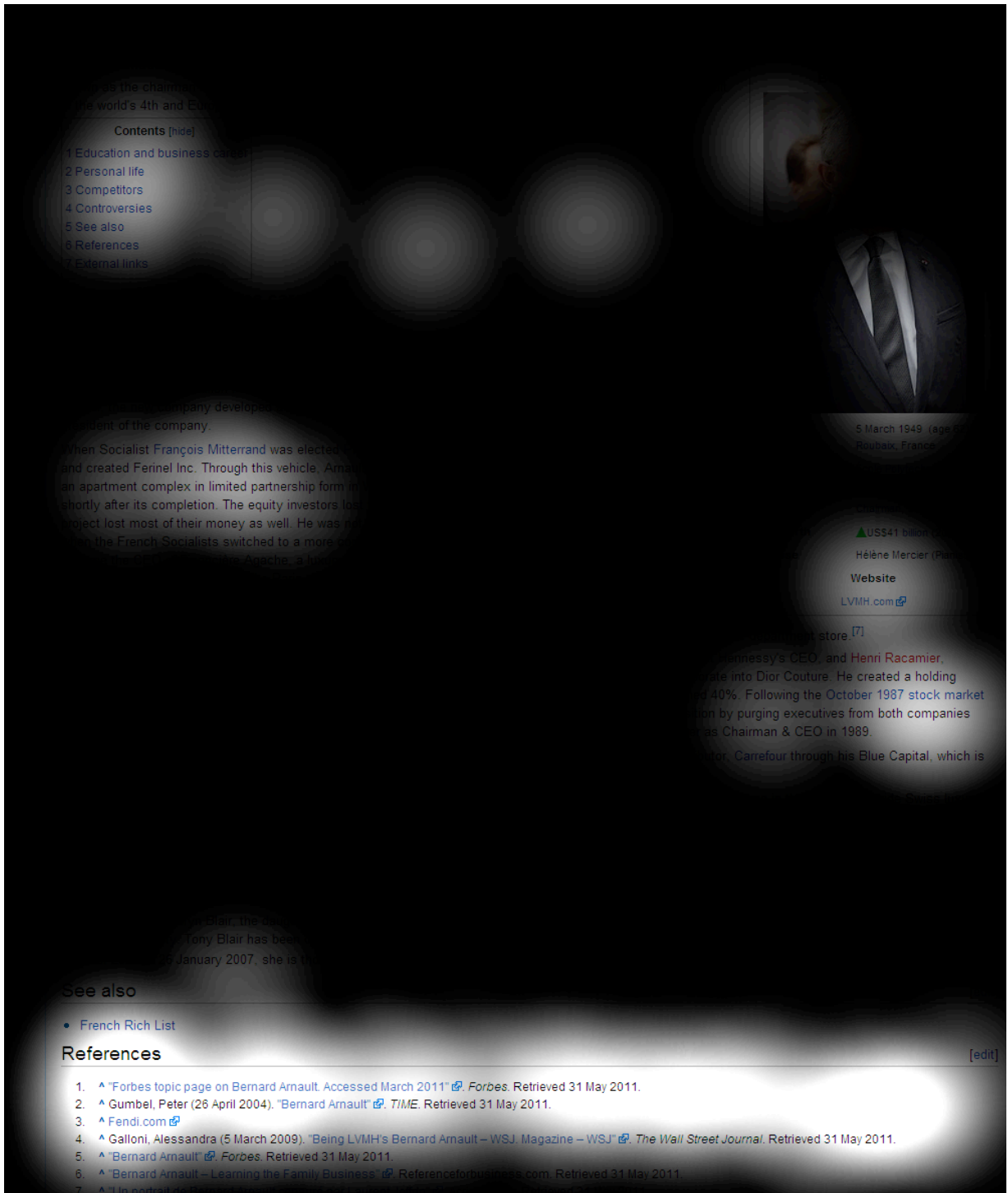
**Figure 4.17: Task Namibia. Fixation Counts Gaze Opacity map (the more bright white the more it was gazed at) shows where all relevant participants looked at the top of the article overall. The Information Box, Main Title and Bullet List was most important for this article according to the map.**



**Figure 4.18: Task Philanthropy ‘The Giving Pledge’.** Fixation Counts Gaze Opacity map (the more bright white the more it was gazed at) shows where all relevant participants fixated the most over the whole of the article. The participants gazed and navigated from top to bottom on the left side using the Main Title, Contents List (most prominent), Sub Title then Bullet Lists.



**Figure 4.19: Task Philanthropy 'The Giving Pledge'. Fixation Duration Gaze Opacity map (the more bright white the more it was gazed at) shows where all relevant participants looked at the longest over the whole of the article. The participants gazed and navigated from top to bottom on the left side using the Main Title, Contents List (most prominent), Sub Title then Lists of names (second most prominent).**



**Figure 4.20: Task Philanthropy 'Bernie Anault' biography. Fixation Counts Gaze Opacity map (the more bright white the more it was gazed at) shows where all relevant participants looked at the longest over the whole of the article. The participants gazed at the Contents List and Information Box including two areas of plain text. However, by far the most prominent area was the References section.**

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## Chapter 5: Conclusions and Future Work

### 5.1 Introduction

The main aims and research questions were designed to investigate genre and, in particular, forms, i.e., the value of textual forms, visual cues and common structural characteristics in an IS & R context, by conducting one exploratory study and two types of user studies. The user studies involved two types of tasks, firstly, a categorisation exercise and, secondly, a simulated situations experiment related to information. One further aim was to locate theories from other disciplines which could benefit research on genre in terms of cognition, i.e., perception, ocular behaviour and IS & R.

The first user study in Chapter 3 was conducted to examine an e-mail CoP or discourse community. This study was an extension of the pilot study carried out by Watt (2009) and was also inspired by Toms & Campbell (1999a) *Genre as interface metaphor: exploiting form and function in digital environments*, although there were some notable differences. For example, Watt only conducted a paper exercise involving eight academics, while Toms & Campbell conducted an experiment based around web pages. The similarity between Watt, Toms & Campbell and the study in Chapter Three consisted in the stimuli conditions, i.e., semantic information was removed, or formatting was removed leaving only content and so on. Although there were some slight similarities in methodology, the study presented in Chapter 3 described major methodological enhancements through novel expansions in data collection which resulted in a good balance of qualitative and quantitative data (four forms of analysis: time-response, fixation, saccade and scanpath derived eye tracking data). In Chapter 4b, the focus shifted to a different CoP, Wikipedia (online). Again, a good balance of qualitative and quantitative data was collected (two forms of analysis: time-response and fixation derived eye tracking data). The user studies were designed to meet the research aims and test the research questions. A comparison of the aims enabled the following contributions to be compiled.

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## **5.2 Contributions**

### **5.2.1 Introduction**

The lab-based categorisation and task-based user evaluations employing simulated search scenarios revealed ‘how’ and ‘why’ users make decisions while interacting with the textual features of structure and layout within a discourse community. A large amount of qualitative and quantitative data (ocular behaviours, answers to questionnaires and search results) was collected while the different groups of users carried out their tasks within their allocated online CoP, e.g., Wikipedia, and this data is now available for use in future research for any interested researchers wanting to continue this work.

Extensive evaluation of the quantitative data revealed the features that were used by the participants in the user studies and the effects of the interpretation of genre in the search and categorisation process as well as some hints regarding the perceptual processes used in the various communities. This will be of benefit for the re-development of old systems as discussed in Section 5.4. As far as is known, this is the first detailed and systematic investigation into the perception of features and layout of genre using eye tracking in online communities, such as Wikipedia.

### **5.2.2 Summary of contributions**

1. Examined previous studies of the usefulness of genre, in terms of form, for IS & R, and designed studies to advance previous findings (Toms, 2001; Toms, 2002; Toms & Campbell, 1999a, 1999b; Toms et al., 1999; Watt, 2009). Expanded research by Toms & Campbell and Watt. A new dimension of cognitive (ocular) data has been added to genre research.
2. Advanced the findings of the studies listed above (1) by studying the usefulness of the form (and purpose) of genre for IS & R user studies in two domains which use layout and formatting, i.e., e-mails in university accounts and Wikipedia, using eye tracking.
3. Developed more scope for further research. Explored the ways in which other research fields (English Lit (Frow/Paltridge), Neurology etc.) can benefit IR & S knowledge. Garnered deeper understanding of genre interpretation.
4. User evaluations: search and categorisation scenarios revealed ‘how’ and ‘why’ users make decisions in a cognitive context.
5. Investigated, analysed and presented ocular evidence of the use of skimming and scanning by subjects during user studies in an IR & S context. Convincing evidence showed how users interact with textual features of structure and layout within a discourse community

(skimming/scanning).

6. Investigated clues to the perceptual (e.g. ecological, constructivist) processes used by participants during categorisation and information seeking activities. First investigation into the evolution of structures, perception of features, perceptual processes (ecological, constructivist) and layout of genre using ocular measurements in CoPs (to best of the author's knowledge).

### **5.2.2.1 Main Contributions**

This research has enabled the following contributions to be made:

- **Advanced research on the ways in which people perceive and use features of form by recording the useful sets of features (genre) used by participants for IS & R in two domains: e-mails in university accounts and Wikipedia.** This research has helped to demonstrate how form could be used extensively by the 54 participants in both CoPs for categorising the eight types of e-mail genres and for seeking the information required for the simulated situation tasks in Wikipedia. In a wider context, the results of this research can be taken as a clear indication that form features of genre are suited to enhance research in IS & R, for example, for filtering information by categories and indexing using form features, as well as for finding the salient features of pages by navigating the layout and formatting for retrieval of information.
- **Advanced research and understanding of the ocular behaviours involved in viewing text structure by using eye tracking to conduct experimental user studies, that employ associated eye tracking metrics and exploit temporal, distance and quantity based measures to gather evidence of the perceptual processes involved, e.g., related to the constructivist, ecological, Gestalt theories.** A thorough statistical analysis was carried out on the data by employing a careful balance of temporal, distance and quantity based metrics, such as scanpath duration, scanpath length and fixation/saccade derived counts. This helped to identify the ocular techniques employed by the participants and to show which of these techniques played the most important role when the participants were viewing types of form in the stimuli. During each of the user studies, the types of perceptive processes taking place were observed and noted. If evidence of skimming was found, the text could be said to have afforded its genre to the participant; evidence of scanning, on the other hand, was indicative of attempts to match previous knowledge to the current stimuli, i.e., evidence of constructivism.
- **Enhanced understanding of perceptual behaviour, by closely evaluating the**

**importance of skimming and scanning of texts (e-mails and Wikipedia articles) during information seeking.** The skim/scan methodology proposed by Buscher et al. (2008c) and Campbell & Maglio (2001) was employed. Both types of ocular behaviour were observed and noted, i.e., skimming and scanning in the e-mail collection; skimming, scanning and reading in Wikipedia. One particular example of a page that stimulated reading<sup>56</sup> in Wikipedia was the cannabis page<sup>57</sup>: the participants were asked to find specific information related to the simulated situation, i.e., the potential health benefits and health problems linked with smoking/ingesting cannabis for medical reasons.

- **Introduced a wider context of literary theories that can be adopted to advance IR & S research on Automatic Document Identification by experimenting with the genres and the usefulness of ‘Frames’ (Frow, 2006b; Gardner, 1983; Paltridge, 1997), ‘Landmarks’ (Heffron et al., 1996) and ‘Signaling Devices’ (Lorch, 1989): for example, interpretation and categorisation features/methods.** As shown in the answer to RQ5, analysis of the data collected during the user studies showed that mainly e-mails and, to some extent, Wikipedia articles, such as Cinema, Call for Papers and Lists (respectively) acted as a frame, providing a structure of expectations for the perceiver much like the Summons (Figure 2.2). The ‘*Landmarks*’ which can trigger a change of strategy, and the ‘*Signaling Devices*’, such as headings, titles, and tables, were shown to be highly important for information seeking in Wikipedia as well as for categorising the e-mails. In a broader context, the genres, related feature sets and identification cues (frames etc.) described in the theories can be utilised for automatic document (genre) identification, which is vital for areas such as retrieving and storing documents within large archives.

### 5.2.2.2 *Smaller-Contributions*

- **Collected and evaluated empirical evidence data on useful form features in e-mail texts, e.g., call for papers, spam.** As shown in Section 3.8, there was a good balance between the reports of the participants regarding the features they found important for the e-mail categorisation task, and the solid data obtained from the eye tracking experiment. Further research is required, however, to substantiate these results.
- **Evaluated the usefulness of structure versus non-structure in e-mail messages for categorisation.** Structure (or Form) played a significant role in the timed response and eye

<sup>56</sup> Since the user study in 2011 the Cannabis and Medical Cannabis pages have both evolved with more formatting and external links

<sup>57</sup> <http://en.wikipedia.org/wiki/Cannabis>



tracking data for the identification of genre. The form attributes enhanced the participants' ability to identify the e-mails with added accuracy, and the eye tracking data helped to explain how this was performed by the 24 participants.

- **Evaluated how participants utilised formatted text as well as unstructured text when categorising texts, and whether format alone is enough to identify texts effectively.** The study presented in Chapter 3 allowed the recording and evaluation of the many types of strategies and ocular techniques employed by the 24 participants while they were categorising the four types of e-mail representations (N, X, U, UX). In many cases, as in the stimuli in Watt (2009) and Toms & Campbell (1999a), the e-mails were identifiable by the participants by using format alone and correctly more than just chance.
- **Evaluated the types of structural attributes of form by using a search and analysis exercise looking at the pages within the English version of Wikipedia.** The search exercise in Chapter 4a proved to be crucial for examining not only the conceptual links between the pages but also their related structural attributes. This exercise was also crucial to the aim of discovering whether the Wikipedia Encyclopaedia was a useful vehicle for the research in Chapter 4b. Many types of 'Signaling Devices' and Wikipedia pages acting as Frames were discovered, such as Information Boxes, Contents Lists, References, Sub Title (of several types) and Main Title, which can be exploited for information seeking. Many of these features can be broken down into smaller features, for example, Information Box: Image Text, Sub Title and Contents.
- **Evaluated the usefulness of Wikipedia for a study of structural features and tasks using genre.** An examination of the ways in which the participants used structural features while carrying out the simulated situations (Chapters 4b) showed that Wikipedia is a useful vehicle for genre research.
- **Evaluated how genres (forms) emerge and evolve in Wikipedia by recording new evolving and interlinking articles.** While carrying out the search and exercise discussed in Chapter 4a to examine the conceptual links and structures, examples were found of evolving genres, e.g., the 'bands' article, which had grown so large that a discography was created. However, the Spike Milligan case study provided an excellent example of how an article had emerged and evolved over a period of many years (Section 4.7).
- **Evaluated ocular evidence of useful genre features in Wikipedia articles, e.g., lists, biographies using eye tracking.** The useful features of genres such as lists, biographies and discographies were identified by evaluating the eye tracking data, that is, fixation-derived

ocular data (Sections 4.17 & 4.18). The statistical analysis helped with the identification of the most important features, for example, the Contents List was rated highly by the 30 participants.

- **Evaluated how biographies and lists are perceived in those first seconds using eye tracking.** “...how does document Form affect the user in those first few seconds?” (Toms & Campbell, 1999a, p. 2014). Chapters 3 & 4b present an analysis of the ocular data that was collected while the participants were looking at whole articles, lists and biographies. The results are not conclusive because they are limited to only two CoPs and 54 participants. However, the studies results does offer clues in several ways, that is, Wikipedia biographies.
- **Evaluated which features of Wikipedia are most and least important during the search tasks.** The analysis in Section 4.17 & 4.18 revealed the most important and least important features of Wikipedia for the search tasks. Processing the results of this analysis is a complex task but statistically, the Summary Text and Contents Lists were very important compared with the other features at the top of the article (Search Box, Information Box, Menu Bar, Main Title). However, when taking into account the rest of the article, the Summary Text, Contents Lists and Bullet Lists were found to be important when the participants were navigating to find the required information.
- **Evaluated structured text compared to non-structured text in Wikipedia.** The comparison between the structured text and non-structured text highlighted the fact that the participants were more dependent (statistically significant difference) on the structured text than on the non-structured text.

### 5.2.3 Discussion

The experiments with eye tracking technology in the two user studies showed *how* and *why* whole genres, and features which represent them, can be used to facilitate IS & R. This research has not only broken new ground by extending and enhancing our understanding of the results of the pilot studies conducted by Toms & Campbell (1999a) then Watt (2009), but also by adding a new dimension of cognitive (ocular) data to analyse.

In the context of genre, the form features provide immediate and clear clues as to the nature of the material and this lessens the need for processing and navigation. When searching a Wiki page, for example, we use genre attributes and features of layout to narrow down our efforts and do not have to read all the content when seeking specific information. This, in itself, contributes to lowering the need for cognitive effort. The reduction of processing needs is important when

relevant information is being sought because the time required to understand, or process information, is also reduced. This is where such theories as Frames (Frow, 2006a), work on Landmarks and Signalling by Heffron et al. (1996); Lorch (1989) cited in Toms and Campbell (1999a, p. 2013) come into play. The features within the frames, such as centred and emboldened titles, paragraph alignments (e-mails) and the Contents Lists, Information Boxes, Sub Title (Wikipedia) all have a strong effect on the perceivers and act as 'signals' through salient features to aid the location of information meaning and purpose. Depending on previous experience and knowledge, the information may be passed into STM then WM or STM, WM, then possibly LTM via the neural pathways: Dorsal (DAN) and Ventral (VAN) (Figure 5.1). If the former, it is via the Dorsal Stream and acted upon, i.e., found relevant through its "*textual affordances*" (Toms, 1997, p. 183) without much or any 'conscious'<sup>58</sup> processing; if the latter, it will pass into LTM via the Ventral Stream so the information can be matched to previous knowledge and acted on by being recognised as relevant by being constructed, using the strategy of '*perpetual perceptual hypothesis*'. Further research is required to identify such behaviour (c.f. Section 5.5 Future Work).

Much research has been carried out that indicates different neural pathways: (Young, 2006) found clear evidence that either ecological or constructivist theory processes occurred during information searches. In the ocular context, skimming and scanning are said to be related to the ecological and constructivist (and Gestalt) processes respectively. This claim has some merit, since during skimming, cognitive suppression takes place so that information is only 'processed' via the Dorsal Stream (DAN) in STM and the Iconic Memory in the Sensory Store (Figure 5.1). Scanning is aligned with cognitive activity and the constructivist process. This takes place by routing along the Ventral Stream (VAN) through the Iconic memory in the Sensory Store through the WM and eventually the LTM, which results in the perceiver calling upon LTM and matching previous knowledge (Figure 5.1). The fact that the perceiver's brain seeks to match shapes and configurations of patterns may be seen as evidence of the strong links between Gestalt theory and constructivism. A Wikipedia CoP could be perceived as a 'Gestalt' configuration of patterns since it employs shapes or forms which, when put together, form a whole (genre). In some cases, however, this could also apply to e-mails.

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<sup>58</sup> How much, if any, consciousness being utilised is a huge area for debate. Some scholars believe it is pre-conscious where others do not believe such a state is possible.

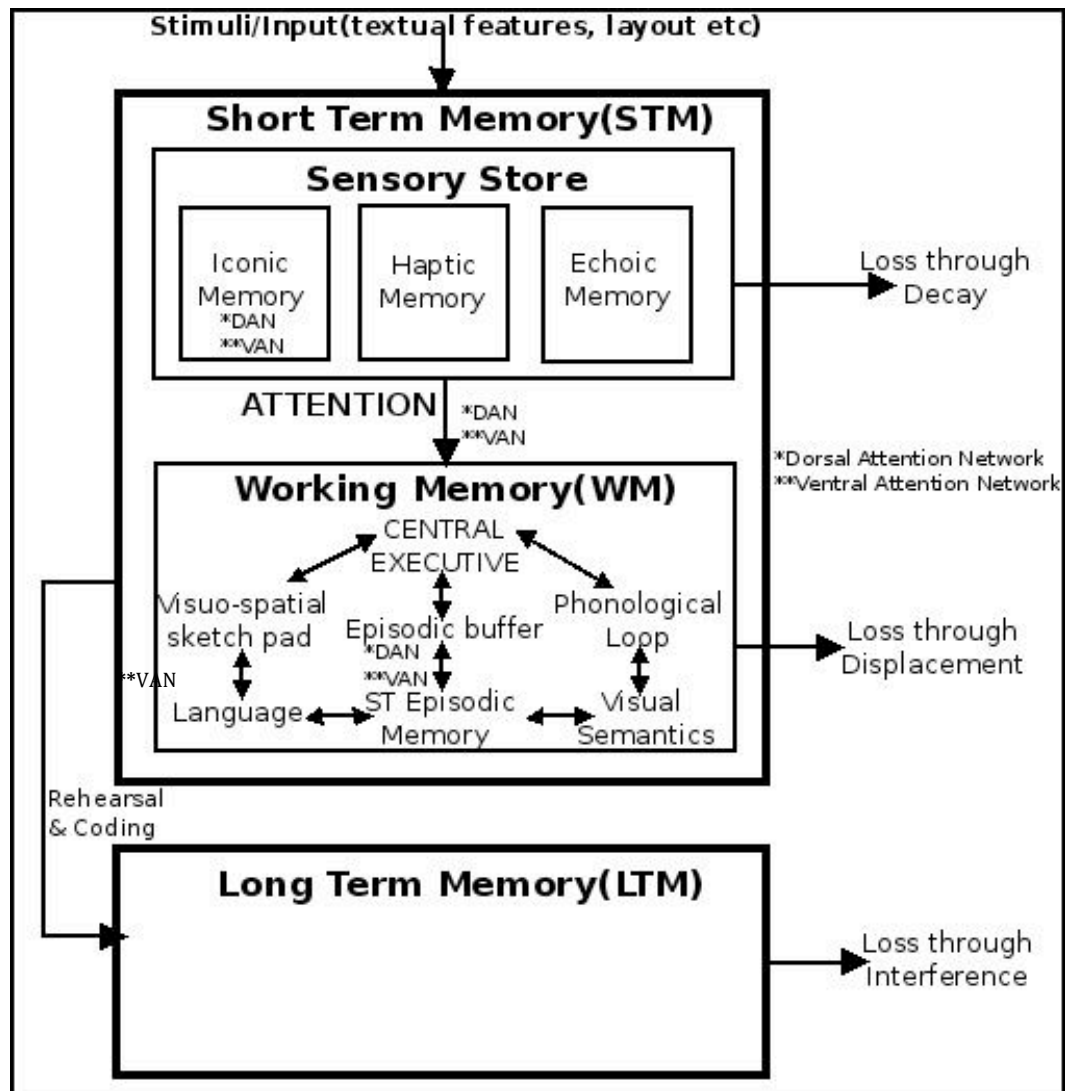


Figure 5.1: Adapted model of Atkinson & Shiffrin (1968) and important modules of the 'Working Memory Model' by Baddeley & Hitch (1974); Baddeley et al. (1996). Dorsal (DAN) and Ventral (VAN) Network added for this thesis.

By utilising the methodology by Buscher et al. (2008c) and Campbell & Maglio (2001), ocular behaviours were detected which also indicate the types of perception behaviour. As discussed in *Timed-Response Measures, Fixation and Saccade Derived Data*, and from the collected data, certain heuristics can be drawn, for example, the Cinema e-mail (Section 3.8.3-3.8.4, RQ13):

- a) unfamiliar with genre: the blocks of numerics (layout and format features) *afforded* the information/action, e.g. the title of a movie, rating and list of times guided attention and/or allowed the decision of whether to go and watch a movie or not. As Toms states in her thesis (Toms, 1997, p. 183) affordances in this context are "*textual affordances*" which are "*the point of user-text interaction in a digital text*".
- b) fully familiar with genre: leads to an 'expectation of purpose/form'. The perceiver would

compare knowledge expectation to construct the visual attributes together and thus recognise the purpose and form.

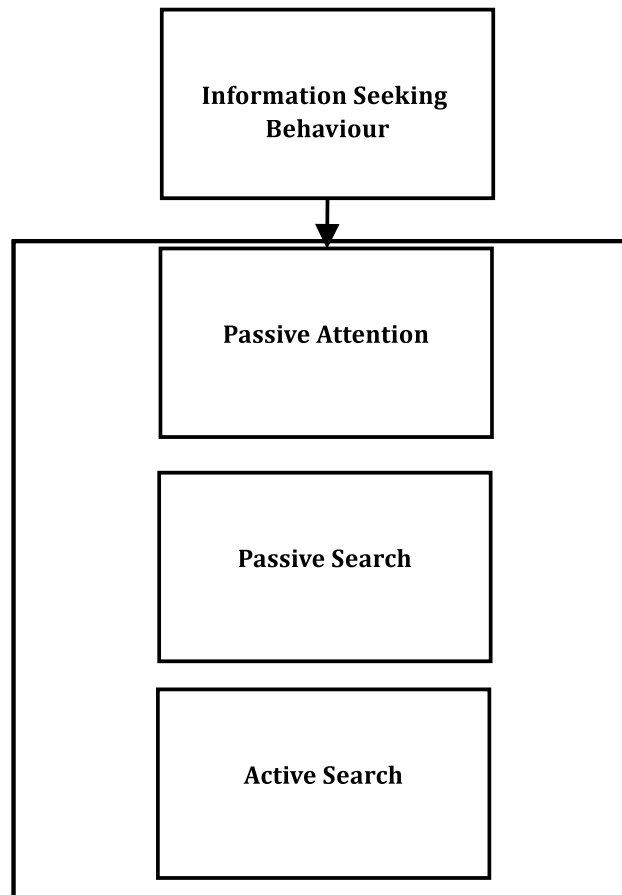


Figure 5.2: Small segment of Wilson (1997, p. 562) cited in Ingwersen & Järvelin (2005, p. 68) model on information behaviour. 'Ongoing Search' omitted from model.

Wilson (1997, p. 562) provided a framework, one small segment of which is shown above (Figure 5.2) but his definitions are intended for a wider context. However, the definitions he used for “*Information Seeking behaviour*” could also be used in this research context. In addition, the definitions of the components used by Wilson have some similarities with the descriptions that follow (Passive Attention etc.), but could also be valid in the context of how cognitively information (text in this case) is sought. For each part of Figure 5.2, Wilson’s definition and the new definition adopted in this thesis are stated:

**Passive Attention (Wilson):** “...where information acquisition may take place without intentional seeking;...”

**Passive Attention (Thesis):** Similar to Passive Search but both kinds of search behaviour cognitive streams are used. There is no predominant stream, but skimming is used to obtain the gist of a text/

to understand the meaning, while scanning is used to obtain specific information. Switching between the behaviours and streams was also observed.

**Passive Search (Wilson):** an occasion (similar to browsing) “...when one type of search (or other behaviour) results in the acquisition of information that happens to be relevant to the individual...”

**Passive Search (Thesis):** The understanding of the meaning of a text takes place without excessive cognitive effort mainly via the Dorsal Attention Network (Figure 5.1) stream (Ecological). The text affords its purpose through passive interpretation via ‘Textual Affordances’, possibly casual glancing/skimming. The skimming technique is used to obtain the gist of a text, in order to understand the meaning and purpose.

**Active Search (Wilson):** “...where an individual actively seeks out information...”

**Active Search (Thesis):** This behaviour is predominantly an active cognitive exercise, i.e., scanning, looking for specific information in an information search task along the Ventral Attention Network (Figure 5.1) stream (Constructivist). However, switching among the streams and behaviour sometimes takes place. The two examples of behaviour regarding the cinema e-mail (this section) could be placed within the model as Passive and Active Search.

It became apparent during the literature review of all the research discussed in this thesis that in the mainstream of IR (and other subject areas) little thought is given to how diverse fields of study can be of benefit to each other to advance learning, for example, English literature ‘Frames’, the two streams hypothesis in theoretical visual perception and the two neural pathways in a neurological context. These three fields all overlap on occasion and, if they were all studied together, could provide opportunities to advance our current understanding and perhaps even contradict the models shown in Figures 5.1-5.2. In order to find answers to questions, such as, *how humans perceive and use genres*, we need to create multi-disciplinary groups for research and leave behind narrow-minded attitudes.

### 5.3 Limitations

There are several limitations:

1. The number of participants was 54 (30 Wikipedia/24 E-mails) but a larger number of participants for studies using eye tracking would lead to even more reliable data which may lead to even more useful results.
2. Only two CoP were examined; a study conducted within an organisation’s intranet website or similar would have helped to further substantiate the findings of this research.

3. The user studies were conducted on the university premises in the researcher's office. Although the environments for the studies were comfortable and warm, the ideal environment would be a naturally relaxed setting, such as the participants' homes or own work areas, and the use of their own laptops or Personal Computers.
4. According to Kelly (2009, p. 74), one drawback of the kind of studies presented in this thesis is that the replication of a user study would be difficult if not impossible to carry out, due to the dynamic nature of the WWW (e.g. Wikipedia) which is constantly evolving. One problem highlighted was that two participants might search the same Web pages or produce two matching queries at two separate junctures and then retrieve entirely dissimilar results.
5. One limitation became evident during the Simulated Situations issued to the participants in the Wikipedia user study. As stated in Kelly (2009, p. 81):

*“One of the primary rationales for developing simulated work task situations is the criticism that assigned search tasks are artificial, that subjects may not have a context for executing the task and making relevance judgments and that subjects may simply be unmotivated to search for artificial tasks”.*

However, as Kelly adds: the reason for the tasks being assigned is to loosely regulate the search state and produce situations that allow for it to be contrasted. The original pilot study for tasks for Wikipedia (previously mentioned in this thesis in Section 5.3.1), which did not give rise to any data that could be analysed, is a testament to using the kinds of allocated simulated situations that were designed for the user study described in Chapter 4b.

#### **5.4 Future Work**

Firstly, apart from the collection of more data, the experimental work presented would benefit from a wider range of methods being used for data collection in a cognitive sense. One such method would be the use of fMRI (functional Magnetic Resonance Imagery) equipment. This would enable the eyes of the participants and the functional attention networks to be tracked simultaneously, McMains & Kastner (2011), which would produce more valuable data pertaining to cognitive attention, genre and behaviour. Many examples of fMRI research examining these perceptual processes exist as an inspiration for following on from the work in this thesis, for example, Corbetta et al. (2008); Corbetta & Shulman (2002); Fincham et al. (2002); Majerus et al. (2011); Marois et al. (2000); McMains & Kastner (2011); Shulman et al. (2007); Todd & Marois (2004). Such a setup would allow the 'illumination' of the DAN or VAN in the visual cortex as discussed in Section 2.7 and

Table 2.2 (Neural Processing and Theoretical Visual Processing) and would also, in particular, provide information on one of the main themes of this thesis: affordances and constructivism.

In addition, it would be useful to consider the research carried out by Lehnert & Martin (1982); Schank & Riesbeck (1981) on discourse structure and other programs that utilise the previously mentioned “*Landmarks*” and “*Frames*” and potentially “*Signaling Devices*” (Section 2.2.7). Could the form and purpose features enable the skimming of “*its input texts to determine their main themes without slogging through each and every word?*” (Mauldin, 1991, p. 351). The key here is to develop a machine that is able to emulate the human behaviour that has been observed and noted during the user studies.

Secondly, a genre framework should also be developed to show how people use different types of texts in different CoPs and to model user behaviour in relation to genre and perception, but before such a framework can be developed, more research involving larger numbers of users will have to be conducted. One approach would be to repeat the studies in different work and home environments within different organisational communications systems.

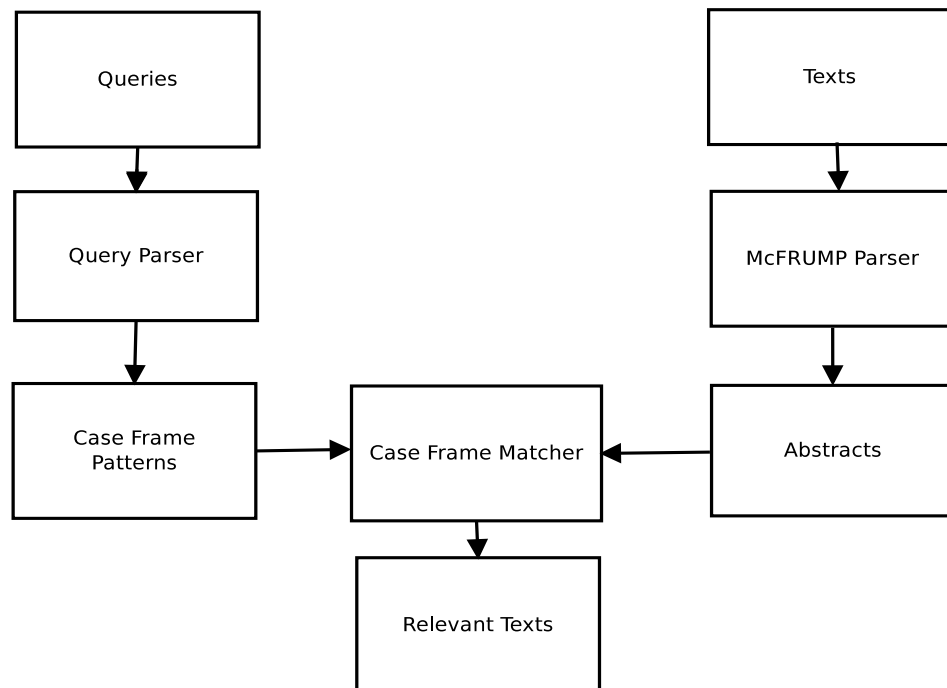


Figure 5.3: FERRET architecture (Mauldin, 1989, p. 46; 1991, p. 350)



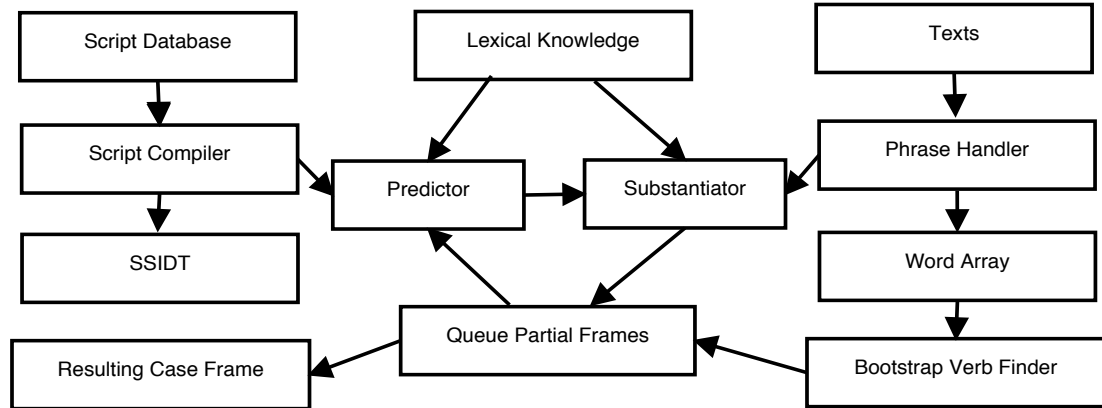


Figure 5.4: Inside the FERRET McFRUMP Parser with Predictor/Substantiator (Mauldin, 1989, p. 60; 1991, p. 351)

Thirdly, as described in Section 2.6.3, it would be useful to model the findings with the evaluation system based on FERRET. A new system loosely based on the models FRUMP (Figure 5.4), and FERRET (Figure 5.3). Even the similar contextual memory program, SAM (Cullingford, 1981), could be adapted by using genre features to categorise and understand the meaning and purposes of texts. The use of such systems would help access information more speedily from communities of organisational communication that use academic document collections, legal documents or patent collections. The ‘Postulates of Impotence’ by Swanson (1988, pp. 94-5), in particular, P5, stated “...machines cannot recognize meaning and so cannot duplicate what human judgement can in principle bring to the process of indexing and classifying documents.”

As Mauldin said: “We do take issue with P5” – and one of the keys to solving Postulate 5<sup>59</sup> and problems inherent in IS & R is the understanding and the utilisation of the features contained within the forms of **genre**.

<sup>59</sup> Despite the disagreement, this thesis completely agrees with: “P6: Word-occurrence statistics can neither represent meaning nor substitute for it.” (Swanson, 1988, pp.92.8). However, genre form and purpose would be a step forward.

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## Appendix A: Documents For Experiment One

**A1 Research Governance Checklist (Form E1)**

CREDO REFERENCE
0 /

THE ROBERT GORDON UNIVERSITY

Research Governance Checklist

APPLICABLE FOR ALL INTERNALLY AND EXTERNALLY RESOURCED PROJECTS

Inform CREDO as early as possible BEFORE submission

A MINIMUM of 5 working days is required to obtain the appropriate approvals

Draft bids are usually acceptable. If final drafts differ substantially, these may need re-authorisation

Proposals must not be submitted to funder without appropriate authorisation

Failure to comply with this authorisation procedure is a breach of the Research Governance Policy and may result in any subsequent award not being accepted

**1. TO BE COMPLETED BY PRINCIPAL INVESTIGATOR****1.1 APPLICANT(S) DETAILS**

Applicant name / Other named RGU Participants	School/ Department/ Centre	Status to the project (PI/ Researcher/ Support/ Other (Please state)):
1.Patrik O'Brian Holt	CTC/Smartlab/School of Computing	PRINCIPAL INVESTIGATOR
2.Malcolm Clark	CTC/Smartlab/School of Computing	Researcher
3.Stuart Watt	CTC/Smartlab/School of Computing	Researcher
4. Chris McKillop	CTC/Smartlab/School of Computing	Researcher

**1.2 PROJECT DETAILS**

Proposal Type <sup>60</sup> :	INTERNALLY RESOURCED <input checked="" type="checkbox"/> EXTERNAL EOI <input type="checkbox"/> EXTERNAL FULL PROPOSAL <input type="checkbox"/>
Project Title/Acronym:	Structured Text Retrieval
Funding Body (if internal state "RGU"):	RGU

<sup>60</sup> EOI – Refers to Expression of Interest or Stage 1 applications (FP6) without financial commitment

RGU Status:	Sole Applicant	If Other, please state
Partner/ Co-ordinator Name and Contact Details (if RGU is not the sole applicant):		
Deadline for Submission:	N/A	
Expected Start Date and Duration:	31/05/07 2 Years Duration(31/05/09)	

### 1.3 PROJECT SCOPE/KEYWORDS

Fit with University Expertise Areas (see 2010 RGU Strategic Vision)	Choose from list
Keywords (enter up to 5)	1)Eye, 2)Tracking, 3)Categorization, 4)E-mail, 5)

### 1.4 DISPATCH OF APPLICATION (Complete ONLY if CREDO is to send application)

Please state below how many copies (plus the original) the funder requires, the name and address to which the application should be sent, and any other relevant information.

Name and Address:		
	Number of Copies:	

### 1.5 ETHICAL REVIEW CHECKLIST (E1) TO BE COMPLETED BY PRINCIPAL INVESTIGATOR

This checklist should be completed by the Principal Investigator who is intending to carry out any research activity (whether internally or externally resourced). This checklist will identify whether a project requires an application for ethics approval to be submitted to the Head of School or Research Ethics Committee.

Before completing this section, please refer to the Research Ethics and Research Governance Policies which can be found online at <http://www.rgu.ac.uk/policies>. The Principal Investigator is responsible for exercising appropriate professional judgement in this review.

E2 and E3 forms can be found online at <http://www.rgu.ac.uk/credo/staff/page.cfm?pge=10193>

#### E1 Ethics Review PART 1

	Yes	No
Is the research solely literature-based?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If YES, please go to the E1 Ethics Review Part 2

Does the research involve the use of any dangerous substances?

Does the research involve ionising or other type of dangerous “radiation”?

Could conflicts of interest arise between the source of funding and the potential outcomes of the research?

Is it likely that the research will put any of the following at risk:

stakeholders?

the environment?

the economy?

living creatures?

Does the research involve experimentation on animals or animal/human tissues?

Does the research involve the observation, experimenting on, interviewing or examining the records of human participants?

If the answer to 7 is NO, please go to E1 Ethics Review Part 2

Could the research induce psychological stress or anxiety, cause harm or have negative consequences for the participants (beyond the risks encountered in their normal lifestyles)?

Will the research involve prolonged or repetitive testing, or the collection of audio or video materials?

Will financial inducements be offered?

Will deception of participants be necessary during the research?

Are there problems with the participant’s right to remain anonymous?

Will there be a need at anytime to withhold the right to withdraw from the research?

Does the research involve participants who may be particularly vulnerable (such as children or adults with severe learning difficulties)?

E1 Ethics Review Part 2

Please give a summary of the ethical issues and any action that will be taken to address the problem

NOTE – If you believe there to be NO Ethical issues please enter “NONE” into the box.

If Ethics approval is required E2/ E3 forms must be completed and attached with this form.

The ethical issues involve the storage of user data for a set of experiments using an Eye Tracker equipment. All data will only ever be accessible to the applicants in section 1.1.

A safety issue arises from the exposure to infrared irradiance. The manufacturers of Viewpoint Eye tracker assure the users that exposure to these amounts of IR are completely harmless in short term exposure. We plan on an experiment length of a maximum of 15 mins for each participant which results in short term exposure. The expected duration of the actual eye tracking will be about 9 minutes and remaining time setting up each participant.

According to the manual :‘Viewpoint Eye tracker PC-60 Software User Guide’ the following applies to IR exposure:

“10 mW cm sq is probably the same maximum figure for corneal exposure over a prolonged period” (Clarkson, T.G. 1989, Safety aspects in the use of infrared detection systems, I. J. Electronics, 66, 6, 929-934).

The infrared corneal dose rate experienced out of doors in daylight is of the order of 10-3 W / cm-2... However, safe chronic ocular exposure values particularly to the IR-A, probably are of the order of 10-2W/ cm-2” (D.H. Sliney & B.C. Freasier, Applied Optics, 12:1, 1973). ISO/DIS 10342 (page 7) give a maximum recommended fundus irradiance for use in Ophthalmic Instruments of 120 mW / sq cm but this is for short term exposure.

Eye tracking will be recorded on a separate monitor using Wink desktop recording software. Audio recording will be used to record the participants genre identification. Neither type of recording will or can be used to identify the participant. Data will be stored on a secured external hard drive.

Financial enducements may have to be offered due to lack of student volunteers(see E3).

Any data taken will be anonymised and I will obtain consent from each participant by issuing a consent form req. All consent hardcopies will be stored in a locked cabinet when stored and the web page questionnaire(not live) data will be stored on a mobile pen drive.

Supporting documentation included (please tick all that apply):

- Copy of the proposal
- Copy of call for proposal/funding guidelines/ preliminary correspondence with funding body (as appropriate)
- E2 form (Ethics form for approval of issues involving non-human subjects)
- E3 form (Ethical approval for issues involving human subjects)

*Confirmation by signature/e-mail affirms your acceptance of the obligations under the RGU Research Governance and Ethics Policies*

TO BE SIGNED BY PRINCIPAL INVESTIGATOR

Signature:

Date:

SEND SIGNED COPY (or CONFIRMATION BY E-MAIL innovation@rgu.ac.uk) TO CREDO, to complete Research Proposal Authorisation NB **\*\*Applications to external funding bodies must **\*\*NOT\*\*** be made, nor internally resourced projects commenced, without confirmation from CREDO of the completion of the Research Proposal Authorisation Process\*\***

**A2 Research Student Project Ethical Review (Rsper) Form**

(TO BE COMPLETED AND APPENDED TO A RESEARCH STUDENT REGISTRATION APPLICATION)

**SECTION A: TO BE COMPLETED BY STUDENT**

Before completing this section, please refer to the *Research Ethics Policy* and *Research Governance Policy* which can be found online at <http://www.rgu.ac.uk/policies>. The research student's supervisor is responsible for advising the research student on appropriate professional judgement in this review.

Please ensure that the statements in **Section C** are completed by the research student and supervisor prior to submission to the Head of School/Centre.

<b>Project Title:</b>	Structured Text Retrieval in terms of Genre
<b>Student:</b>	Malcolm Clark
<b>School/Centre:</b>	IDEAS
<b>Supervisor:</b>	Patrik Holt
<b>Start Date:</b>	31/05/07

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**SECTION B: ETHICS REVIEW CHECKLIST - PART 1**

*To be completed by research student*

	No	Yes
Is approval from an external Research Ethics Committee required/being sought?		<input checked="" type="checkbox"/>
Is the research solely literature-based?	<input checked="" type="checkbox"/>	

**If you answered YES to 1 and/or 2 please go to the Ethics Review Checklist - Part 2**

Does the research involve the use of any dangerous substances?	<input checked="" type="checkbox"/>
Does the research involve ionising or other type of dangerous “radiation”?	<input checked="" type="checkbox"/>
Could conflicts of interest arise between the source of funding and the potential outcomes of the research?	<input checked="" type="checkbox"/>
Is it likely that the research will put any of the following at risk:	
(i) living creatures?	<input checked="" type="checkbox"/>
(ii) stakeholders?	<input checked="" type="checkbox"/>
(iii) the environment?	<input checked="" type="checkbox"/>
(iv) the economy?	<input checked="" type="checkbox"/>
Does the research involve experimentation on any of the following?	

- 
- (i) animals?
- (ii) animal tissues?
- (iii) human tissues (including blood, fluid, skin, cell lines)?
- Will the research involve prolonged or repetitive testing, or the collection of audio, photographic or video materials?
- Could the research induce psychological stress or anxiety, cause harm or have negative consequences for the participants (beyond the risks encountered in normal life)?
- Will financial inducements be offered?
- Will deception of participants be necessary during the research?
- Are there problems with the participant's right to remain anonymous?
- Does the research involve participants who may be particularly vulnerable (such as children or adults with severe learning disabilities)?

## **SECTION B: ETHICS REVIEW CHECKLIST - PART 2**

*To be completed by research student*

Please give a summary of the ethical issues and any action that will be taken to address the issue(s).  
If you believe there to be no ethical issues please enter "NONE" into the box.



Examination of participants eye movements using Infra Red Eye Tracking. The amounts of IR are very small and harmless.

Any data taken will be anonymised and I will obtain consent from each participant by issuing a consent form req. All consent hardcopies will be stored in a locked cabinet when stored and the web page questionnaire (not live) data will be stored on a mobile pen drive.

### **Section C: Statement By Research Student**

**I believe that the information I have given in this form on ethical issues is correct.**

Signature:

Date:

\_\_\_\_\_

### **SECTION D: SUPERVISOR RECOMMENDATION ON THE RESEARCH PROJECT'S ETHICAL STATUS**

**Having satisfied myself of the accuracy of the research project ethical statement, I believe that the appropriate action is:**

The research project proceeds in its present form	
The research project proposal needs further assessment under the School Ethics procedure*	
The research project needs to be returned to the research student for modification prior to further action*	

\* The School is reminded that it is their responsibility to ensure that no project proceeds without appropriate assessment of ethical issues. In extreme cases, this can require processing by the University's Research Ethics Sub-Committee or by external bodies.

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**AFFIRMATION BY PRINCIPAL SUPERVISOR**

**I have read this Ethical Review Checklist and I can confirm that, to the best of my understanding, the information presented by the research student is correct and appropriate to allow an informed judgement on whether further ethical approval is required.**

Signature:

Date:

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**INSTRUCTIONS FOR RESEARCH STUDENT:**

Once the School is satisfied with the ethical check surrounding your research work, please attach original signed copy of this form to your Registration Application Form (RDR). Once your RDR form is complete, signed and has all appropriate attachments, you should then forward it to the Research Degrees Office, AB44, Schoolhill.

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### *A3 Information and Consent Sheet*



## **Information and Consent Sheet**

*ID of Participant e.g. 1 etc:*

*Date:*

### **Introduction**

Thank-you for your interest in this research study. Participation is voluntary. You may participate if you are 18 years or older. You may withdraw from participation at any time, and you may decline to answer any question.

### **Purpose**

The overall purpose of this research is to better understand how human beings look at texts.

### **What you will be asked to do?**

In this study you will be using a computer connected to some equipment known as an Eye Tracker (Arrington PC-60 Viewpoint). The session will take the following form:

1. After you have read this document, we will respond to any questions or concerns that you may have.
2. A short tutorial on how to conduct yourself with the equipment will then be provided to you.
3. We will then go through the process of calibration and testing if you are particularly suitable for the Eye Tracking equipment as unfortunately a small percentage of human subjects are not suited to experiments of this nature.
4. Once callibration is complete you will be shown images of e-mails.
5. We will automatically track the decisions you make about the e-mails and time your responses, using computer software. It is anticipated that the task will take approximately 20 minutes (hopefully).
6. We will also ask you to fill in two questionnaires before and after the study.

### **Risks/Benefits**

We do not anticipate any risks, as the research setting resembles a normal on-line e-mail-composing environment conforming to standard occupational health and safety guidelines.

Due to the very low levels of IR it would not be a problem if the participants were to expose themselves to irradiance from Infrared. The levels from eye tracking are much lower than in normal sunlight and our living environments so we are continually being exposed to IR.

Participating in this research will not provide any personal benefits for you by the way of financial payment or gifts; however we may learn something that will help us better understand how people identify document types similar to the ones used in this study for faster access to information for future IT users.

### **Confidentiality & Anonymity**

Your responses will be recorded but you will NOT be identifiable at all. The results of your interaction with the search system will be reported without any reference to you specifically. Your name will appear only on this sheet. This sheet will be stored separately from any data collected for this study. No names will be attached to the logs of your interactions with the system. The eye tracking data or questionnaires will not have any content to identify you as an individual so you shall remain anonymous. *However, despite this only the researchers will have access to any experimental data and will be for the purposes of data analysis only.* All information that you provide will be treated confidentially and your identity will not **EVER** be revealed in reporting the study results.

I have read the explanation about this study. I have been given the opportunity to discuss it and my questions have been answered to my satisfaction. I hereby consent to take part in this study and have my search interactions tracked by computer software. However, I realise that my participation is voluntary and that I am free to withdraw from the study at any time.

Name:

Signature:

Date:

### A4 Pre-Questionnaire

(hidden)

## Pre-Experiment Questionnaire

<b>1. Age:</b>	<input type="text"/>
<b>2. Gender:</b>	<input checked="" type="radio"/> Male <input type="radio"/> Female
<b>3. What is your first language?</b>	<input type="text"/>
<b>4. What language is spoken at home?</b>	<input type="text"/>
<b>5. Current Occupation:</b>	<input type="text"/>
<b>6. Which high school/college/university diplomas/degrees have you been awarded?</b>	

<u>Degree(tick all that apply)</u>
<input type="checkbox"/> High School
<input type="checkbox"/> College Diploma
<input type="checkbox"/> Under graduate
<input type="checkbox"/> Graduate: Masters or equivalent;
<input type="checkbox"/> Graduate: PhD, Doctoral or equivalent
<input type="checkbox"/> Professional Degree (medicine,law etc)

<u>Degree/Major</u>
<input type="checkbox"/> Under graduate
<input type="checkbox"/> Graduate: Masters or equivalent;
<input type="checkbox"/> Graduate: PhD, Doctoral or equivalent

Professional Degree(medicine, law, etc.)

8. General E-mail Information. Are you familiar with (1= least familiar. 5= most familiar)?	1	3	4	5
a. Genre studies?:	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Automatic genre classification?	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. How many years, approx, have you been using e-mail facilities?	<input type="text"/>			
d. How many e-mail accounts do you own?	<input type="text"/>			
e. Approx how many e-mails (non-spam) do you receive a day?	<input type="text"/>			
f. Approx how many internal to RGU e-mails do you receive each day?	<input type="text"/>			
g. Approx how many external to RGU (non-spam) e-mails do you receive each day?	<input type="text"/>			
h. Approx how many known group list e-mails do you send/receive per day? (KBS etc)	<input type="text"/>			
i. How many mailing lists do you subscribe to?	<input type="text"/>			
j. Which type of mailing lists do you subscribe?	<input type="text"/>			
k. Do you setup keyword filters/rules for you e-mail?	<input type="text"/>			
l. Do you categorise e-mails into personal folders?	<input type="text"/>			

Please, choose a number closest to your experience (1= not experienced at all. 5= extremely familiar):	1	2	3	4	5
<b>m. E-mail Clients</b>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>n. Webmail</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Which clients do you use e.g Outlook, Thunderbird etc?

Which webmail providers do you use e.g BT Openmail, Tiscali, Yahoo etc?

Send

reset

**A5 Post-Questionnaire**

**Post-Experiment Questionnaire**

Top of Form

*(hidden)*

1. How would you rate this **Frustrating** **Neutral** **Easy**  
experience?

2. How easy to do? **Frustrating** **Neutral** **Easy**

If either/or 1 and 2 (above) frustrating please briefly explain why? How could it be improved?

3. Task (1 = meaning no idea. 5 = completely sure)	1	2	3	4	5
Overall did you identify/use/learn any specific features to identify the types of e-mail?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. E-mail Genres and Familiarity (1= not familiar at all. 5=completely familiar)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	1	2	3	4	5
4a. Were you familiar with Call for Papers e-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



mails?					
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If you answer values 4 or 5 to question 4a: which visual attributes would you expect to see in a Call for Papers e-mail?

**1            2            3            4            5**

4b. Were you familiar with Spam e-mails?                   

If you answer values 4 or 5 to question 4b: which visual attributes would you expect to see in a Spam e-mail?

**1            2            3            4            5**

4c. Were you familiar with Orders e-mails?                   

If you answer values 4 or 5 to questions 4c: which visual attributes would you expect to see in an Orders e-mail?

**1            2            3            4            5**

4d. Were you familiar with Library e-mails?                   

If you answer values 4 or 5 to question 4d: which visual attributes would you expect to see in a Library e-mail?

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
--	----------	----------	----------	----------	----------

4e. Were you familiar with Seminar e-mails?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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If you answer values 4 or 5 to question 4e: which visual attributes would you expect to see in a Seminar e-mail?

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
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4f. Were you familiar with Cinema e-mails?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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If you answer values 4 or 5 to question 4f: which visual attributes would you expect to see in a Cinema e-mail?

	1	2	3	4	5
4g. Were you familiar with ITS Outage e-mails?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you answer values 4 or 5 to question 4g: which visual attributes would you expect to see in a ITS e-mail

	1	2	3	4	5
4h. Were you familiar with Newsletter e-mails?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you answer values 4 or 5 to question 4h: which visual attributes would you expect to see in a Newsletter e-mail?

## **Appendix B: Documents For Experiment Two**

***B1 Information Sheet*****Information sheet to be given to participants****Purpose**

The overall purpose of this research is to better understand how human beings look at texts.

**What you will be asked to do?**

In this study you will be using a computer connected to some equipment known as an Eye Tracker Tobii T-60. The session will take the following form. This experiment will consist of three tasks but all involving Wikipedia Search. This will be recorded using eye tracking Technology.

**Wikipedia**

For this experiment, you will be asked to search on three tasks. You will have as long as you wish to search on each question, but plan your search wisely. You will be asked to save text and images to a Word file on your desktop and/or save whole articles to a pre-created folder. You will also be asked to complete several questionnaires:

1. Pre-Experiment Questionnaire
2. Post Task Questionnaire (one after each task).
3. Post-Experiment Questionnaire

**Risks/Benefits**

We do not anticipate any risks, as the research setting resembles a normal on-line e-mail-composing environment conforming to standard occupational health and safety guidelines.

Due to the very low levels of IR it would not be a problem if the participants were to expose themselves to irradiance from Infrared. The levels from eye tracking are much lower than in normal sunlight and our living environments so we are continually being exposed to IR.

Participating in this research will not provide any personal benefits for you by the way of financial payment or gifts; however we may learn something that will help us better understand how people identify document types similar to the ones used in this study for faster access to information for future IT users.

**Confidentiality & Anonymity**

Your responses will be recorded but you will NOT be identifiable at all. The results of your interaction with the search system will be reported without any reference to you specifically. Your name will appear only on this sheet. This sheet will be stored separately from any data collected for this study. No names will be attached to the logs of your interactions with the system. The eye tracking data or questionnaires will not have any content to identify you as an individual so you shall remain anonymous. *However, despite this only the researchers will have access to any experimental data and will be for the purposes of data analysis only.* All information that you provide will be treated confidentially and your identity will not **EVER** be revealed in reporting the study results.

**Signed and Informed Consent to be Agreed by You:**

I have read the explanation about this study. I have been given the opportunity to discuss it and my questions have been answered to my satisfaction. I hereby consent to take part in this study and have my search interactions tracked by computer software. However, I realise that my participation is voluntary and that I am free to withdraw from the study at any time.

**Name**

**Date**

**Signature**

**B2 Informed Consent****Consent Form****Project: A Study of Wikipedia****Researcher: Malcolm Clark**

Please tick box(es)

1. I confirm I have read and understand the information sheet for the above study and have had the opportunity to ask question.
  
2. I understand that my permission is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected.
  
3. I agree to take part in the above study.

---

Name of Participant

Date

Signature

**B3 Entry Questionnaire**

## ENTRY QUESTIONNAIRE

This questionnaire will provide us with background information that will help us analyse the answers you give in later stages of this experiment. You are not obliged to answer a question, if you feel it is too personal.

User ID:

Please place an “X” in the box that best matches your opinion. Please answer the questions as fully as you feel able.

**Part 1: PERSONAL DETAILS**

This information is kept completely confidential and no information is stored on computer media that could identify you as an individual.

1. Please provide your AGE (Years):

2. Please indicate your GENDER:

Male..... 1

Female..... 2

3. Please provide your current OCCUPATION:

Since:

4. What is your FIELD of work or study?

5. Education Experience	
Secondary/High School	<input type="checkbox"/>
College Diploma	<input type="checkbox"/>
Undergrad Degree	<input type="checkbox"/>
Postgrad Masters or equivalent	<input type="checkbox"/>
PhD	<input type="checkbox"/>
Professional Degree (medicine, law etc)	<input type="checkbox"/>
Professorial	<input type="checkbox"/>

**Part 2: COMPUTER EXPERIENCE**

Put "X" in the space that is the closest to your experience.

How often do you...	Never	Once or twice a year	Once or twice a month	Once or twice a week	Every day
6. Use a computer in your work, study or spare time?					
7. If you do use a computer at all what do you normally use the computer for?					



**Part 3: ONLINE EXPERIENCE**

Put "X" in the space that is the closest to your experience.

How often do you...	Never	Once or twice a year	Once or twice a month	Once or twice a week	Every day
8. Use the WWW?					
9. On average how long do you spend online per day?					

**Part 4: EXPERIENCE WITH ENCYCLOPAEDIAS**

Put "X" in the space that is the closest to your experience.


How often do you use...	Never	Once or twice a year	Once or twice a month	Once or twice a week	Every day
10. Online encyclopaedias?					
11. If any, which Online encyclopaedias do you use?					
12. Encyclopaedic books					
13. Which encyclopaedic books do you use?					
14. If you had to answer a general knowledge question would you consult Wikipedia?	Yes <input type="checkbox"/> No <input type="checkbox"/>				
15. Have you contributed knowledge /edited articles to Wikipedia? If yes, which topic (s)?					

16. If yes to 15 how many edits on an average week?	
17. Would you trust the information in Wikipedia?	Yes <input type="checkbox"/> No <input type="checkbox"/>
18. Would you cite Wikipedia?	Yes <input type="checkbox"/> No <input type="checkbox"/>

**Part 5: FAMILIARITY**

19. To what extent are you familiar with Wikis?

Not at all




Completely

5 4 3 2 1

20. To what extent are you familiar with Wikipedia?

Completely



Not at all

5 4 3 2 1

21. To what extent are you familiar with Wikipedia discussion and history pages?

Completely

Not at all

5

4

3

2

1

**B4 Post Task Questionnaire****Post-Search Questionnaire**

To evaluate the search task you have just used, we now ask you to answer some questions about it. Your feedback is important, so please answer freely. There are no right or wrong answers.

User ID:		Task:	1
----------	--	-------	---

Please place an "X" in the box that best matches your opinion. Please answer all questions.

**PART 1: TASK**

In this section we ask about the search task you have just attempted.

1.1. The task we asked you to perform was:

unclear

clear

easy

difficult

unfamiliar

familiar

1.2. I believe I have succeeded in my performance of the task.

Completely

Not at all


  
5

  
4

  
3

  
2

  
1

What are the things that helped your performance (Please circle the answer)?	Agree  Disagree				
1.3. I understood the task.	5	4	3	2	1
1.4. I had enough time to do an effective search.	5	4	3	2	1

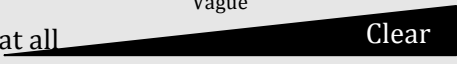
**PART 2: RETRIEVED ANSWERS**

In this section we ask you about the answers you received from the results.

2.1 The answer(s) I have received from the results for this task are:

Relevant to the topic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	not relevant to the topic
Inappropriate to the task	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Appropriate to the task
	5	4	3	2	1	N/A
						<input type="checkbox"/>

2.2 I had an idea of which kind of Wikipedia articles were relevant for the topic before starting the search.


		Vague					
Not at all						Clear	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
5	4	3	2	1			

2.3. If you had an idea of what to look for before starting the search what was it?

Empty response area for question 2.3.

2.4. I am satisfied with my search results.

Somewhat

Not at all  Clear

5     4     3     2     1

**B5 Exit Questionnaire****Exit Questionnaire**

Please consider the entire search experience that you just had as you respond to the following questions.

User ID:

Please place an “X” in the box that best matches your opinion. Please answer the questions as fully as you feel able to.

**Part 1: TASKS and INFORMATION NEEDS**



1.1 To what extent did you find the tasks **similar** to other searching tasks you typically perform?

1.1 To what extent did you find the tasks <b>similar</b> to other searching tasks you typically perform?				
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="background-color: black; color: white; padding: 5px; transform: rotate(-15deg);">Completely</div> <div style="background-color: black; color: white; padding: 5px; transform: rotate(15deg);">Not at all</div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <span>5</span> <span>4</span> <span>3</span> <span>2</span> <span>1</span> </div>				

Which of the tasks did you...	Task1	Task2	Task3
1.2. ... find easy to understand (Rank 1-3. 1 being best, 3 being worst)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4. ... think better provided clues to what kind of documents you were looking for (Please Rank 1-3 bigger is better)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Part 2: SEARCH EXPERIENCE

2.1. How satisfied were you with the search experience and how satisfied were you with the retrieved answers?

Search Experience		Results	
Not at all  Completely 1      2      3      4      5		Not at all  Completely 1      2      3      4      5	
Task 1	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Task 1	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Task 2	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Task 2	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Task 3	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Task 3	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

2.2. Do you have any further comments or suggestions about the entire search experience?

a) Comments?



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**B6 Task Sheet For User One**

1. You are joining a debating society and need some notes to make a Powerpoint presentation on the first topic which is: “Cannabis: Good or Bad?” Since being made illegal in 1928 in the UK and the introduction of the 1971 Dangerous Drugs Act 1971, cannabis’ use for medicinal reasons became restricted. However, in recent years, some countries (for example, Austria) legalised the smoking/ingesting of cannabis by certain patients for pain relief and other medicinal benefits. Thus ‘medical cannabis’ has become a subject of huge debate. You want to understand the arguments for and against the use of marijuana for medical purposes. Therefore, you decide to do some preliminary research on this subject using Wikipedia. What are the possible health benefits and health problems that may entail from smoking/ingesting Cannabis for medical reasons?

Please copy/paste any relevant text and/or images into the Word document named ‘U1\_Task One\_Wikipedia.docx’ on the desktop contained in folder Desktop>Wikipedia User data> U1>Task One.

2. You are in the third year of a social studies degree and have been given coursework on ‘Philanthropy’. On the 4<sup>th</sup> August 2010 thirty-eight US billionaire philanthropists have pledged at least 50% of their wealth to charity through a campaign started by investor Warren Buffet and Microsoft founder Bill Gates. Some of those who have signed the pledge include Michael Bloomberg and George Lucas. Many mentioned in ‘The Giving Pledge’ project are the most influential people in the contemporary United States, and debatably the world. Your coursework states that you have to investigate who **YOU** think is the most influential philanthropist in the pledge group.

Please copy/paste any relevant text and/or images into the Word document named ‘U1\_Task Two\_Wikipedia.docx’ on the desktop contained in folder Desktop>Wikipedia User data> U1>Task Two.

3. You have been tasked to write an essay on the Arab Spring which started to be reported circa late 2010. The beginning of the so-called 'Arab Spring' event led to a huge wave of demonstrations and uprisings in at least 17 countries resulting in many long standing military regimes being overthrown and in some cases civil war. Using Wikipedia find out some useful information which you feel is appropriate and can be used later to form a basis for the essay. For example, countries involved and so on.

Please copy/paste any relevant text and/or images into the Word document named 'U1\_Task Three\_Wikipedia.docx' on the desktop contained in folder Desktop>Wikipedia User data> U1>Task Three.

### ***B7 Tabular Results for Experimental Study 2 (Chapter 4b)***

The Tables in this chapter relate to the experiment discussed in Chapter 4b.

**Table B.1: Bonferroni Post Hoc Tests for Fixation Durations**

<b>AOI Feature and Mean</b>	<b>AOI Feature and Length of Duration Significance (Longer than featured AOI)</b>	<b>AOI Feature and Length of Duration Significance (Shorter than featured AOI)</b>
Sub Title Plain 0.36	Summary Text Bold (p=.048), Bullet Lists Paragraphs Left/Right (p=.049), References Right (p=.002), Table Categories Banner (p=.007), Quotations Centred and Boxed (p<.0001).	
Sub Title Bold 0.33	Bullet Lists Paragraphs Left & Right (p=.014), Numeric List (p=.035), Table Categories Banner (p<.0001), Quotations Centred (p=.002) and Boxed (p<.0001).	
Sub Title Italic 0.34	Bullet Lists Paragraphs Right (p=.003), Table Categories Banner (p=.010), Quotations both Centred and Boxed (p<.0001).	
Contents Title 0.34	Bullet Lists Paragraphs Left (p=.043) & Right (p=.002), Table Categories Banner (p=.006), Quotations both Centred and Boxed (p<.0001).	
Contents Numeric 0.37	Bullet Lists Paragraphs Left & Right (p<.0001), References Right (p<.0001), Numeric List (p<.0001), TC Banner (p<.0001), TC Contents (p=.001), Quotations Centred and Quotations Boxed (p<.0001).	
Contents Content 0.32	Bullet Lists Paragraphs Left (p=.038) & Right (p=.001), TC Banner (p=.005), Quotations Centred and Boxed (p<.0001).	
Summary Text Plain	Bullet List PR (p=.049), Quotations Centred (p=.003),	

0.31	Quotations Boxed (p<.0001).	
Summary Text Bold 0.31	Quotations Boxed (p<.0001)	
IB Title 0.42	Bullet List PR (p<.0001), Bullet List PL (p=.014), Numeric List (p=.034), TC Banner (p=.002), Quotations Centred (p<.0001), Quotations Boxed (p<.0001).	
IB Banner Sub Title 0.48	Quotations Boxed (p<.0001)	
IB Bullet List 0.50	Bullet List PR (p=.001), Bullet List PL (p=.019), Numeric List (p=.045), TC Banner (p=.002), Quotations Centred and Quotations Boxed (p<.0001).	
IB Image 0.36	Bullet List PR (p=.009), TC Banner (p=.032), Quotations Centred and Quotations Boxed (p<.0001).	
IB Image Text 0.40	Bullet List PR (p=.031), Quotations Centred (p=.002), Quotations Boxed (p<.0001).	
IB Sub Title 0.42	Bullet List PR (p<.0001), Bullet List PL (p=.010), Numeric List (p=.026), TC Banner (p=.001), Quotations Centred (p<.0001), Quotations Boxed (p<.0001).	
IB Contents 0.44	Bullet List PR (p<.0001), Bullet List PL, References Right, Numeric List, TC Banner, TC Contents, Quotations Centred and Quotations Boxed (p<.0001).	
Bullet List Small 0.38	Bullet List PR (p<.0001), Bullet List PL (p<.0001), References Right (p=.005), Numeric List (p<.0001), TC Banner (p<.0001), TC Contents (p=.026), Quotations Centred (p<.0001),	

	Quotations Boxed (p<.0001).	
Image Caption Image 0.34	Bullet List PR (p=.005), TC Banner (p=.018), Quotations Centred (p<.0001), Quotations Boxed (p<.0001).	
Image Caption Text 0.36	Bullet List PR (p=.002), Quotations Centred (p<.0001), Quotations Boxed (p<.0001).	
Table Header 0.36	Quotations Centred (p=.005), Quotations Boxed (p<.0001).	
Table Contents 0.37	Bullet List PR (p=.008), TC Banner (p=.026), Quotations Centred (p<.0001), Quotations Boxed (p<.0001).	
Main Title 0.29	Quotations Boxed (p<.0001)	
References Left 0.36	Bullet List PR (p=.008), TC Banner (p=.026), Quotations Centred (p<.0001), Quotations Boxed (p<.0001).	
Menu Bar 0.45	Quotations Centred (p=.010), Quotations Boxed (p<.0001).	
Search Box 0.44	Bullet List PR (p<.0001), Bullet List PL (p<.0001), References Right (p=.002), Numeric List (p<.0001), TC Banner (p<.0001), TC Contents (p=.010), Quotations Centred (p<.0001), Quotations Boxed (p<.0001).	
Wikipedia Icon 0.37	Quotations Centred (p=.037), Quotations Boxed (p<.0001)	
Bullet List PR 0.32		Sub Title Plain (p=.002), Sub Title Bold (p<.0001), Sub Title Italic (p=.003), Contents List Title (p=.002), Contents List Numeric (p<.0001), Contents List Content (p=.001), Summary Text Plain (p=.049), IB Title (p<.0001), IB Bullet List (p=.001),

		<p>IB Image (p=.009),  IB Image Text (p=.031),  IB Sub Title (p&lt;.0001),  IB Content (p&lt;.0001),  Bullet List Small (p&lt;.0001),  Image Caption Image (p=.005),  Image Caption Text (p=.002),  Table Contents (p=.008),  References Left (p=.008),  Search Bar (p&lt;.0001).</p>
Bullet List PL 0.33		<p>Sub Title Plain (p=.049),  Sub Title Bold (p=.014),  Contents List Title (p=.043),  Contents List Numeric  (p&lt;.0001),  Contents List Content  (p=.038),  IB Title (p=.014),  IB Bullet List (p=.019),  IB Sub Title (p=.010),  IB Content (p&lt;.0001),  Bullet List Small (p&lt;.0001),  Search Box (p&lt;.0001).</p>
References Right 0.35		<p>Contents List Numeric  (p&lt;.0001),  IB Content (p=.004),  Bullet List Small (p=.005),  Search Box (p=.002).</p>
Numeric List 0.40		<p>Sub Title Bold (p=.035),  Contents List Numeric  (p&lt;.0001),  IB Title (p=.034),  IB Bullet List (p=.045),  IB Sub Title (p=.026),  IB Content (p&lt;.0001),  Bullet List Small (p&lt;.0001),  Search Box (p&lt;.0001).</p>
TC Banner 0.29		<p>Sub Title Plain (p=.007),  Sub Title Bold (p=.002),  Sub Title Italic (p=.010),  Contents List Title (p=.006),  Contents List Numeric  (p&lt;.0001),</p>

		<p>Contents List Content (p=.005),  IB Title (p=.002),  IB Bullet List (p=.002),  IB Image (p=.032),  IB Sub Title (p=.001),  IB Content (p&lt;.0001),  Bullet List Small (p&lt;.0001),  Image Caption Image (p=.018),  Image Caption Text (p=.009),  Table Contents (p=.026),  References Left (p=.026) and  Search Box (p&lt;.0001).</p>
TC Contents 0.33		<p>Contents List Numeric (p=.001),  IB Content (p=.020),  Bullet List Small (p=.026),  Quotations Boxed (p=.011)  and Search Box (p=.010).</p>
Quotations Centred 0.32		<p>All features significantly shorter (p&lt;.0001), except:  Summary Text Plain (p=.003),  IB Image Text (p=.002),  Table Header (p=.005),  Menu Bar (p=.010),  Wikipedia Icon (p=.037).</p>
Quotations Boxed 0.23		<p>All features significantly shorter (p&lt;.0001) apart from TC Contents (p=.011).  Bullet List PR, Bullet List PL, Numeric List, TC Banner and Quotations Centred not significant.</p>

**Table B.2: Bonferroni Post Hoc Tests for Mean Fixation Counts**

<b>AOI Feature and Mean</b>	<b>AOI Feature and Mean Fixation Counts Significance (More)</b>	<b>AOI Feature and Mean Fixation Counts Significance (Fewer)</b>
Sub Title Plain 47.03		Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p=.004)
Sub Title Bold 49.47		Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p=.008)
Sub Title Italic 17.16		Contents List Numeric (p=.010), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Image Caption Image (p=.040), Table Contents (p<.0001)
Contents Title 27.65		Summary Text Plain, Bullet List Small, Table Contents all (p<.0001)
Contents Numeric 84.78	Sub Title Italic (p=.010), Summary Text Bold (p=.001), IB Title (p<.0001), IB Banner Sub Title (p<.0001), IB Bullet List (p=.015), IB Image Text (p<.0001), IB Sub Title (p=.038), Bullet List PR (p=.002) & PL (p=.005), Image Caption Text PL (p=.013), Table Header (p=.018), References Right (p=.005), TC Banner PL (p<.0001), TC Contents PL (p<.0001), Quotations Centred PL (p<.0001), Quotations Boxed PL (p=.013), Wikipedia Icon PL (p<.0001)	Summary Text Plain (p<.0001),
Contents Content 78.56		Summary Text Plain, Bullet List Small and Table Contents all (p<.0001)
Summary Text Plain	All other features had less fixation counts (p<.0001)	



243.06		
Summary Text Bold 9.04		Contents List Numeric (p=.001), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Image Caption Image (p=.003), Table Contents (p<.0001).
IB Title 4.42		Contents List Numeric (p<.0001), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Image Caption Image (p=.001), Table Contents (p<.0001)
IB Banner Sub Title 5.72		Contents List Numeric (p<.0001), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Image Caption Image (p=.001), Table Contents (p<.0001)
IB Bullet List 25.12		Contents List Numeric (p=.015), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents(p<.0001).
IB Image 31.53		Summary Text Plain, Bullet List Small, Table Contents all (p<.0001)
IB Image Text 5.75		Contents List Numeric (p<.0001), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Image Caption Image (p=.001), Table Contents (p<.0001).
IB Sub Title 24.45		Contents List Numeric (p=.038), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p<.0001).
IB Contents 39.97		Summary Text Plain, Bullet List Small, Table Contents all (p<.0001).
Bullet List Small 145.84	All features significantly fewer fixations (p<.0001), Image Caption Image (p=.014) Contents List Numeric and Table Contents (not sig).	
Bullet List PR 32.45		Contents List Numeric (p=.002), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Image Caption Image (p=.008),

		Table Contents (p<.0001).
Bullet List PL 26.5		Contents List Numeric (p=.005), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Image Caption Image (p=.022), Table Contents (p<.0001)
Image Caption Image 82.13	Sub Title Italic (p=.040), Summary Text Bold (p=.003), IB Title (p=.001), IB Banner Sub Title (p=.001), IB Image Text (p=.001), Bullet List PR (p=.008), Bullet List PL (p=.022), References Right (p=.020), TC Banner (p=.001), TC Contents (p=.001), Quotations Centred (p=.002), Quotations Boxed (p<.0001), Wikipedia Icon (p=.001).	Summary Text Plain (p<.0001), Bullet List Small (p=.014).
Image Caption Text 18.68		Contents List Numeric (p=.013), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p<.0001).
Table Header 22.11		Contents List Numeric (p=.018), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p<.0001).
Table Contents 129.97	Sub Title Plain (p=.004), Sub Title Bold (p=.008), References Left (p=.001). All other features are (p<.0001), Contents List Numeric, Bullet List Small and Image Caption Image (not sig.).	Summary Text Plain (p<.0001)
Main Title 19.53		Summary Text Plain, Bullet List Small, Table Contents all (p<.0001)
References Left 47.61		Summary Text Plain, Bullet List Small both (p<.0001), Table Contents (p=.001).
References Right 22.24		Contents List Numeric (p=.005), Summary Text Plain (p<.0001), Bullet List Small (p<.0001),

		Image Caption Image (p=.020), Table Contents (p<.0001).
Numeric List 53.07		Summary Text Plain, Bullet List Small, Table Contents all (p<.0001).
TC Banner		Contents List Numeric, Summary Text Plain, Bullet List Small, Table Contents all (p<.0001) except: Image Caption Image (p=.001).
TC Contents (Box)		Contents List Numeric, Summary Text Plain, Bullet List Small, Table Contents all (p<.0001). Image Caption Image=(p=.001).
Quotations Centred		Contents List Numeric, Summary Text Plain, Bullet List Small, Table Contents all (p<.0001) except: Image Caption Image (p=.002)
Quotations Boxed		Contents List Numeric, Summary Text Plain, Bullet List Small, Image Caption Image, Table Contents all (p<.0001).
Menu Bar 34.58		Bullet List Small and Table Contents (p<.0001)
Search Box 29.19		Summary Text Plain, Bullet List Small and Table Contents all (p<.0001)
Wikipedia Icon 6.58		Contents List Numeric, Summary Text Plain, Bullet List Small, Table Contents all (p<.0001). Image Caption Image (p=.001).

**Table B.3: Bonferroni Post Hoc Tests for Total Fixation Duration**

AOI Feature and Mean	AOI Feature and Total Fixation Duration Significance (Longer)	AOI Feature and Total Fixation Duration Significance (Shorter)
Sub Title Plain 16.87		Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p=.003).
Sub Title Bold 16.17		Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p=.002).
Sub Title Italic 5.77		Contents Numeric (p=.004), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p<.0001).
Contents Title 9.54		Summary Text Plain, Bullet List Small, Table Contents all (p<.0001)
Contents Numeric 31.77	Sub Title Italic (p=.004), Summary Text Bold, IB Title, IB Banner Sub Title, IB Image Text all (p<.0001), Bullet List PR (p=.001), Bullet List PL (p=.002),	Summary Text Plain (p=.004), Bullet List Small (p=.004)

	<p>Image Caption Text (p=.007)</p> <p>Table Header (p=.010),</p> <p>References Right (p=.002),</p> <p>TC Banner (p&lt;.0001),</p> <p>TC Contents (p=.010),</p> <p>Quotations Centred, Quotations Boxed, Wikipedia Icon all (p&lt;.0001).</p>	
<p>Contents Content 25.10</p>	<p>Summary Text Bold (p=.047),</p> <p>IB Title (p=.026),</p> <p>IB Banner Sub Title (p=0.27),</p> <p>IB Image Text (p=.037),</p> <p>TC Banner (p=.027),</p> <p>Quotations Centred (p=.036),</p> <p>Quotations Boxed (p=.010),</p> <p>Wikipedia Icon (p=.038)</p>	<p>Summary Text Plain (p&lt;.0001),</p> <p>Bullet List Small (p&lt;.0001).</p>
<p>Summary Text Plain 74.71</p>	<p>All features significant (p&lt;.0001)</p> <p>Except: Bullet List Small (not sig).</p>	

<p>Summary Text Bold 2.76</p>		<p>Contents Numeric (p&lt;.0001), Contents Content (p=.047), Summary Text Plain (p&lt;.0001), Bullet List Small (p&lt;.0001), Image Caption Image (p=.012), Table Contents (p&lt;.0001)</p>
<p>IB Title 1.88</p>		<p>Contents Numeric (p&lt;.0001), Contents Content, (p=.026), Summary Text Plain (p&lt;.0001), Bullet List Small (p&lt;.0001), Image Caption Image (p=.006), Table Contents (p&lt;.0001)</p>
<p>IB Banner Sub Title 2.78</p>		<p>Contents Numeric (p&lt;.0001), Contents Content, (p=.027), Summary Text Plain (p&lt;.0001), Bullet List Small (p&lt;.0001), Image Caption Image (p=.007), Table Contents (p&lt;.0001).</p>
<p>IB Bullet List 12.61</p>		<p>Summary Text Plain, Bullet List Small, Table Contents</p>

		(p<.0001).
IB Image 11.47		Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
IB Image Text 2.28		Contents Numeric (p<.0001), Contents Content (p=.037), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Image Caption Image (p=.009), Table Contents (p<.0001).
IB Sub Title 10.32		Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
IB Contents 17.54		Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p=.004).
Bullet List Small 55.94	All features (p<.0001) except: Contents Numeric (p=.017), Summary Text Plain (not significant).	

<p>Bullet List PR 10.30</p>		<p>Contents List Numeric (p=.001), Summary Text Plain (p&lt;.0001), Bullet List Small (p&lt;.0001), Image Caption Image (p=.029), Table Contents (p&lt;.0001).</p>
<p>Bullet List PL 8.83</p>	<p>Contents Numeric (p=.002), Summary Text Plain (p&lt;.0001), Bullet List Small (p&lt;.0001), Table Contents (p&lt;.0001).</p>	
<p>Image Caption Image 27.84</p>	<p>Summary Text Bold (p=.012), IB Title (p=.006), IB Banner Sub Title (p=.007), IB Image Text (p=.009), Bullet List Small (p&lt;.0001), Bullet List PR (p=.029), TC Banner (p=.007), Quotations Centred (p=.009), Quotations Boxed (p=.002), Wikipedia Icon (p=.010).</p>	<p>Summary Text Plain (p&lt;.0001)</p>
<p>Image</p>		<p>Contents Numeric (p=.007),</p>



Caption Text 6.67		Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p<.0001).
Table Header 7.91		Contents Numeric (p=.010), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p<.0001).
Table Contents 47.62	All features (p<.0001) except: Sub Title Plain (p=.003), Sub Title Bold (p=.002), IB Content (p=.004), References Left (p=0.01). Contents Numeric, Bullet List Small and Image Caption Image (not sig).	
Main Title 6.17		Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
References Left 17.25		Summary Text Plain (p<.0001), Bullet List Small (p<.0001),

		Table Contents (p=0.01).
References Right 7.68		Summary Text Plain, Bullet List Small, Table Contents (p<.0001).  Contents Numeric (p=.002)
Numeric List 21.0		Summary Text Plain, Bullet List Small, Table  Contents (p<.0001).
TC Banner 3.01		Contents Numeric, Summary Text Plain,  Bullet List Small, Table Contents (p=.0.00),  Contents Content (p=.0.27),  Image Caption Image (p=.0.07).
TC Contents (Box) 2.53		Contents Numeric (p=.0.010).  Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
Quotations Centred 5.51		Contents Numeric (p<.0001),  Contents Content (p=.0.036),  Summary Text Plain (p<.0001),  Bullet List Small (p<.0001)

		Table Contents (p<.0001), Image Caption Image (p=.0.009).
Quotations Boxed 0.69		Contents Numeric (p<.0001), Contents Content (p=.0.010), Summary Text Plain (p<.0001) Bullet List Small (p<.0001), Table Contents (p<.0001), Image Caption Image (p=.0.002).
Menu Bar 15.56		Summary Text Plain, Bullet List Small and Table Contents (p<.0001)
Search Box 12.71		Summary Text Plain, Bullet List Small and Table Contents (p<.0001)
Wikipedia Icon 2.42		Contents Content (p=.0.038), Image Caption Image (p=.0.010). Contents Numeric, Bullet List Small, Table Contents, Summary Text Plain all (p<.0001).

Table B.4: Bonferroni Post Hoc Tests for Mean Visit Count

AOI Feature and Mean	AOI Feature and Mean Visit Count Significance (More)	AOI Feature and Mean Visit Count Significance (fewer)
Sub Title Plain 31.38	Sub Title Italic (p=.002), Contents List Title (p=.0.033), Search Bar (p=.009), Summary Text Plain, Summary Text Bold, IB Title, IB Banner Sub Title, IB Bullet List, IB Image Text, Bullet List PR, Bullet List PL, Image Caption Text, Table Header, References Left, References Right, Numeric List, TC Banner, TC Contents, Quotations Centred, Quotations Boxed, Wikipedia Icon all (p<.0001).	
Sub Title Bold 30	Summary Text Plain, Summary Text Bold, IB Title, IB Banner Sub Title, IB Bullet List, IB Image Text, Bullet List PR, Bullet List PL, References Right, Numeric List, TC Banner, TC Contents, Quotations Centred, Quotations Boxed, Wikipedia Icon all (p<.0001). Image Caption Text (p=.002), Table Header (p=.001), References Left (p=.001),	

	Sub Title Italic (p=.008), Search Box (p=.035).	
Sub Title Italic 11.53		Sub Title Plain (p=.002), Sub Title Bold (p=.008), Contents Numeric (p<.0001), Contents Content (p<.0001), Bullet List Small (p=.001), Image Caption Image (p=.038).
Contents Title 14.77		Sub Title Plain (p=.033), Contents Numeric (p=.001), Contents Content (p<.0001), Bullet List Small (p=.017).
Contents Numeric 34.59	Summary Text Plain, Summary Text Bold, Sub Title Plain, IB Title, IB Banner Sub Title, IB Bullet List, IB Image Text, Bullet List PR, Bullet List PL, Image Caption Text, Table Header, References Left, References Right, Numeric List, TC Banner, TC Contents, Quotations Centred, Quotations Boxed, Search Bar, Wikipedia Icon all (p<.0001), Contents Title (p=.001),	

	<p>IB Image (p=.004),</p> <p>IB Sub Title (p=.003),</p> <p>Table Contents (p=.035).</p>	
<p>Contents Content 37.06</p>	<p>All features (p&lt;.0001) except Table Contents (p=.003).</p> <p>Sub Title Plain, Sub Title Bold, Contents Numeric, Bullet List Small, Image Caption Image and Main Title not significant.</p>	
<p>Summary Text Plain 38.12</p>		<p>Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content and Image Caption Image (p&lt;.0001).</p>
<p>Summary Text Bold 7.52</p>		<p>Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image all (p&lt;.0001).</p>
<p>IB Title 3.46</p>		<p>Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image all (p&lt;.0001),</p> <p>Main Title (p=.003),</p> <p>IB Content (p=.010).</p>

<p>IB Banner Sub Title 4.17</p>		<p>Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image all (p&lt;.0001),</p> <p>Main Title (p=.002),</p> <p>IB Content (p=.006).</p>
<p>IB Bullet List 11.29</p>		<p>Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small all (p&lt;.0001),</p> <p>Image Caption Image (p=.002).</p>
<p>IB Image 16.63</p>		<p>Contents Numeric (p=.004),</p> <p>Contents Content (p&lt;.0001).</p>
<p>IB Image Text 4.43</p>		<p>Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image all (p&lt;.0001).</p> <p>IB Content (p=.028),</p> <p>Main Title (p=.008).</p>
<p>IB Sub Title 16.76</p>		<p>Contents Numeric (p=.003),</p> <p>Contents Content (p&lt;.0001),</p>

		Bullet List Small (p=.041).
IB Contents 21.77	<p>IB Title (p=.010),</p> <p>IB Banner Sub Title (p=.006),</p> <p>IB Image Text (p=.028),</p> <p>Bullet Lists PR (p=.005),</p> <p>Bullet Lists PL (p=.016),</p> <p>Numeric List (p=.046),</p> <p>TC Banner (p=.004),</p> <p>TC Contents (p=.007),</p> <p>Quotations Centred (p=.008),</p> <p>Quotations Boxed (p=.001).</p>	
Bullet List Small 32.03	<p>Sub Title Italic (p=.001),</p> <p>Contents Title (p=.017),</p> <p>IB Sub Title (p=.041),</p> <p>Search Bar (p=.004),</p> <p>Summary Text Plain, Summary Text Bold, IB Title, IB Banner Sub Title, IB Bullet List, IB Image Text, Bullet List PR, Bullet List PL, Image Caption Text, Table Header, References Left, References Right, Numeric List, TC Banner, TC Contents, Quotations Centred,</p>	



	Quotations Boxed, Wikipedia Icon all (p<.0001).	
Bullet List PR 6.55		Sub Title Plain, Sub Title Bold, Contents Numeric  Contents Content, Bullet List Small, Image Caption Image all (p<.0001). Main Title (p=.001) and IB Content (p=.005).
Bullet List PL 5.94		Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image all (p<.0001). Main Title (p=.005) and IB Content (p=.016).
Image Caption Image 29.35	Sub Title Italic (p=.038), References Left (p=.008), Image Caption Text (p=.011), Table Header (p=.005), IB Bullet List (p=.002). Summary Text Plain, Summary Text Bold, IB Title, IB Banner Sub Title, IB Image Text, Bullet List PR, Bullet List PL, References Right, Numeric List, TC Banner, TC Contents, Quotations Centred, Quotations Boxed, Wikipedia Icon all (p<.0001).	

Image Caption Text 10.61		Sub Title Bold (p=.002),  Image Caption Image (p=.011). Contents List Numeric, Contents List Content, Bullet List Small, Sub Title Plain all (p<.0001).
Table Header 10.89		Sub Title Bold (p=.001),  Image Caption Image (p=.005). Contents List Numeric, Contents List Content, Bullet List Small, Sub Title Plain all (p<.0001).
Table Contents 19.41	Quotations Boxed (p=.025)	Contents List Numeric (p=.035),  Contents List Content (p=.003).
Main Title 14.53	IB Title (p=.003),  IB Banner Sub Title (p=.002),  IB Image Text (p=.008),  Bullet List PR (p=.001),  Bullet List PL (p=.005),  References Right (p=.021),  Numeric List (p=.014),	

	<p>TC Banner (p=.001),</p> <p>TC Contents (p=.002,</p> <p>Quotations Centred (p=.002),</p> <p>Quotations Boxed p&lt;.0001),</p> <p>Wikipedia Icon (p=.020).</p>	
<p>References Left</p> <p>11.43</p>		<p>Sub Title Bold (p=.001),</p> <p>Image Caption Image (p=.008).</p> <p>Sub Title Plain, Contents List Numeric, Contents List Content, Bullet List Small (p&lt;.0001).</p>
<p>References Right</p> <p>7.24</p>		<p>Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image all (p&lt;.0001).</p> <p>Main Title (p=.021).</p>
<p>Numeric List</p> <p>8.64</p>		<p>Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image all (p&lt;.0001),</p> <p>IB Content (p=.046),</p>

		Main Title (p=.014).
TC Banner 3.92		Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image all (p<.0001).  IB Content (p=.004),  Main Title (p=.001).
TC Contents (Box) 4.16		Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image all (p<.0001),  IB Content (p=.007),  Main Title (p=.002).
Quotations Centred 7.89		Sub Title Plain, Sub Title Bold, Bullet List Small, Image Caption Image all (p<.0001),  IB Content (p=.008),  Main Title (p=.002).
Quotations Boxed 1		Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Bullet List Small, Image Caption Image, Main Title all (p<.0001),

		IB Content (p=.001), Table Contents (p=.025).
Menu Bar 18.96		Contents List Numeric (p=.004), Contents List Content (p<.0001).
Search Box 13		Sub Title Plain (p=.009), Sub Title Bold (p=.035), Contents Numeric (p<.0001), Contents Content (p<.0001), Bullet List Small (p=.004),
Wikipedia Icon 5.62		Sub Title Plain, Sub Title Bold, Contents Numeric, Contents Content, Image Caption Image and Bullet List  Small all (p<.0001),  Main Title (p=.020).

Table B.5: Bonferroni Post Hoc Tests for Total Visit Duration

<b>AOI Feature and Mean</b>	<b>AOI Feature and Total Visit Duration Significance (Longer)</b>	<b>AOI Feature and Total Visit Duration Significance (Shorter)</b>
Sub Title Plain 17.45		Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
Sub Title Bold 16.65		Summary Text Plain, Bullet List Small and Table Contents (p<.0001).
Sub Title Italic 5.84		Contents Title, Contents Numeric (p=.011), Summary Text Plain, Bullet List Small and Table Contents (p<.0001).
Contents Title 10.03	Sub Title Italic (p=.011), Summary Text Bold, IB Title, IB Banner Sub Title, TC Banner, TC Contents, Quotations Centred (p=.001). Bullet List PR (p=.003), Bullet List PL (p=.008), Image Caption Text (p=.016), Table Header (p=.026), References Right (p=0.010), Wikipedia Icon (p=.002), Quotations Boxed and Summary Text Plain (p<.0001).	
Contents Numeric 37.55	Sub Title Italic (p=.011), Summary Text Bold, IB Title, IB Banner Sub Title, IB Image	Summary Text Plain (p<.0001)

	Text, TC Banner, TC Contents, Quotations Centred all (p=.001). Bullet List PR (p=.003), Bullet List PL (p=.008), Image Caption Text (p=.016), Table Header (p=.026), References Right (p=.010), Wikipedia Icon (p=.002), Quotations Boxed (p<.0001).	
Contents Content 31.11	IB Title (p=.041), IB Banner Sub Title (p=.038), TC Banner (p=.040), TC Contents (p=.037), Quotations Boxed (p=.019).	Summary Text Plain (p<.0001), Bullet List Small (p=.002).
Summary Text Plain 85.82	All features (p<.0001) except: Table Contents (p=.015), Bullet List Small (not sig).	
Summary Text Bold 2.76		Contents List Title, Contents List Numeric (p=.001). Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
IB Title 2.06		Contents Title and Contents Numeric (p=.001), Contents Content (p=.041), Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
IB Banner Sub		Contents Title and Contents Numeric

Title 2.78		(p=.001), Contents Content (p=.038), Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
IB Bullet List 12.94		Summary Text Plain, Bullet List Small, Table Contents all (p<.0001).
IB Image 12.41		Summary Text Plain, Bullet List Small, Table Contents all (p<.0001).
IB Image Text 2.33		Contents Title and Contents Numeric (p=.001), Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
IB Sub Title 10.32		Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
IB Contents 18.37		Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
Bullet List Small 65.82	All features (p<.0001) except: Contents Content (p=.002), Image Captions Image (p=.001), All Contents AOI, Summary Text Plain and Table Contents not significant.	
Bullet List PR 10.76		Contents Title and Contents Numeric (p=.003), Summary Text Plain, Bullet List Small and Table Contents (p<.0001).



Bullet List PL 9.44		Contents Title and Contents Numeric (p=.008), Summary Text Plain, Bullet List Small and Table Contents (p<.0001).
Image Caption Image 31.42		Summary Text Plain (p<.0001), Bullet List Small (p=.001) Quotations Boxed (p=.028).
Image Caption Text 6.71		Contents Title and Contents Numeric (p=.016), Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
Table Header 8.36		Contents Title and Contents Numeric (p=.026), Summary Text Plain, Bullet List Small and Table Contents (p<.0001).
Table Contents 60.25	All features (p<.000) except: References Left (p=.001), Search Box (p=.024), Bullet List Small and all Contents areas (not significant).	Summary Text Plain (p=.015)
Main Title 15.57		Summary Text Plain, Bullet List Small, Table Contents (p<.0001).
References Left 20.68		Bullet List Small (p<.0001) and Table Contents (p=.001).
References Right 8.58		Contents Title and Contents Numeric (p=.010), Summary Text Plain (p<.0001), Bullet List Small (p=.006), Table Contents (p<.0001).
Numeric List		Summary Text Plain, Bullet List Small

33.73		and Table Contents (p<.0001).
TC Banner 3.11		Contents Title (p=.001), Contents Numeric (p=.001), Contents Content (p=.040), Summary Text Plain (p<.0001), Bullet List Small (p<.0001), Table Contents (p<.0001).
TC Contents (Box) 2.56		Contents Title (p=.001), Contents Numeric (p=.001), Contents Content (p=.037), Summary Text Plain (p<0001), Bullet List Small (p<0001), Table Contents (p<0001).
Quotations Centred 5.73		Contents Title (p=.001), Contents Numeric (p=.001), Summary Text Plain, Bullet List Small, Table Contents (p<0001).
Quotations Boxed 0.69		Contents Title (p=.001), Contents Numeric (p=.001), Contents Content (p=.019), Summary Text Plain (p<0001), Bullet List Small (p<0001), Image Caption Image (p=.028), Table Contents (p<0001).
Menu Bar 18.19		Summary Text Plain, Bullet List Small and Table Contents (p<0001).
Search Box 24.14		Summary Text Plain and Bullet List Small (p<0001), Table Contents (p=.024).
Wikipedia Icon		Contents Title and Contents Numeric

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3.61		(p=.002), Summary Text Plain (p<0001), Bullet List Small (p<0001), Table Contents (p<0001).
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