

Towards a Typology of Reading Goals

Kenton O'Hara

Technical Report EPC-1996-107

Copyright © Rank Xerox Ltd 1996.

Rank Xerox Research Centre
Cambridge Laboratory
61 Regent Street
Cambridge CB2 1AB

Tel: +44 1223 341500
Fax: +44 1223 341510

Rank Xerox Research Centre Cambridge Laboratory

Towards a Typology of Reading Goals

RXRC Affordances of Paper Project

Kenton O'Hara
RXRC Cambridge Laboratory
61 Regent Street,
Cambridge, CB2 1AB
U.K.

Tel: 44-1223-341502
e-mail: ohara@cambridge.rxrc.xerox.com

Abstract

Reading is not a unitary activity. Rather, skilled readers have at their disposal a variety of reading strategies which can be effectively applied in a wide range of situations. The typology presented here is an initial attempt at characterising how reading strategies are influenced by the goals and motivations of the reader. The reading styles and support activities, as well as navigational and manipulation issues are used as the means by which a characterisations of reading can be built in relation to specific reading goals. These goals include: reading to learn; reading to search/answer questions; reading for research; reading to summarise; reading to do; reading for problem solving and decision making; proof-reading; reading for critical review; reading to write and revise documents; reading for enjoyment. From this characterisation it can be seen how the different reading strategies make a range of demands on the properties required of the medium in which the document is presented.

CONTENTS

INTRODUCTION	4
HOW A TEXT IS READ.....	5
Receptive Reading.....	5
Reflective Reading	5
Skim Reading	5
Scanning	5
Serial/Non-Serial Reading.....	6
Single/Repeated Reading.....	6
SUPPORT ACTIVITIES.....	6
Underlining.....	6
Note-taking.....	6
Outlining.....	6
Networking.....	6
WHY A TEXT IS READ	7
Reading to Learn	7
Reading to Self Inform	8
Reading to Search/Reading to Answer Questions.....	8
Reading for Research	9
Reading to Summarise.....	10
Reading for Discussion.....	10
Proof-Reading	10
Reading While Writing from Multiple Sources.....	11
Reading for Text Revision.....	12
Reading for Critical Review	13
Reading to Apply.....	14
Reading for Problem Solving and Decision Making	14
Reading for Enjoyment.....	15
OTHER ISSUES.....	15
CONCLUSIONS.....	16
REFERENCES	17

Towards a Typology of Reading Goals

INTRODUCTION

People interact with documents in different ways towards specific ends. Understanding these different ways is essential in identifying how the properties of various artifacts support these interactions. One important artifact with which users frequently interact in support of their work practices is paper. Paper is a simple yet extremely versatile piece of “technology”. However, despite its almost ubiquitous role in work practice, there has been little concerted effort aimed at understanding its strengths and weaknesses in supporting users in their work.

The Affordances of Paper project is a project within Xerox that aims to develop a framework within which to understand the interactional properties of paper. The project draws on the notion of “affordances” as first introduced by Gibson (1979), to refer to the possibilities for action that an environment or artifact offers an actor. An affordance is defined in terms of the complimentary relationship between the actor and the medium. For this reason, the concept has since been espoused by a number of authors as a powerful tool for thinking about technologies and design, encouraging attention to be drawn to the interaction between the technologies and the user (e.g. Gaver, 1991, 1992; Norman, 1988).

The framework developed by the project will provide the means by which the affordances of paper can be systematically compared and contrasted with those of other technologies (Sellen, 1995). Sellen argues that this is important for a number of reasons: to develop an understanding of the persistence of paper; to predict the likely future usage patterns of paper by identifying situations where new technologies will be able/unable to supplant paper; and to create a database of affordances on which the design of future technologies can draw.

Given that a significant proportion of the ways in which people interact with documents involves reading, an understanding of reading behaviour is a vital concern for Xerox as “the document company”. One aim of the Affordances of Paper project, therefore, is to deepen our understanding of how the affordances of paper support the task of reading and comprehending documents. These affordances can then be compared to the affordances of digital document readers for the same class of reading tasks. The hope is that such an understanding can then be used to drive the design and development of usable and useful technological alternatives for reading digital documents.

In trying to gain this understanding of reading, it is important to recognise that reading is not a unitary activity but rather can take many forms. Skilled readers have at their disposal a variety of reading strategies which can be effectively utilised for a wide range of situations and goals (Oakhill and Garnham, 1988; Lorch, Lorch and Klusewitz, 1993). The way in which a newspaper is read by browsing and reacting to interesting headlines differs from the serial and complete way in which a novel might be read. Furthermore the same piece of text may be read in different ways. For example, reading a newspaper article for its story is different from reading it just to find out who the President of Nigeria is. Each of these reading strategies differs in terms of the range of affordances they demand from an artifact. A useful starting point, then, from which to develop our understanding of reading is to

identify the range of reading situations and goals people have and characterise these in terms of the different reading strategies employed.

To this end a literature review has been undertaken and is presented in this paper¹. The paper starts by outlining some of the different ways in which a piece of text can be read and the supporting activities which may accompany it. These will then be used as the means by which characterisations of reading can be built in relation to specific reading goals. Some additional influences on reading style will then be discussed. Finally conclusions will be drawn as to how these characterisations may be useful for understanding interaction with documents.

HOW A TEXT IS READ

Text can be read in various ways according to the type of information which the reader wishes to extract from the text. This section presents a number of these reading styles which have been identified in the literature. These different styles can be used as building blocks with which to develop a typology of reading. Lunzer (1979) distinguishes between four different types of reading:

Receptive Reading

With this type of reading the reader receives a continuous piece of text in a manner which can be considered as approximating listening behaviour. Comprehension of the text requires some portion of the already read text to be held in working memory to allow integration of meaning with the currently being read text.

Reflective Reading

This type of reading involves interruptions by moments of reflective thought about the contents of the text.

Skim Reading

This is a rapid reading style which can be used for establishing a rough idea of the text. This is useful in instances where the reader needs to decide whether the text will be useful to read or to decide which parts to read.

Scanning

This is related to skimming but refers more specifically to searching the text to see whether a particular piece of information is present or to locate a piece of information known to be in the text.

These are broad characterisations and require further qualification based on the specifics of a task. For example, the way in which a reader scans a text will depend on whether or not the information is known to be there. Furthermore, in larger documents, scanning activity may

¹ One difficulty here lies in the assumptions underlying the work whereby any form of interaction with a document, such as reading, may be affected by the medium in which the document is presented. Analysis of the reading process is therefore not possible in isolation from a particular presentation medium. However, since the majority of reading strategies discussed in the literature are developed from paper-based interaction, this can be considered as some form of benchmark. Therefore, unless explicitly mentioned, the characterisations of reading discussed below will refer to interaction with paper-based texts.

get more detailed as the reader gets progressively closer to the desired location. For example, locating a book, then a section of a book, then a page, then a sentence and so on. These different types of scanning style will require different navigation and manipulation techniques which reflect the level of fine tuning required.

Other important distinctions include:

Serial/Non-Serial Reading

A further important distinction in the way people read text is whether it is in a serial or non-serial fashion. Serial reading refers to when the text is read in a linear fashion from start to finish. Non-serial reading involves moving from one section of a text to another in a non-linear and/or incomplete manner.

Single/Repeated Reading

A text can also be read once or repeatedly. With repeated readings of a text other factors are introduced which affect the reading style such as familiarity and a sense of text.

SUPPORT ACTIVITIES

In addition to these distinct reading styles, there are various supporting activities associated with reading. These refer to activities which occur concurrently with the actual reading processes (Anderson and Armbruster, 1982). They are not just a tag on to the reading process but an integral part of it, changing the way in which reading occurs and the way information is processed.

Underlining

Underlining is popular because it is quick and easy. It will often be accompanied by a deep processing of the material as the reader needs to decide what is important enough to underline. This deeper processing can facilitate understanding and recall.

Note-taking

Like underlining, note taking may facilitate a deeper level of comprehension of the text because of the need to decide what is important. However, if the reader doesn't just simply copy verbatim the text of the author, note-taking additionally allows the information in the text to be reworked and reorganised as well as integrated with other knowledge. This requires an understanding of the original piece of text and how the content and relationships presented in the text can be restructured to create a new, more goal-specific organisation.

Outlining

Outlining allows the reader to produce an alternative representation of the meaning of the text. It involves an initial skim of the article for the reader to identify the main subdivisions. Once these have been established, the article is read more carefully and facts extracted from the text are assigned to each subdivision. The production of this alternative representation of the text meaning requires considerable cognitive effort and can be very time consuming.

Networking

Networking is a means by which linear prose can be transformed into non-linear diagrammatic representations. It assumes that there are a few standard relationships in texts (e.g. definition, temporal, causal, compare-contrast) that are cued by standard lexical and syntactic structures. These relationships are captured in the form of a diagram. This kind of

support activity focuses the reader's attention on the relationships among the different ideas in the text.

WHY A TEXT IS READ

There are a range of purposes for which people interact with a document by reading. This section discusses some of the more common reading goals referred to in the literature (see Table 1) and presents typical profiles of the reading strategies used to achieve them.

READING GOAL	LITERATURE
Reading to learn	(Robinson, 1970; Lorch et al., 1993)
Reading to self inform	(Lorch et al., 1993)
Reading to search/answer questions	(Mynatt, 1992; Askwall, 1985)
Reading for research	(Dillon, Richardson, & McKnight, 1989)
Reading to summarise	(Kintsch & van Dijk, 1978; Brown and Day, 1983; Winograd, 1984)
Reading for discussion	(Lorch et al., 1993)
Proof-reading	(Gould & Grischowsky, 1984; Wilkinson & Robinshaw, 1987; Creed, et al., 1987; Wright & Lickorish, 1984a)
Reading to write and revise documents	(Hayes et al., 1987; McGinley, 1992; Bartlett, 1981; Stallard, 1974; Sommers, 1980)
Reading for critical review	(Wright & Lickorish, 1984b)
Reading to apply	(Coulson & Kayser, 1982; Lorch et al., 1993; Sticht, 1985)
Reading for problem solving and decision making	(Greatbatch et al., 1992)
Reading for enjoyment	(Lorch et al., 1993)

Table 1. Common reading goals referred to in the literature

Reading to Learn

One of the most important purposes of reading is to be able to learn about something. A good indication of the make-up of reading activities that take place while learning is the SQ3R technique suggested by Robinson (1970). This involves a preliminary *survey* of the text/document using skim reading, allowing the reader to anticipate what to expect from the text. From this readers can ask the kinds of *questions* which they think can be answered by reading the text. After this the text can be read in a *receptive* fashion followed a *recital* of the main points to confirm that something is being learned from the reading. At the end, the

main points should be *reviewed* with special attention given over to important points which may have been missed.

Along similar lines, Lorch et al. (1993) discussed reading for learning information to be able to answer questions at a later date, such as for examinations. Such reading was perceived as being slow with great attention to detail. Reading was reflective with regular checks of understanding. Re-reading is a typical characteristic of this type of reading, whether to improve understanding of the subject matter or to quickly review a particular topic. Thus, there is a need to support efficient navigation back and forth as well as quick skim-based reviews of topics (the ability to turn back pages and re-read material is an important factor in determining preference for paper based text; Muter et al., 1982). In addition, this type of reading is often characterised by the integration of the material with information from other sources. Therefore, there is sometimes a need to support simultaneous presentation of several documents or sections of text as well as navigation between them without disrupting the ongoing learning activity. The reading process is also accompanied by various support mechanisms such as, outlining, underlining, and note-taking.

Reading for the purpose of learning text verbatim is very difficult and slow. The text does not have to be processed for meaning but high cognitive demands are made by the need for constant rehearsal of the text. The level of re-reading will be high. The attention of the reader will shift between the reading and rehearsal activities such as when there is a problem of recall. Thus, the reader will be continuously entering and leaving the text at different points.

Reading to Self Inform

This refers to reading which is for the purpose of furthering knowledge about a particular topic without any specific goal to which the information will be applied. It is relatively demanding and relatively slow. It also may involve reflection, memorisation and testing of understanding Lorch et al. (1993).

Reading to Search/Reading to Answer Questions

When reading to search, or answer a question, or for reference, the reader is sampling information in the text which satisfies the goal of the search. Questions differ in terms of the type and amount of information necessary to answer them and with this so does the nature of the search activity (Mynatt et al., 1992). For example, searching for a single fact is a clearly defined goal and may involve just a scan of the text for relevant keywords which may indicate the location of the answer (there is some evidence that readers can scan more information when text is presented on paper compared to a VDU; Askwall, 1985). These different locations can then be read in more detail to check whether the information is there. Other questions may be less clearly defined or require inferences to be made from a combination of a number of different facts. This type of search involves not just the location of relevant bits of information but the movement between these bits to allow them to be combined for the purpose of inference.

A number of different search strategies have been identified in a study by Askwall (1985). The first is called forward search in which a reader begins to read somewhere near the beginning of the text and continues to read the sentences in the order in which they are written until the information is found. This kind of search was found to be more frequent when working with a computer-based text rather than a paper-based text. The second type of search is called zig-zagging and involves jumping back and forth between sentences. Readers start to read somewhere in the text, read a couple of sentences forward, then they

would jump backwards and again start to read forwards. This kind of search is used more in paper-based reading situations. The third kind of search is selective search. Readers start to read at the beginning of a text and then continue by reading every second sentence or so. This is most common in the computer-based situation and usually takes place every second time they search for information in the text. A fourth strategy is referred to as dog-ear marking. Readers in this situation begin by scanning the text for something important. When they find something deemed to be important it is marked by, for example, holding a thumb on the page. When reading continues, comparisons are made between the new text and the marked text. This type of strategy could only be performed in paper-based situations.

When searching, or reading for reference, readers may use materials such as contents pages and indexes to focus their search. With contents pages this will involve a scan of the section to find potentially relevant entry points and then movement to and from the main body of text. With index pages search is more structured by factors such as alphabetic organisation. Search may also take place in documents with which the reader is more familiar. In these circumstances, the reader can make use of a sense of text to support the location of relevant information. The development of this sense of text is thus an important factor to be supported by the document presentation medium (e.g., Hansen and Haas, 1988).

Search activity is also influenced by other factors such as size of the document to be searched, time constraints and issues of uncertainty. Larger documents may reduce the precision with which a document can be searched given time constraints as well as placing increased demands on the development of a sense of text. The level of certainty that a piece of information can be located in the document will affect the level of search detail and the length of time given to the search.

Reading for Research

Information search is not just a within document activity but rather may take place across multiple documents. Part of reading for research involves this higher level search activity to determine which are the best sources to read given time and other constraints. A detailed analysis of how people may choose whether an academic journal is appropriate for their purposes has been carried out by Dillon, Richardson, and McKnight (1989). They observed that firstly users browse the contents page of the journal to make an initial judgement of its usefulness. If an article is selected, the reader then turns to the page and will make another assessment of the quality of the article on the basis of the academic institution of the author. After that, the abstract is read either fully or by just skimming it. A quick scan of the rest of the article then ensues. This often involves a browse of the start of the introduction to get a further impression of contents. Headings are also browsed at this stage as well as a quick scan of diagrams and tables. Skimming the conclusions is another common method of extracting the main idea from the article at this early part of the interaction. References may also be accessed for more information about the article's relevance. At this point the reader has a basic sense of the text on which to make another judgement as to whether to proceed further with the article. This will include such things as the amount of space devoted to different sections and the way it is structured. This can give information on the likely audience level at which the text is based and whether it is suitable for the reader's purposes.

If the decision is made to proceed, then a further two types of reading strategy are commonly used. One of these strategies is a non-serial scan reading of the article with the object of extracting the relevant information. Some sections such as the introduction are generally fully read. However, the reading of these sections may be interspersed with

flicking back and forth to reference and results sections as the need arises. The method and results sections are generally skim read with some parts being read more fully and others being skipped completely. The other strategy is a detailed linear reading of the article from start to finish. Reading involves high concentration and intellectual involvement, placing demands on working memory, as content is critically evaluated and integrated with other information.

Reading for research will frequently consist of interaction with multiple documents. The document presentation medium should allow for efficient navigation between multiple documents and the integration of material from these documents. Furthermore, activities such as note-taking or outlining may also form part of the reading process. These aspects need to be supported without interfering with the main comprehension process.

Reading to Summarise

In order to summarise a piece of text it is necessary to extract from it a general theme as well as the important and interesting points. The summary should be concise and avoid any repetition. When reading to create a summary, readers move through the text and, from the microstructures (words and sentences), build up a more holistic representation of the text (a macrostructure) by applying a series of transformations known as macrorules (Kintsch and van Dijk, 1978; Brown and Day, 1983; Winograd, 1984). Thus reading in these situations must be receptive. The macrorules include the deletion of trivial or irrelevant material, the substitution of superordinate terms for lists of items or subcomponents of an action, and the selection or invention of appropriate topic sentences for individual paragraphs or sections of text. The way in which these rules are applied to the microstructures is guided by specific schemas which classify them as relevant or irrelevant. These schema fall in to a number of different categories. The first is a textual schema which is knowledge about the structure of particular text types and various linguistic techniques which signal importance. The second is a specific purpose schema which refers to knowledge about the reader's personal interests, background knowledge, and purposes of the summary (e.g., abstract, précis, abridging digest, locational digest, restructuring digest).

Reading may also be accompanied by some form of annotation or note-taking to record the main points and to plan the structure of the summary. These notes and annotations act as some sort of intermediate text between the source and the draft texts. Reading attention will therefore be distributed across the source text, the notes made, and any drafts of the summary, though not necessarily in any linear fashion. The process is iterative and so movement between the different documents will continue throughout the course of the task.

Reading for Discussion

This refers to reading in preparation for a class or a meeting. This involves reading to review the basic concepts for discussion or to supplement lectures. Details are generally skipped over with attention being focused on the main points (Lorch et al., 1993).

Proof-Reading

Proof reading entails identifying errors at a grammatical and syntactic level. It involves, for example, the identification of spelling mistakes such as letter and word omissions, substitutions, transpositions and letter and word additions (Gould and Grischowsky, 1984). Additional errors to be identified in a proof-reading task include: missing or additional spaces, misfits or inappropriate characters, and missing or inappropriate capitals (Wilkinson and Robinshaw, 1987). Other authors (Creed, et al, 1987) distinguish between visually

similar errors, visually dissimilar errors, and syntactic errors (which rely on a knowledge of grammatical correctness of the passage and are thus more demanding).

Proof-reading is essentially a visual recognition and discrimination task. Spellings in general can be checked on a word-by-word basis using basic processes of word recognition. There is little need for a detailed global understanding of the text. Any understanding that may be required in a proof-reading task will be limited to the sentence level in order to check for grammatical correctness, a missing word, or sometimes if the misspelling of a desired word results in a correctly spelt but inappropriate new word (e.g. “trial” and “trail”). This aspect of the proof-reading task makes little demand on the text presentation medium. There is no real need for moving around between different parts of the text and so requirements for navigation and development of a sense of text are low. This detection aspect of the proof-reading task essentially only makes demands on legibility of the text presentation medium (e.g., Creed et al., 1987). With technological advances in screen design there is no reason why these demands should not be met by emerging electronic media.

However, proof-reading is not simply about detecting errors but also about recording them. The annotation of the text to record errors is an inherent part of the proof-reading task (e.g., Wright and Lickorish, 1984a). Proof-readers must temporarily leave the detection task and once the recording has finished be able to return to the text where they left off. Thus the text presentation medium should provide support for this by causing as little disruption as possible to the actual error detection task and in a way which facilitates relocation of the exit point. Paper supports the coupling of these processes very well.

Reading While Writing from Multiple Sources

Reading while composing a piece of text from multiple sources is very reflective. There is a need for this reflection in order to analyse and evaluate the content of the information. Readers must test whether the information is consistent, how it compares and contrasts with the information from the other sources and how it compares and contrasts with their own knowledge structures. Readers need to select, collate, and organise all this different information into their own continuous text. One way in which this is supported is through the use of note-making. The notes form an intermediate text that functions as a means for planning, reviewing, and re-shaping ideas and information in the source texts and the reader’s own thoughts. This process is a very dynamic activity which involves much re-reading of the various documents. Re-reading supports the 2-way relationship between the reader’s own knowledge and the interpretation of information in the source (Spivey and King, 1989; McGinley, 1992). All this requires the reader to continually move back and forth within documents and between the composition text, the notes and the various different source texts (McGinley, 1992). Reading, in this situation, will involve some sort of scanning behaviour in order to search for relevant and related bits of information. This kind of movement requires not just a sense of the texts but also a sense of the document space so that search and navigation between the documents is efficient. In addition document manipulation must be such that the movement is free flowing and not disruptive.

As well as reading to gather and collate information for the purpose of developing an argument, readers must also read their own compositions in order to evaluate and revise what they have written. This is discussed more fully in the next section.

Reading for Text Revision

When writing the writer has a need to monitor what has been written in terms of content, style, and overall presentation. Writers build a representation of the text as it has been written and a representation of the text as intended. These representations are compared and any perceived mismatch leads to various efforts to revise the text to remove the mismatches.

The reviser can be either the original author or some second party. The text is evaluated against a number of different criteria. Firstly, there are rules for grammar and spelling which are clearly defined (as in proof-reading). Secondly, the text can be evaluated against the writer's intentions. When the revisers are the writers, they already have knowledge of their intentions and the plan by which to achieve them. In some ways this can make the reading to revise easier. In other ways, it may prevent the detection of faulty expression in their own text because they know what they mean by a particular expression (Bartlett, 1981). A second-party reviser needs to read the text to try and infer the writer's intentions and compare this with what the writer has actually written. Thirdly the text can be evaluated against criteria which they believe text plans should meet such as whether the structure is interesting, coherent, and complete. The evaluation of a text at the level of a plan is a much more global approach to the revision process than simply evaluating it for rules of grammar and spelling. This is a level of evaluation which allows superior revisions to be made and is what distinguishes expert revisers from novice revisers (Beach, 1976; Hayes, Flower, Schriver, Stratman and Carey, 1987; Sommers, 1980).

The nature of the revision process depends on the level of expertise of the reviser (Hayes, Flower, Schriver, Stratman and Carey, 1987). A novice reviser may wade straight into the text and while considering the purpose and the audience of the text generally fails to apply these considerations beyond the scope of a single word or sentence (Stallard, 1974; Sommers, 1980). That is, the text is not considered in holistic terms but rather more as a collection of sentences which each needs to be evaluated. Thus, navigation through the text will tend to be in a linear fashion with backtracking only at the sentence level.

With experts the process is a more diverse and dynamic activity. They tend to view revision as a collection of subprocesses and are aware of the demands which these processes make on attentional capacity (Hayes, Flower, Schriver, Stratman and Carey, 1987). As such, they have a number of strategies which they can use to manage the execution of these different processes. For example, they may read the entire text in several discrete passes, with each pass devoted to searching for a specific type of text problem. An alternative example would be to read the text only once evaluating it for a range of criteria.

The manner in which the task is defined, and the subsequent choice of strategy, is dependent on a number of factors and can change throughout the course of the revision (Hayes, Flower, Schriver, Stratman and Carey, 1987). For example, the purpose, length and genre of the text will be of some influence, as will the type, number, density, and complexity of the problems. The initial representation comes from an initial read of the text. For some this may be a complete read of the text from which a general gist of the text can be extracted. For others it may be a rapid scan or a survey of the first and last lines of each paragraph. Often when a problem is located early on in the text this may prompt a scan read of the text which concentrates on locating more of these types of problems. This is not so that they can be revised as the reviser reads, but so that some indication of density of the error type can be established. This is for the purpose of making judgements about the appropriate correction strategies (e.g. revise or rewrite).

Making judgements about choice of correction strategies involves defining the problem sufficiently to obtain a solution. For some problems they may already be well defined and can be attended to straight away. For others, the reviser may delay any effort to solve the problem because it is not sufficiently well defined. Further search of the text or memory of the text is necessary to create a more detailed representation of the problem and its scope. For example, what is being read might appear contradictory to what is remembered about the previously read text. This will entail a search of the previously read text for the relevant information to check that initial reading was correct or to find out in what way the assertions are contradictory. Similarly for other problems, such as checking for variety of sentence openers, frequency of particular words and phrases, consistency of subheadings, organisation and coherence, missing or redundant information, and undefined terms.

The way these problems are represented and re-represented depends on the way in which the reader can interact with the text, and these will affect subsequent revision strategies. This may be an important source of differences in the way in which different text presentation media support the creation and development of representations. Paper supports the development of these representations whereas electronic media may interfere with the process in some ways (Haas, 1989; Haas and Hayes, 1986; Hansen and Haas, 1988).

Reading for Critical Review

In many respects reviewing a journal article is closely related to reading to revise someone else's document. Many of the multitude of levels at which the text must be read are shared by these two tasks. However, there are a number of differences. The reviewer does not have to make the changes, so decisions on revision strategies play less of a role in determining the way a text is read (e.g., the delay and search procedure described in the section on reading for text revision). In addition, while there is a need to assess writing clarity and precision, grammatical correctness, and overall presentation, much of the concern of the reviewer focuses on the actual work and ideas which the text is describing. This goes beyond simply reading to revise. There is a need to determine whether the paper furthers the knowledge of the subject area which requires it to be read in relation to a large set of literature. Judgements need to be made as to whether the work adequately relates to the area it is supposed to enhance. It needs to be judged at a methodological level as to whether the procedures used are appropriate and rigorous. Evaluations need to be performed as to whether the arguments it presents are coherent and consistent and whether they are based on a sound interpretation of the data and literature. In light of knowledge about the quality of the journal to which the paper has been submitted, it is necessary to ask whether the article is of sufficient overall quality to warrant publication in the journal.

From the type of tasks described above, reviewing an article demands the ability to move back and forth between different sections of the text in order to compare information in different sections (Wright and Lickorish, 1984b). This may be to test consistency of ideas between sections, to review the methodology to assess data interpretation, to review several types of data concurrently so as to obtain the overall implications of the results, and to check references. This requires firstly having some idea of where the desired to-be-referred-to information is. A good sense of text is important for this purpose; that is, a knowledge of the structural and semantic arrangement of the text, the relative locations of particular topics and sections and the amount of text devoted to them (Hansen and Haas, 1988; Lovelace and Southall, 1983; Rothkopf, 1971). The presentation medium must support interaction with the text which facilitates the development of this sense. The reviewers studied by Wright

and Lickorish (1984b) commented that many of the incidental location cues were lost when reviewing an article on a screen.

Once a rough idea of location is established there is a requirement for moving between the different sections. This can be done by page turning, or by laying out several sheets at once for simultaneous viewing or rapid scanning. On screen multi-windowing is one possible way of providing some support for these tasks. Unlike paper, once the reader has formed an objective, this still requires the conceptual and physical aspects of the operation to be performed. This can affect the efficiency with which the article is read. Furthermore, the disruption to the linearity of the text caused by this approach may interfere with the ability to keep track of where one is going and where one has been (Wright and Lickorish, 1984b). More recent work, however, suggests that such facilities can be useful in supporting information location and access if appropriate training and practice is given (Tombaugh, Lickorish and Wright, 1987).

For some reviewers, an integral part of the review process is the annotation and note-taking activities which take place during the reading. Much of the time these may be ill-formed comments which help record and collate the reviewers thoughts. Part of the reason they are not well articulated is the need to avoid disruption of the critical reading activity. Thus the way in which these annotation processes are supported must also not be disruptive. Paper, for example, allows a seamless combination of these activities with the reading process.

Reading to Apply

Reading to apply refers to the kind of reading one does when orders or instructions about how to do something are present in the text (Coulson and Kayser, 1982; Lorch et al., 1993; Sticht, 1985); for example, following a particular procedure at work or reading a manual to allow operation of some piece of equipment. Reading in these situations is generally slow with attention being paid to both the major points and the details. Re-reading is also common in such circumstances, particularly when something unexpected happens which has implications for navigation around the text. In addition, the reading is likely to be carried out concurrently with the activity for which the instruction applies. In these circumstances it will be necessary for the reader to leave the text at various points to relate the information to the actual task and resume reading when further information is needed to continue. Thus the text presentation medium must allow the reading to be integrated with the ongoing activity and support re-access of the text at appropriate points. Similarly, reference to diagrams or tables may require from the reader further shifts of attention to other parts of the document which need to be located and accessed.

Reading for Problem Solving and Decision Making

When problem solving or making a decision it is often necessary to access and read information from multiple and disparate sources. This information needs to be located, accessed and integrated before a judgement can be made. It is difficult to be very specific about this type of reading because of its dependence on the type of problem. Examples of this reading type can be found in co-ordination centres such as air traffic control facilities, railway control centres, airline ground operations rooms and emergency service communications centres. To take the emergency services as a more specific example, dispatchers need to read and combine information about the location and nature of the incident, the kinds of apparatus required by the incident as dictated by departmental policy, the location of the appropriate emergency units with these apparatus and their availability. With this information the dispatcher can make a judgement, often under heavy time

pressure, about which units to dispatch to tackle the incident in the most efficient and prompt manner.

Another example is the doctor-patient interaction (Greatbatch, Luff, Heath and Campion, 1992). Throughout the course of the consultation the doctor will intermittently read parts of the patient's records. The information obtained helps guide the interaction with the patient in terms of the questions which need to be asked and the interpretation of the answers. In addition, it provides information which is important for choosing the appropriate prescription. The interaction with the patient may subsequently guide the reading of the records. Thus the reading in this kind of situation forms part of a symbiotic relationship with the ongoing problem solving and decision making activities.

Reading for Enjoyment

Sometimes, when reading texts such as thrillers or mysteries, reading for enjoyment is characterised by concentration and high emotional involvement in the text. Such reading may involve trying to anticipate what is ahead in the text and finding relationships among specific ideas and events. This kind of reading will be in a linear fashion and require a high investment in time.

In other situations reading for enjoyment can be much lighter, such as reading letters from friends, or comics, or magazine articles. This is the least cognitively involving type of reading, often used just to kill time (Lorch et al., 1993). Reading speed is high and there is little accompanying thought or criticism of the text. Reading is likely to be done in a linear fashion and there is generally no need for re-reading.

OTHER ISSUES

The reading process is influenced by a number of other factors besides the purpose of the reading episode. One such factor is the type of text. Certain text types have typical reading goals associated with them and are written in a way to try and support these goals. As such, certain genres of text can be characterised by structural regularities. For example, newspapers have the major headlines at the front and the sports pages at the back. Many scientific journal articles come in the form: introduction, method, results, discussion. Text books have contents pages at the front and index pages at the back and are broken down into topic specific chapters. From these structural regularities, skilled readers develop schemata for different text types [e.g. academic journals (Dillon, 1991); novels (Kintsch, 1982); expository texts (Hidi et al., 1982)]. These schemata facilitate readers' predictions about likely events or episodes in the text and thus can aid in the comprehension of the text (van Dijk and Kintsch, 1983). The reading of such texts involves the use of specialised strategies which guide encoding and recall on the basis of these well-defined structures (Kintsch, Mandel and Kozminsky, 1977).

The reading process will also be affected by the level of complexity of the text. One might imagine that more difficult texts are read differently from easier ones. Intuitively it could be argued that re-reading parts of the text will be more frequent as complexity increases. This will be linked to navigation and manipulation processes. Memory load will also be higher which may lead to more disruptions with indirect interface characteristics.

Redundancy of information is a further influencing factor. If a text contains much redundant information then the reader can read the text at a faster rate than would be possible with a

more incomplete text. Incomplete texts require inferences to be made so as to fill in the gaps. This is cognitively more demanding. Thus, not only is reading slower in this situation but also arguably more prone to disruption from poor interaction characteristics of the artifact.

CONCLUSIONS

The typology presented here is an initial attempt at characterising how reading strategies are influenced by the goals and motivations of the reader. From this it can be seen how the different reading strategies make a range of demands on the properties required of the medium in which the document is presented. These include: the ability to make notes on and annotate a document in a way which allows integration with the primary task of reading and comprehension; the ability to integrate reading with other ongoing activities; the ability to move freely through a document in a non-linear fashion without getting lost; the ability to access several pages at once for simultaneous viewing; the ability to support concurrent access to multiple documents; the ability to browse the text to get a feel for which parts may be interesting; the ability to rapidly scan for specific bits of information; and the ability to provide context and other cues which support the development of a sense of text.

Paper generally supports these demands well because it is markable, flexible, tangible, and moveable within space. In addition, it has various physical and visual features which provide context and reference points for the parts of the text which help support development of a sense of text. The ability to support these demands is important for understanding preference and usage patterns of paper within the context of emerging technologies in relation to specific reading goals.

Emerging digital technologies make some progress towards meeting these demands. Electronic document annotation can now support a wide variety of markings and free text annotation of different textures and colours. In addition, lighter, portable displays offer some of the spatial freedom provided by paper. However, there are still issues where improvements need to be made. Displays, in general, place constraints on the spatial area within which documents can be moved around in space as well as limiting it to 2D space. In addition, limited display sizes also limit information for the reader in terms of the context available around each text element within a document. With regards to navigation and manipulation, electronic documents offer a certain amount of flexibility for moving between different parts of the document. However, current techniques lack the directness in terms of the ability to formulate and execute manipulation goals. In addition, they lack stability of text as well as the tactile and visual cues which support document manipulation and development of a sense of text. This sense of text is important not only for navigation but also for comprehension.

The typology should not be taken as some rigid classification since people's goals cannot always be so neatly categorised. Instead, it should be viewed as some sort of high level framework within which more specific reading episodes can be studied and understood. In this respect it may be useful for deciding how the demands of reading tasks with multiple goals might be traded off. In addition, it may also provide an initial orientation when attempting research such as observational and laboratory studies of people reading for different purposes. Similarly, questionnaire and other surveying techniques may also draw on the framework to identify more reader-perceived characterisations of goal-directed

reading for various different populations. The typology can therefore act as a launching point for further investigative studies from which to gain an increased understanding of why and how people access documents.

REFERENCES

Anderson, T.H. and Armbruster, B.B. (1982) Reader and text-studying strategies. In Otto, W. and White, S. (Eds) *Reading Expository Material*. London: Academic Press.

Askwall, S. (1985) Computer supported reading vs. reading text on paper: a comparison of two reading situations. *International Journal of Man Machine Studies*, 22, 425-439.

Bartlett, E.J. (1981) *Learning to write: some cognitive and linguistic components*. Washington D.C.: Center for Applied Linguistics.

Beach, R. (1976) Self-evaluation strategies of extensive revisers and non revisers. *College Composition and Communication*, 27, 160-164.

Brown, A.L. and Day, J.D. (1983) Macrorules for summarising texts: the development of expertise. *Journal of Verbal Learning and Verbal Behaviour*, 22, 1-14.

Coulson, D. and Kayser, D. (1982) Understanding: a variable depth process. In Le Ny, J.F. and Kintsch, W. (Eds) *Language and Comprehension: Advances in Psychology 9*. Oxford: North Holland Publishing Co.

Creed, A., Dennis, I., and Newstead, S. (1987) Proof-reading on VDUs. *Behaviour and Information Technology*, 6, 3-13.

Dillon, A. (1991) Readers' models of text structures: The case of academic articles. *International Journal of Man-Machine Studies*, 35, 913-925.

Dillon, A., Richardson, J., and McKnight, C. (1989) Human factors of journal usage and design of electronic texts. *Interacting with computers*, 1, 183-189.

Gaver, W.W. (1991) Technology Affordances. In *Proceedings of CHI '91*, New Orleans, Louisiana, April 28th - May 2nd. New York: ACM Press.

Gaver, W.W. (1992) The Affordances of Media Spaces for Collaboration. *Proceedings of CSCW '92*, Toronto, Canada, October 31st - November 4th.

Gould, J.D. and Grischowsky, N. (1984) Doing the same work with hard copy and cathode ray tube computer terminals. *Human Factors*, 26, 323-337.

Greatbatch, D., Luff, P., Heath, C., and Campion, P. (1992) *Interpersonal Communication and Human-Computer Interaction: An examination of the use of computers in medical consultations*. Rank Xerox EuroPARC Technical Report, EPC-92-133.

Haas, C. (1989) Does the medium make a difference? Two studies of writing with pen and paper and with computers. *Human-Computer Interaction*, 10, 149-169.

- Haas, C. and Hayes, J. (1986) What did I just say? Reading problems in writing with the machine. *Research in the Teaching of English*, 20.
- Hansen, W.J. and Haas, C. (1988) Reading and writing with computers: A framework for explaining differences in performance. *Communications of the ACM*, 31, 1080-1089.
- Hayes, J.R., Flower, L., Schriver, K.A., Stratman, J.F., and Carey, L. (1987) Cognitive processes in revision. In Rosenberg, S. (Ed) *Advances in Applied Psycholinguistics, vol.2: Reading, Writing, and Language and Learning*. Cambridge: Cambridge University Press.
- Hidi, S., Baird, W., and Hildyard, A. (1982) That's important but is it interesting? In Flammer, A. and Kintsch, W. (Eds) *Discourse Processing: Advances in Psychology* 8. Oxford: North Holland Publishing Co.
- Kintsch, W. (1982) Text Representations. In Otto, W. and White, S. (Eds) *Reading Expository Material*. London: Academic Press.
- Kintsch, W., Mandel, T.S., and Kozminsky, E. (1977) Summarising scrambled stories. *Memory and Cognition*, 5, 547-552.
- Kintsch, W. and van Dijk, T.A. (1978) Toward a model of text comprehension and production. *Psychological Review*, 85, 363-394.
- Lorch Jr., R.F., Lorch, E.P. and Klusewitz, M.A. (1993) College students' conditional knowledge about reading. *Journal of Educational Psychology*, 85, 239-252.
- Lovelace, E.A. and Southall, S.D. (1983) Memory for words in prose and their locations on the page. *Memory and Cognition*, 11, 429-434.
- Lunzer, E. (1979) From Learning to Read to Reading to Learn. In Lunzer, E. and Gardner, K. (Eds) *The Effective use of Reading*. London: Heinemann Educational Books Ltd.
- McGinley, W. (1992) The role of reading and writing while composing from multiple sources. *Reading Research Quarterly*, 27, 227-248.
- Muter, P., Latremouille, S.A., Treunit, W.C., and Beam, P. (1982) Extended reading of continuous text on television screens. *Human Factors*, 24, 501-508.
- Mynatt, B.T., Leventhal, L.M., Instone, K. Farhat, J., and Rohlman, D.S. (1992) Hypertext or Book: which is better for answering questions?. In *Proceedings of CHI '92*, 19-25.
- Norman, D.A. (1988) *The psychology of everyday things*. New York: Basic Books.
- Oakhill, J. and Garnham, A. (1988) *Becoming a Skilled Reader*. Oxford: Blackwell.
- Robinson, F.R. (1970) *Effective Study* (4th Edition). New York: Harper and Row.
- Rothkopf, E.Z. (1971) Incidental memory for location of information in text. *Journal of Verbal Learning and Verbal Behavior*, 10, 608-613.

- Sellen, A.J. (1995) *Affordances of Paper: Report on Phase 1*. RXRC Confidential Report.
- Sommers, N. (1980) Revision strategies of student writers and experienced writers. *College Composition and Communication*, 31, 378-387.
- Spivey, N.N. and King, J.R. (1989) Readers as writers composing from sources. *Reading Research Quarterly*, 24, 7-26.
- Stallard, C. (1974) An analysis of the writing behaviour of good student writers. *Research in the Teaching of English*, 8, 206-218.
- Sticht, T. (1985) Understanding readers and their uses of texts. In Duffy, T.M. and Waller, R. (Eds) *Designing Usable Texts*. London: Academic Press.
- Tombaugh, J. Lickorish, A. and Wright, P. (1987) Multi-window displays for readers of lengthy texts. *International Journal of Man-Machine Studies*, 26, 597-615.
- van Dijk, T.A. and Kintsch, W. (1983) *Strategies of Discourse Comprehension*. London: Academic Press.
- Wilkinson, R.T., and Robinshaw, H.M. (1987) Proof-reading: VDU and paper text compared for speed, accuracy and fatigue. *Behaviour and Information Technology*, 6, 125-133.
- Winograd, P.N. (1984) Strategic difficulties in summarising texts. *Reading Research Quarterly*, 19, 404-425.
- Wright, P. and Lickorish, A. (1984a) Ease of annotation in proof-reading tasks. *Behaviour and Information Technology*, 3, 185-194.
- Wright, P. and Lickorish, A. (1984b) Investigating referee's requirements in an electronic medium. *Visible Language XVIII*, 2, 186-205.