Meta-Interpretation and Hypertext Fiction: A Critical Response

COLIN GARDNER
Bakhtin Centre, University of Sheffield, Floor 8, Arts Tower, Western Bank, Sheffield S10 2TN, UK
E-mail: c.b.gardner@sheffield.ac.uk

Abstract. Traditional discourses upon literature have been predicated upon the ability to refer to a text that others may consult (Landow, 1994, p. 33). Texts that involve elements of feedback and non-trivial decision-making on the part of the reader (Aarseth, 1997, p. 1) therefore present a challenge to readers and critics alike. Since a persuasive case has been made against a critical method that sets out to "identify the task of interpretation as a task of territorial exploration and territorial mastery" (Aarseth, p. 87), this paper proposes the use of readers in an empirically based approach to hypertext fiction. Meta-interpretation, a method that combines individual responses to a text, reading logs, screen recordings and limited qualitative/quantitative analysis, and critical interpretation is outlined. By analysing readers' responses it is possible to suggest both the ways that textual elements may have influenced or determined readers' choices and the ways that readers' choices "configure" the text. The method thus addresses Espen Aarseth's concerns and illuminates interesting features of interactive processes in fictional environments. The paper is divided into two parts: the first part sketches out meta-interpretation through consideration of the main problems confronting the literary critic; the second part describes reading research aimed at generating data for the literary critic.

Key words: choice, critical-theory, empirical, hyperfiction, hypertext, interpretation, methodology, reader-response, textual-criticism

1. Introduction

In traditional literary studies, computer-mediated textuality challenges the reader, critic and theorist. Since non-linear, and in this case hyperfictional, texts foreground the individualised experience of reading, the question arises of how far readers may share their experiences of the text. Although this is not necessarily an issue for readers, who may simply enjoy learning about textual experiences they may have missed, the problem for the traditional critic, who tends to work with a definite textual object in mind, is clear (see Landow, 1994, p. 35). George Landow concludes that, to avoid what he terms "metacritical procedure[s]" that focus on the system producing the text rather than on the text itself, the critic must write in hypertext (p. 36). Through the mechanism of linking, a "fundamental reconception" of what Landow tentatively calls "the genre of criticism and theory in hypertext" is actualised (p. 37). Landow's method of bringing the critic into

closer proximity with the text involves explicitly linking critical commentary and its text. Nevertheless, Landow states that:

> The first attempts to write criticism and theory within a hypertext environment suggest that they inevitably share the medium's characteristic multivocality, open-endedness, multilinear organization, greater inclusion of nontextual information, and fundamental reconfiguration of authorship, including ideas of authorial property, and of status relations in the text (p. 36).

These writings, although theoretically consonant with the medium, do not resolve the practical problem of shared textual experience of hyperfictional texts, which, in the case of the traditional critic, is the problem of defining the object of study. More recently, Jane Yellowlees Douglas (2000) has addressed some of the problems involved with practical methods of hypertext criticism in her analysis of the reading of "interactive narratives", though her account is predominantly framed within the context of "closure" and does not directly address the problem of shared textual experience *between* readers and critics. Consideration therefore needs to be given to how readings may be communicated, and particularly to the way that certain text units may change meaning or significance according to their appearance in a reader's discourse.

It is possible to envisage a form of meta-criticism that is not focused on the "system" but uses the experience of readers to illuminate features of the text and to provide the critic with a sound basis on which to discuss shared textual experiences. This is possible because reading, when carried out on a computer, is an activity that can be conveniently and unobtrusively monitored and analysed. In this study, screen-recording software was used to chart readers' progression through Michael Joyce's well-known hyperfiction novel *Afternoon: A Story*. Time spent reading screens ("spaces" in STORYSPACE), the use made of system functions, mouse behaviours and word choices all provide rich data for "meta-interpretation", a method of critical analysis that attempts to overcome the problem of variability between readers and readings of non-linear literary texts, not by situating the discourse within a hypertext environment, as suggested by Landow, but by analysing and synthesising the various ways that readers have negotiated the text. Meta-interpretation also provides the critic with a basis upon which to make low-level inferences about reader behaviour.

The most important factor informing meta-interpretation is the recognition, partly derived from reader-response theory, that the hyperfictional text is both a structural and a dynamic entity. For example, although a hypertext can be conventionally and accurately defined according to the arrangement of its links and nodes, and by the relationships that pertain between various parts of the structure, it is the way these elements are combined during the process of reading that constitutes the object of study in our case. This study is therefore motivated neither by an interest in readers' "performance", nor by a striving to capture what is going on in the mind of the reader – although observations may lead naturally to that kind of speculation. The objective is to establish how far an analysis of a reader's

negotiation of a fictional text can be used as a basis for critical commentary. This exploratory investigation therefore combines readings carried out by readers with the selections of a critic.

2. Problems for Traditional Criticism Applied to Hyperfiction

The central problem for the literary critic when analysing non-linear fictional narrative is how to define the work under discussion. Hypertext fiction and Web-based fiction, being works of "variable expression", have the ability to "make strange" one of the central assumptions informing our understanding of the traditional literary object – a fixed text. George Landow identifies in hypertext the loss of the "stable" referent, the "fixed multiple text" that forms the basis of our common understanding of the work (Landow, 1997, p. 21). The problem and its associated assumptions can be formulated thus: the reader of a non-linear text constructs a pathway based on a series of individual choices; the probability that two people will share the same pathway decreases in proportion to the time spent reading; over time, depending on the text's access functions, the proportion of the work shared by two readers will increase to the point where both will have seen every screen of the hypertext that there is to see. This loss of the referent text therefore presents the critic with one of the most formidable challenges.

However, it is necessary to take into account a radical theory of textuality that denies any possibility of such a "fixed text". Jerome McGann argues, in *The Textual Condition*, that no two books can be thought of as identical because they give rise to readings that are, out and out, socially constituted (McGann, 1991, p. 177). The words of any text are unstable and "variant": "Variation, in other words, is the invariant rule of the textual condition" (p. 185). McGann's theory of textuality has the unfortunate effect of trivialising the problem of the stable referent, since if no literary work has a stable referential basis there is no particular problem for the literary critic to be concerned with.

To begin to understand why there continues to be a problem, we can usefully point to Espen Aarseth's (1997) concept of the "ergodic" text. Firstly, "ergodic" means that a reader is engaged in non-trivial effort in the reading of a work, and that the text arises precisely from the conscious and orchestrated nature of that effort. Secondly, the hypertext reader may return to a space repeatedly in the same reading session (a process referred to hereafter as "recursion") and, depending on a number of factors, the context in which that space appears may lead to dramatic variations in interpretation (Bernstein, 1998; see also Walker, 1999). So, far from lessening the significance of contextual variation as a means of giving rise to different meanings, hyperfiction appears, through recursion, to reify that very instability. As with the ancient philosopher, Heraclitus, who observed that one can never step twice into the same river, the reader never steps twice into the same work. Thirdly, the variability argument is predicated upon the very stable referent that it seeks to deny. Hyperfiction thus becomes itself an exemplifying comment

upon the problem of the stable referent, and in doing so provides grounds for the study of the implications of variation in hyperfictional discourse. In *The Textual Condition*, it appears that the refractoriness of personal experience is sufficient to override the variability of textual performance; in this study, by contrast, the variability of textual performance is seen to have a more immediate impact on what can be communicated between critics and readers.

Finally, a further factor of variability that must be considered is that the order in which screens are viewed may have a bearing on plot. Thus two very basic orders of hypertext can be posited: order-dependent and order-independent. In the latter, there is a single identifiable plot that any competent reader can reconstruct, thereby restoring a linear temporal sequence to the fictional discourse. The story is independent of the order or manner in which the various parts of the text are combined. In the order-dependent case, however, there is no single identifiable plot, and the emerging storyline depends upon the order in which the text fragments are combined. In order dependency, structural linguistic aspects (grammatical, pragmatic, stylistic and so on) are dominant because it is primarily these structures that are, for want of a better phrase, "doing the work". In order independency, the part played by the reader in bringing all these aspects together to form a coherent whole is dominant and the reader is doing the work.

Meta-interpretation addresses these problems and issues by observing readers and the choices they make in the context of their own readings; and since a persuasive case has been made against a critical method that sets out to "identify the task of interpretation as a task of territorial exploration and territorial mastery" (Aarseth, 1997, p. 87), the use of readers becomes a useful analytical tool. Using reading logs, screen recordings and qualitative analysis, it becomes possible to suggest the ways in which the elements of the hyperfiction may have influenced or determined readers' choices. For example, the way in which readers negotiate a work can be taken to be an expression or *version* of the work, and the process itself becomes a focus for critical analysis. One assumption that has to be made under this approach is that the reader is making informed choices based on what has gone before (see Calvi, 1999), and while the reader can have no way of knowing what outcomes will be (Tosca, 1999), it is likely that at least some of those decisions will be based on quantifiable reactions to the text and conform to identifiable patterns of usage. Furthermore, meta-interpretation should find traces of the hypertextual patterns outlined by Bernstein within its readings. The success of meta-interpretation as a critical methodology rests on a number of assumptions: that there is a problem with the stable referent; that readers make choices that can be analysed and interpreted just as though the readings were themselves texts; that the work, as a dynamic entity, is more than the sum of its parts.

2.1. DELIMITATIONS OF THE STUDY

Research into hypertext cognition and interface design, a potentially fruitful source of information for the literary critic, has limited applicability to fictional texts. For example, studies comparing hypertext and print-based modalities often involve goal-directed search strategies and performance measurements, such as acquisition speed, comprehension and coverage (see, for example, McKnight, 1993; Rouet, 1996). For these measurements, factual texts are most appropriate. A novel, for example, would be inappropriate because of the higher degree of latitude usually permissible when interpreting such a text. Cognitive interface design is both implicitly and explicitly directed toward discerning and disseminating techniques and principles of effective navigation and presentation – assumptions not necessarily shared by hyperfiction writers – and therefore of limited value to the literary critic. It is likely that a wider number of protocols than are used here could be used for further studies. The use of intermediate interventions, where the reader stops and records what is going on in real time ("online"), is another possible way for a critic to gather information about the dynamic process of the interpretation. However, meta-interpretation has actually to be seen as an alternative to such an intervention. Apart from the fact that the reader's intermediate intervention would not itself be "objective" (readers can improvise explanations, as with dream interpretation), intervention would itself become an inextricable aspect of the reader's experience, comparable to the creation of a further, parallel text. Meta-interpretation, almost by definition, aims to see how far, and under what conditions, interpretations can be made in the absence of such verbalizations.

2.2. CONFIDENCE MEASURES

The method attempts to address Espen Aarseth's concerns about critical territorialism and to illuminate interesting features of textual interactions. However, confidence measures are necessary to guard against the most improbable inferences, and I outline in this study two such measures: analysis of reading speed and mouse movements. A log of the time each space is viewed is necessary to guard against analysing the reader's ruminations in the context of a screen that had been skipped over. A theoretical perspective that addresses not only the various fictional representations of time, but the actual time of reading as well, would therefore be a useful counterpoint to the empirical data. Paul Ricoeur (1985), in his extraordinarily detailed analysis of the functions of time and sequence in fictional narrative, makes passing reference to the "real time of reading" (p. 84), but only to question its relevance to the study of narrative emplotment:

> Genette's study of the distortions of duration leads me to the same reflections. I shall not go back over the impossibility of measuring the duration of the narrative, if by this is meant the time of reading (p. 86).

Such doubts about the usefulness of "time of reading" can be cast aside in the case of computer-based methods, although there are limits to the usefulness of reading time as a factor. For example, Rouet and Passerault (1999), in their discussion of the drawback of "segmented presentation" (which is, essentially, the hypertext mode), observe that time spent on one segment may not reflect the cognitive activity for that particular segment (p. 205). In a similar way, reading time is of limited use to the literary critic where it is embedded as a trope within the text, as it so obviously is, for example, in Stuart Moulthrop's (1997) Web-based *Hegirascope 2.0*, where new windows are automatically loaded after a few seconds. The time of reading is therefore relevant to this study only insofar as it represents a comparative test of the reader's hesitation on any one particular screen. The figure for reading speeds for screens is also affected by movements of the mouse and general exploration of the interface.

To decide whether hesitations or decisions are significant, a mean reading speed for the reader is first calculated. Then, the effect on the reading rate of the number of words on the screen must be factored in. If time taken to read a space of ten words is one second, and the time taken to read a space of 100 words is ten seconds, there is a perfect positive correlation between time of reading and text length. If, on the other hand, readers change the rate of reading according to text length, and there is a significant negative or positive correlation between reading rate and word length, we can use this information when deciding whether the reader has hesitated over a particular space in the story. A two-tailed Pearson's correlation coefficient was used to test the significance and direction of the correlation.

It would be possible, though this is not attempted here, to link time of reading and the content matter of the text. In June Downey's recently republished exploration of factors in the psychology of reading, *Creative Imagination*, a link is made between specific content and its effect upon a reader. Descriptive passages are said to give rise to images in the mind of readers, causing them to enter a phase of intense imagination in which the eyes fixate (Downey, 1929 [1999], p. 26). Content may thus indirectly have a marked effect on reading time and it would be interesting to note whether, for example, vivid descriptions of geographical or psychological landscapes and action sequences affect the rate at which readers move through the story.

The second means of increasing the level of confidence used in this study was the readers' use of the mouse. Mouse behaviour may have a significant effect on interpretation and therefore must be observed and categorised, since there would be little point focusing on a screen in which a reader had spent an unusually long time exploring the interface. The behaviours described below are taken from actual observations of the movements of the cursor in the reader's recordings.

2.3. Terms used for mouse activity

Beeline cursor moves from resting position to target word and selects
Skid cursor moves across target word then back to select
Roundabout cursor encircles target word before selecting
Ponder cursor is placed over a target object but does not select
Waver cursor oscillates between possible target words before selecting
Roam cursor makes wide exploratory sweeps across the screen with little hesitation
Judder small fluctuations in cursor position
Nudge cursor obscuring screen objects is moved into "neutral" space

2.4. Text used

It is usual for hypertext documents to highlight link anchors in order to aid readers' navigation of the structure. I chose *Afternoon: A Story* by Michael Joyce firstly, because I was interested in a work in which any word selection made by a reader would, through some default mechanism, normally lead the reader to a further space. This is because meta-interpretation is most useful for the critic when analysing the reader's responses to the verbal content, rather than simply the link structure, of the document. What is primarily of interest, therefore, is not what links the reader activates, but what choices the reader makes. Secondly, this work, raised to the status of a classic amongst aficionados of hypertext literature, has been the focus of extended discussion, thus providing useful comparative perspectives. The use of screen-recording software, as well as a time-stamped log, then becomes necessary to pick up the non-link selections.

3. Method

A call for readers was made through an e-mail distribution list. When participants arrived they were briefed as to the nature of the study, assured of confidentiality and generally put at their ease. It was particularly important to explain that the study was not in any way measuring their reading "performance". None of the participants had had experience of reading hypertext fiction. Each participant was seated at the computer and then completed an online questionnaire (adapted from the questionnaires freely available at the Graphic Visualization, and Usability Center's (GVU) User Survey site), which covered computer literacy and reading preferences.[1] The reader submitted the questionnaire to my data area, *Afternoon* was loaded, and the screen recording program HYPERCAM started, at which point I left the room. The reading lasted approximately 30 minutes and was followed by a short debriefing session, in which readers were asked to respond to a set of prepared questions relating to their experience of the text. The readings were carried out by three English Literature undergraduates and two academics.

Table I. Overall results across five readers

Total screens visited by all readers	614
Total spaces visited by all readers	200
Total reading time for five readers	146 min

Once the data had been processed and put into a spreadsheet, further data, such as space length, was acquired from the READINGSPACE program by running "about this space". In the following, the word "space" is used to refer to an individually named text unit in a STORYSPACE work and "screen" when a space window is made active. If a reader moves backwards, then forwards, between three spaces in *Afternoon*, there are six screens.

4. Results

Table I is a summary of the screens, spaces and reading time for the study. There are 539 spaces in *Afternoon*, so the combined readings cover just over one third of the available spaces. From these results it would be impossible to predict when, or whether, a complete coverage of the work would occur. It would be of practical interest, however, to know what pattern of coverage would occur with repeated reading sessions of fixed duration, for example, to ascertain how the rate of coverage decreases over time. Combining this knowledge with a structural analysis would make sense of spatial terms of reference for spaces, such as "central" and "peripheral", by locating them within communally shared experience of the text. The critic could then focus attention on areas of the text covered by those readers and, conversely, bring to readers' attention those areas not covered. The resulting "map" would be one describing the structure of the text according to how the text had been navigated, rather than through its potentials. The pedagogical value of this analysis is clear, in that it facilitates a focus for the shared text and shared experience, giving a tutor, for example, a firm basis on which to discuss the most relevant aspects of the text. A much more detailed level of meta-interpretation is made possible by this approach, and this is described below.

In Table II, n is the total number of screens visited in the session. The figure also includes any screens activated by the reader where, for example, more than one window is open simultaneously and the reader has switched between them. The third column shows the number of unique spaces, arrived at by subtracting recursals from the total figure in column 1. For example, although Reader 1 has visited 170 screens in the session, only 94 are unique ($Qn = 94$), representing 55% of the total (n). The fourth column shows the level of recursal averaged across all spaces, arrived at by counting all recursal spaces except the first. For example, Reader 4 paid 8 visits to the space "1/" and 10 visits to "2/", a total of 18 visits ($n = 18$). Since only 2 spaces are unique ($Qn = 2$), there are 16 recursals ($Rn =$

Table II. Summary of reading data

Reader	n	Number of Unique % (Qn)	Number of Recursal % (Rn)	Number of Intervention % (In)
1	170	55 (94)	45 (76)	33 (56)
2	82	71 (58)	29 (24)	95 (78)
3	100	83 (83)	17 (17)	44 (44)
4	160	55 (88)	45 (72)	43 (69)
5	102	69 (70)	31 (32)	99 (101)

Numbers in brackets indicate actual numbers.

16) – a recursal rate of 89%. The final column shows the number of interventions, which includes word selections, the use of the various tools such as the history, text entry and link dialog tool, and the back button. The figure does not include default choices (where the reader chooses the <Enter> key). Reader 1, for example, made 56 interventions (33%), the remainder being default choices, while Reader 5 made 101 interventions out of the 102 screens visited (99%).

Analysing the data in a way that does not appear to be "performance" based is quite difficult. Meta-interpretation is oriented towards providing the critic with the means of objectifying experience for the purpose of commentary and analysis by focusing on the text and reader dynamic. The following should be read, therefore, as a characterisation of readings based on observable anomalies, and not as an attempt to draw readers into a hierarchy of performance. In a teaching and learning situation this would be a crucial distinction. Readers 1 and 4 had the lowest percentage of Unique, showing that just over half of the screens they visited were unique spaces within the context of their reading. However, they had the highest actual number (Qn = 94; Qn = 88 respectively). The anomaly, couched in the language of performance, would be that while these readers appear less "efficient", they are more effective. The recursal data for these two readers are most easily explained, however, as a decrease in the rate of coverage as discussed above; in structures containing loops, default paths and dead-ends, a reader without access to a map structure is likely to come back repeatedly to the same screens. It is also possible that an increased exposure to recursals led these two readers to realise that their selections sometimes had no effect on the outcome of their choice, and thus to reduce their intervention rate.

Remarkably high intervention rates are recorded by Reader 2 and Reader 5 (In = 95%; In = 99% respectively). Does this explain the lower recursal rates (Rn = 29%; In = 31% respectively)? It seems likely that there is a link in each individual case but the level of intervention is not a predictor of recursion, since Reader 3 has a low intervention rate but a very low rate of recursal (Rn = 17%).

Table III. Number of screens shared between two readers as percentage of total unique screens (%)

Reader		*x*				
		1	**2**	**3**	**4**	**5**
y	**1**		32 (30)	40 (38)	37 (35)	29 (27)
	2	52		19 (11)	36 (21)	31 (18)
	3	45	13		8 (7)	29 (24)
	4	40	24	8		43 (38)
	5	39	26	34	54	

Numbers in brackets are actual number of screens shared.

It is important to remember that recursion does not necessarily entail redundancy since, depending on the content, it is quite possible that the perceived significance of a space will change over the course of a reading. The fact that spaces may enter readings at various points, and change function according to their position in the discoursed text, is one of the reasons that interactions are so important to critical interpretation in the case of hyperfictional texts.

Table III extends the comparison of reading data and shows the number of unique spaces shared between two readers as a proportion of the number of screens visited (*n*) by the readers.[2] It should be read as follows: "Reader *y* shares x% of the shared spaces, as a proportion of Reader *y*'s total number of unique screens, with Reader *x*". The figure in brackets is the actual number of spaces shared by any two readers. For example, it can be seen that Readers 1 and 2 share 30 spaces: Reader 1 has 94 unique spaces and shares 32% of the total number of those spaces with Reader 2; Reader 2 has 58 unique spaces and shares 52% of the total number of those spaces with Reader 1. Another way to say this is that Reader 1 "participates in" 52% of Reader 2's text, while reader 2 "participates in" 32% of Reader 1's text. Once again it should be obvious that, in pedagogical situations, this kind of information would be an invaluable aid to tutors and students. The critic, on the other hand, might use the data to evaluate the social context of various readings. For example, it can be seen that Readers 3 and 4 share only 8% of their text, and the critic may well ask what it is about Reader 3's and 4's readings that leads them to apparently quite different experiences of the text. Only Readers 2 and 5 share more than half their visited spaces with another reader. This tool refines still further the focus of shared experience by quantifying the actual amount of text, in terms of spaces, shared by any two readers.

Table IV shows the spaces shared by all readers along the top. Of the 200 screens visited, out of a total of 539 in *Afternoon*, **only three are shared by all readers**. The "Visits" column shows the number of times the reader has visited the space and the "Time" column is the total time spent viewing the space for the duration of the reading session. The thirty-minute session is, of course, a limiting factor

Table IV. Spaces visited by all readers

| Screen | Begin | | Yes6 | | yesterday2 | |
Reader	Visits	Time	Visits	Time	Visits	Time
1	1	0:00:15	1	0:00:04	4	0:00:22
2	1	0:01:47	1	0:00:07	2	0:00:49
3	2	0:00:58	1	0:00:43	1	0:00:28
4	2	0:00:28	3	0:00:11	3	0:00:34
5	3	0:00:56	3	0:00:56	1	0:00:16

in this study. More time would be desirable, although there is some evidence that increased exposure would simply lead to much higher recursal rates before having any impact on coverage. This statistic is perhaps the most remarkable demonstration of how the stable referent is compromised, and of the problems that might be encountered by a critical assumption of that referent in hyperfiction reading.

Table V shows the significance of the correlation between the speed of reading and space length. There is a significant parametric (r) and non-parametric (r_s) correlation of reading speed and space length for all readers. The correlation scores are all positive, suggesting that an increase in space length is proportional to an increase in reading rate. In other words, Readers 2, 3 and 5 read longer space lengths at a significantly greater speed than shorter ones (Reader 2 $r = +0.465$, $n = 81$, $p < 0.01$, two tails; Reader 3 $r = +0.408$, $n = 98$, $p < 0.01$, two tails; Reader 5 $r = +0.439$, $n = 101$, $p < 0.01$, two tails). Readers 1 and 4 also showed a significant correlation between space length and reading speed although at a lower level of significance (Reader 1 $r = +0.364$, $n = 166$, $p < 0.01$, two tails; Reader 4 $r = +0.214$, $n = 159$, $p < 0.01$, two tails). However, although there is a low level of significance for all readers, as Greene and D'Oliveira point out, "If a researcher is investigating a very large number of subjects, a quite low correlation might turn out to be significant" (1999, p. 78). To investigate the impact of recursals and skipped screens on the significance of the correlation, a further test was run on Reader 4's data set with those screens omitted. The result was found to be not significant in this case ($r = +0.228$, $n = 66$, $p > 0.05$, two tails). To ascertain whether this might be the same for the other readers, the same test was applied, with skipped screens and recursals omitted, on Reader 3's data set, since this Reader showed the lowest correlation of the three undergraduates (Readers 2, 3 and 5). In this test, the significance of the correlation increased slightly ($r = +0.422$, $n = 81$, $p < 0.01$, two tails).

Figure 1 shows a multiple recursal trend for two readers with the highest number of recursals, Readers 4 and 5. Unlabelled trend lines relate to Reader 5. Of particular note are the variations in the reading rate for the spaces "dream pools", which shows a decrease and increase, and "I want 1", where the trend is the

Table V. Correlation of speed and space length

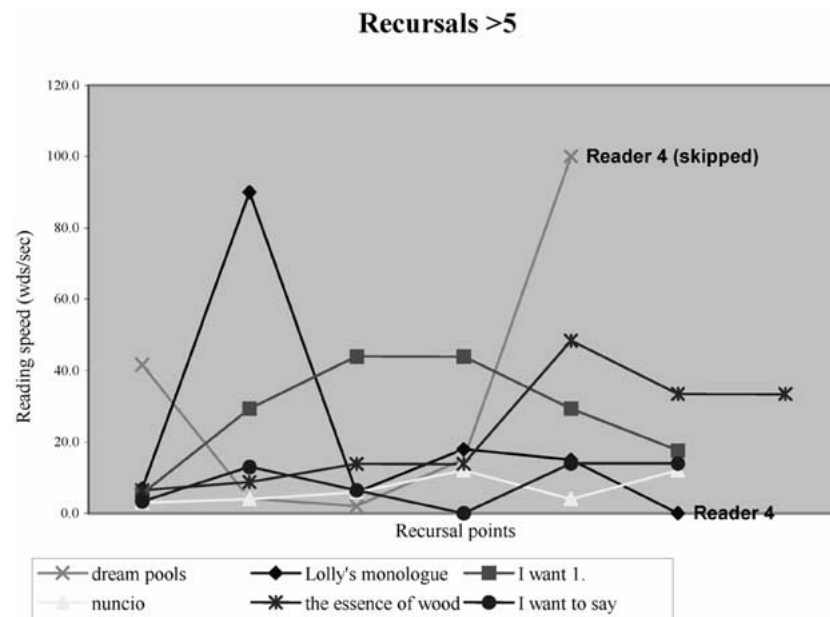| Reader	n	Correlation Parametric r	Correlation Non-parametric r_s
1	166	+0.364	+0.443
3	98	+0.408	+0.681
4	159	+0.214	+0.240
5	101	+0.439	+0.602

Significance at $p = 0.01$.

Figure 1. Recursal chart for points greater than five.

opposite: gradual increase followed by a gradual decrease. From the above graph, it is possible to tabulate broad classifications of the different kinds of recursal behaviours.

In Table VI, the types can be combined so that, for example, in Figure 1 above, "dream pools" is BA, "I want 1" is AB, "nuncio" is C and "Lolly's Monologue" is type D. It was felt that further analysis of recursal patterns would only be useful with significantly higher levels of recursion, through either a longitudinal study or one involving a greater number of participants.

Table VII shows a common sequence (shared thread). Such threads frequently occur between readers and this table provides the focus for more detailed comparisons between readers as a basis for narrative context analysis.[3] Column 2,

Table VI. Classification of recursal pattern

Type	A	steady increase
Type	B	steady decrease
Type	C	constant
Type	D	no discernible trend

"Context", is the sentence from which the reader chose the link. Column 3, "Selection", details the nature of the selection, and the final column, "Part of speech", records the grammatical function of a word in the text.

The "thread", italicised in the table, contains three spaces and occupies a different place within the text of each reader's discourse. For example, Readers 1, 2 and 4 arrive at "self destruction" from "monsters", Reader 5 from "obligations". For Readers 1 and 4, the outcome is the result of a default choice, whereas for Reader 2 it follows the choice "Wert". In "self-destruction", both the space title and the overt reference to Mary Shelley's *Frankenstein* suggest an unleashing of sinister, possibly uncontrollable forces: "Someone said all films affirm capitalism; thus they save him from her, no?". The apparently comical mixing of frames in this space – the fictional creature is murdered in order to save it from the ideological system in which it is embedded – appears as the narrator's wry comment upon venture capitalism. This is apparently confirmed when, in the following space, the narrator ruminates on Peter's misdirected allegiance to Dataquest:

> Because he fears Dataquest, he gives it value. He should instead understand that it is merely what other men do, what money does. Money needs to build these complicated systems for itself: options, calls, margins, puts, expert systems . . . ("The Good Soldier").

At "Dream Pools", Reader 1 chooses "dollars" which, in the immediate context, refers to money paid by a client (trick) to a prostitute. However, the narrator uses this metaphor of sexual conquest to characterise grand schemes that merely satisfy the desire to "conquer time with money" (dream pools'). In the narrative context (that is, taking into consideration the previous screens in the reading) the reader's choice coincides with these latent signifieds of the text, first through acquiescence (default), then through activating what appears to be a key idea. The choices of Reader 2 set out an emphasis on the discovery of identity or relationships between characters, choosing personal pronouns and proper nouns, before apparently bailing out at "Dream Pools" through the "History" tool. However, there is no "felicity" between the expectations of this reader and the outcome programmed by the author (there is a single link joining these three spaces). Despite this, meta-interpretation recognises that in this space identity has been expressed as somehow important. The exact nature of that "somehow" is a natural limit of inference to which the method must submit itself. Reader 4 enjoys use of the default, then

Table VII. Shared threads

Space	Context	Selection	Part of speech
Reader 1			
Lovers		Default	
touching myself		Default	
monsters		Default	
self-destruction		Default	
The Good Soldier		Default	
Dream pools	I think they merely want to see it with their own eyes, the waste, the result of dollars spent and minutes gone.	Dollars	Noun
star wars	I think these lasers and starship and particle beams will be this way, a comet's spew of silvery water into mother's belly.	Comet's	Noun
Reader 2			
Brown		Default	
touching myself		LINK	
monsters	He fears this project, and fears Wert even more.	Wert	Noun Proper
self-destruction	thus they save him from her, no?	her	Pronoun
The Good Soldier	The point is Peter needs to be saved from this sensitivity he has, for in sustaining it, he also sustains the value of what he fears most, do you see?	Peter	Noun Proper
Dream pools		HISTORY	
What I say		LINK	
Reader 4			
Lovers		LINK tool	
touching myself		Default	
monsters		Default	
self-destruction		Default	
The Good Soldier	People will still walk along roadsides and search for baby's breath and loose strife.	Baby's	Noun
dream pools		BACK	
The Good Soldier		Default	
dream pools		Default	
star wars		Default	
Reader 5			
obligations	She recites: "Too much reality can be a dazzle, a surfeit . . ."	dazzle	Noun (verb)
self-destruction		YES	
The Good Soldier	Because he fears Dataquest, he gives it value.	Dataquest	Noun proper
dream pools	Do you know what I think of when I think of Dataquest or Star Wars?	Dataquest	Noun proper
star wars		HISTORY	

Table VII. Continued

Space	Context	Selection	Part of speech
dream pools	Do you know what I think of when I think of Dataquest or Star Wars?	Star	Noun (adj)
star wars	Consider the possibilities: the value of all the world can be somehow quantified.	HISTORY	
dream pools	It is like Star Wars, exactly.	Star	Noun (adj)
star wars		HISTORY	
dream pools	Do you know what I think of when I think of Dataquest or Star Wars?	wars	Noun
star wars		YES	
Lolly's monologue	An accident often occurs both spatially and temporally at the location where, for psychic reasons, it should.	accident	Noun
1/		YES	

chooses "baby's". The critic cannot know what the reader intended with this selection but can meta-interpret what this selection can mean in the immediate context of the space and the overall context of the thread. In this case it signifies humanity's enduring interest in self perpetuity standing in marked contrast to that implied by "self-destruction": "People will still walk along roadsides and search for baby's breath and loose strife" ("The Good Soldier"). Reader 5 responds with the "Yes" button to the question "Someone said all films affirm capitalism; thus they save him from her, no?", giving a clear indication of dialogue within the interaction. Repeated selection of "Dataquest" suggests that, for this reader, there is an expectation that the word is somehow loaded and, ironically (the reader's own quest for data is reflected in it) will yield some interesting perspective.

To interpret at a distance, to "meta-interpret" what these selections are doing in the context of a reading, moves us closer to a stylistics of reader response. Just as authors might be said to be exercising choices in the content and structuring of the text, deciding which words to use for link anchors, so the reader is, within limits, similarly anchoring expectations within the navigation of this text by making specific linguistic choices. Of course, the nature of those choices is subject to many variables in behaviour and in the use of the mouse in selections, and the position of selections within the context of the screen can be used as a useful measure of the conditions under which choices are made.

Table VIII shows selection data and mouse activity immediately prior to intervention.[4] Although there are few data available for the chosen thread, they are sufficient for demonstrating the usefulness of the technique. The selection data give an indication of the position of the selection within the immediate context of

Table VIII. Selection data and mouse activity

Space	(a)	(b)	(c)	(d)	Sentence type	Selection position	Mouse prior to selection
Reader 2							
Brown							Default
Touching myself							LINK
monsters	3	2	3	1	Complex	Medial	Skid
self-destruction	3	3	4	4	Complex	Medial	Waver
The Good Soldier	4	1	2	2	Complex	Medial	Skid
Dream pools							HISTORY
what I say							LINK
Reader 4							
Lovers							LINK
Touching myself							Default
monsters							Default
self-destruction							Default
The Good Soldier	4	3	3	3	Complex	Medial	Roundabout
Dream pools							BACK
The Good Soldier							Default
Dream pools							Default
star wars							Default
Lolly's monologue							
Reader 5							
obligations	5	5	1		Simple	Medial	Waver
self-destruction							YES
The Good Soldier	4	2	3	1	Complex	Medial	Roundabout
Dream pools	2	2	4	1	Complex	Medial	Beeline
star wars							HISTORY
Dream pools	2	2	4	1	Complex	Medial	Beeline
star wars							HISTORY
Dream pools	2	1	5	1	Simple	Medial	Skid
star wars							HISTORY
Dream pools	2	2	4	1	Complex	End	Roundabout
star wars							YES
Lolly's monologue	5	5	1		Simple	Medial	Beeline
1/							YES

a) Number of text units in space.
b) Position of selected text unit.
c) Number of syntactic units in selected text unit.
d) Position of selected syntactic unit in selected text unit.

the space. There is no discernible pattern in Reader 2's data. For example, the first selection at "monsters" is in the middle text unit of the space, the second in the last text unit and the third in the first. The second and third selections are, however, both in the last sentence unit of the text unit. Reader 4 made a choice only at "The Good Soldier". All three readers chose different text units when navigating this space. Reader 5 made identical selections at "dream pools" for the first two visits, changed to the first text unit while choosing a simple syntactical unit, before changing back to the second text unit while changing the focus of the selection to the "End" position.

The mouse data show varying degrees of assertiveness with which readers made these selections, ranging from roundabout movements to beelines. Roundabouts suggest uncertainty or prolonged consideration; beelines, on the other hand, suggest direct choices. The waver is a more definite uncertainty than the roundabout, since there are usually only two elements contemplated by the reader.

4.1. THE USE OF COMMUNICATIVE DYNAMISM

In considering "The Rhetoric and Stylistics of Writing for E-Space", Landow recognises that the content of writing itself, as much as the software or system design, can significantly affect disorientation: "Linking, by itself, is not enough" (1997, p. 123). The implication is that use of language, not just formal navigational functions, will affect the navigation of the text. It would be natural for a reader to think that the actual words used to highlight link anchors in a page of hypertext will coincide with something the author wishes to communicate. For example, in the sentence, "Of interest to the reader will be the works of Jan Firbas", highlighting "the works of Jan Firbas" will communicate a different message than "Jan Firbas". In the first case, a reader might expect a bibliography or review, whereas in the second, a biography. Where there are no highlighted links, as is the case with *Afternoon*, it is up to the reader to choose the link word and, in doing so, s/he focuses analysis on the function of that choice in the context of the reading.

The principle of communicative dynamism (CD), which is given cogent form in Jan Firbas (1979; see also Firbas, 1992, 104ff.), can be applied to the selections of readers to ascertain how far the selections coincide with the informational stress in a sentence:

> It can be said that the degree of CD carried by a linguistic element is the relative informational (communicative) value the element acquires in the development of the communication. Informational (communicative) value or importance can, of course, be judged from various viewpoints. The viewpoint applied in my approach to FSP [functional sentence perspective] is the place an element takes up in the development of the communication, the completion of this development coinciding with the fulfilment of the communicative purpose. The closer an element comes to this completion, the greater its informational (communicative) value or importance (p. 105).

Table IX. Selection focus data for readers

	Focus information				
	Reader 1	Reader 2	Reader 3	Reader 4	Reader 5
Initial	3	9	4	0	3
Medial	36	42	20	11	36
End	14	23	8	1	12

In other words, we can consider how far the reader's choice coincides with the element that completes the communicative purpose of the sentence and, by extension, the importance attached to that information by the author. For example, in Reader 5's interactions with the space "dream pools", the element "Dataquest or Star Wars" comes at the end of a sentence in the middle of the space. The principle of end focus is such that information value in a sentence increases from low at the beginning to high at the end: the sentence appears to display this characteristic and the reader appears to have picked up on this. In actual fact there is only one link from "dream pools" to "star wars", so any word choice would have had the same result. However, what is interesting is the coincidence between the author's structuring and the reader's selection. By applying focus markers (I: Initial, M: Medial, and E: End) to the selections, and observing the relative importance of elements within the sentence, it is therefore possible to ascertain to what extent a reader may be reacting to the position of information within the sentence.

Table IX extends the selection data in Table VIII and shows that, while M is by far the most usual position for selections, the incidence of E is greater than I for all readers, which may indicate that readers have made selections according to the end-weight principle. The table also shows considerable variation between readers but a remarkable coincidence in the selection profiles of Readers 1 and 5. What is most interesting, of course, is that very few of the selections made by all readers choose words that occur at the beginning of the sentence.

Table X shows that noun selections are more numerous than any other word type across all readers, followed by proper nouns, and then adjectives for four of the five readers. Reader 2 differs in having more verbs than adjectives.

Table XI represents a thematic summary of the first ten spaces of the reader's narrative path at the beginning of their readings. It can be seen that each reader has a completely different experience of the text. Reader 2 displays what seems to be the most coherent thematic experience, although Reader 5 has a broader range of themes and shares more with other readers.

Table X. Selections according to grammatical function

	Part of speech information				
	Reader 1	Reader 2	Reader 3	Reader 4	Reader 5
noun	41	45	25	10	43
noun proper	12	22	11	2	8
adjective	5	9	2	2	2
verb	2	12	2	0	6
adverbial	2	0	1	1	0
pronoun	0	6	3	0	0
numeral	0	1	0	0	0
article	0	0	0	0	0

Table XI. Themes in first ten screens

Thematic summary	Readers
Lovers' dialogue	1, 3, 5
Confessional monologue	1, 5
Death–enigma	2, 5
Death–anecdotal	2
Retrospective analysis of marriage	2
Death–symbolic	2
Cold/winter	3
Heat/summer	4
Poetic prose	5

4.2. SUMMARY OF READER AND TEXT INTERACTIONS

Aarseth (1997) comments that *Afternoon* "relentlessly leads the reader in labyrinthine circles", "alienate[s] the reader" and "turns into a dense, multicursal labyrinth, [where] the reader becomes not so much lost as caught, imprisoned by the repeating, circular paths and his own impotent choices" (pp. 89–91). However, the variation shown in the experiences of readers, in terms of recursals, selections, and outcomes, demonstrates that to speak of "a reader" is not as straightforward as Aarseth might lead us to believe. Furthermore, although we share the same declared intention of looking at "the text at work" as a means of overcoming the limitations of a purely structural approach, Aarseth seeks to accomplish this by uncovering "intrinsic tropes and figures" (p. 90), whereas I have taken readers themselves in

an attempt to examine some of the claims made about *Afternoon* in the context of readings and real readers.

Both Edward Falco (1995) and Joyce invoke notional readers to introduce their texts, and it is interesting to compare these readers with actual readers whose activities are referred to in this study. Falco's "conscientious reader" is one who systematically searches the text, hoping to cover all there is to see using a sequential and logical system, while Joyce's "playful" reader is more interested in exploring the textures of words. Readers 2 and 5 made the highest proportion of interventions yet did not cover as much of the text as Reader 1, who had the lowest intervention rate, but the highest number of unique screens. In fact, excluding the results for Reader 4, the number of interventions is inversely proportional to the number of unique screens: the more defaults, the greater the coverage. So much for Joyce's playful reader. But do the playful readers fare any better in other ways? In terms of the spaces shared between readers, Table III shows that Reader 2 shares about the average amount, Reader 5 slightly higher than the average but, once again, Reader 1 shares the highest proportion of the shared spaces with all other readers. A reader interested primarily in exploring the interface and searching for boundaries seems to share less. Reader 4 was interested in establishing the boundaries of the text and in arranging various windows, and seems to show signs of clear discomfort in the environment. This observation is confirmed in the Reader's debrief. In response to one of the questions in the debrief, which relates to feeling lost in the text, Reader 4 replied that more effort went into finding links and paths than content. It is clear from the reading log that a high number of screens towards the end of the session were simply skipped. The thematic summary for Reader 4 shows that, in the ten spaces after "begin", the reader had not been introduced to any of the themes of the story shared by many other readers.

Finally, it is interesting to note that readers who showed the most significant correlations between reading speed and space length (Readers 2, 3 and 5) are the three English Literature undergraduates. The lowest correlations, though still significant (bearing in mind the large volume of data), are those of the academics (Readers 1 and 4). It must be remembered, however, that these tests do not, in any way, provide causal explanations for behaviours. They merely illustrate trends and suggest possible relationships and associations between various factors.

5.   Problems of the Meta-Interpretive Method

Meta-interpretation uses linguistic frameworks that stipulate the nature and distribution of information in a situation and applies these to the choices made by readers as they navigate the text. An important component of the method, therefore, is the steps taken to ensure that analysis is confined to areas in which the reader can be seen to be processing information. Interpretation is not an exact science and below is an attempt to anticipate some of the grounds upon which some will wish to remain sceptical.

5.1. THE CAMERA EFFECT

The reader may be conscious of presenting a particular kind of reading to the researcher by selecting some words and not others. One reader in this study made full use of the note tool, writing comments about the difficulty of navigation. Since this was a one-off reading study, who could the notes have been intended for if not the researcher?

5.2. RANDOM SELECTION

There is no way of knowing whether a selection is the result of a spontaneous or a considered action on the part of the reader – even where an inordinate length of time has been spent reading a particular screen. It is for this reason that various confidence measures were introduced into the analysis. The method is not designed to demonstrate the internal workings or state of a reader's mind at any point in the reading process, and debriefing questions, used elsewhere, have been used to more usefully fulfil that function. Instead, the critic can bring into consideration: the manner in which selections are made using the mouse data (did the reader waver between two words?); the selection position in terms of information focus (were readers choosing significant "information units"); part of speech information (were readers selecting words according to their grammatical function and did those selections conform to any recognisable pattern?). The pattern of selections according to grammatical function appears to show a remarkable coincidence, although further analysis would be necessary to demonstrate whether the selections were statistically significant. They may, for example, merely reflect the relative frequencies of parts of speech in the text. Further research along similar lines will reveal more about textual engagements with this form.

5.3. "OVERINTERPRETATION"

If we concede that the reader can make arbitrary selections without any form of mentation, might we not regard meta-interpretation as futile, more a case of over-interpretation? It is possible to think of any activity, even one that we would normally categorise as "random", as motivated. Such activity, if no interpretive strategies can be attributed to its performer, may be the result of boredom. (In one reading, there is a five-minute period in which there is no screen activity whatsoever – a long time to spend staring at a few words on a screen. Was the reader more interested, perhaps, in the books on the shelf above the computer? Was something more interesting going on outside?) I do not attempt to account for such activities here, since the main aim of the study is to analyse text – reader interactions. No claim is made to be investigating what is going on in the mind of the reader, only what impact certain readings might have on interpretation. Since the locus of interest in this study is the text and the ways that reading can bring out

aspects unrecoverable by the critic, such a project would fail to address the initial problem – that of the unstable referent.

6. Conclusion

Hardman *et al.* (1999) observe that most systems do not have time controls and therefore do not give time control to authors and designers. If they did, using reading times as a confidence measure in meta-interpretation would be pointless. Perhaps the increased development of functionality by designers and authors would, ultimately, work against the kinds of feedback that system designers would like to see and depend upon. For example, the rubric for a hypertext designers' conference panel states that system and design aspects of hypertext "have not explicitly incorporated user expectations, nor explicitly considered the ways in which both writers and readers will use these systems" (Westbomke *et al.*, 1999, p. 198). The provision of "design criteria for shaping the stories" is a contentious issue that brings to the forefront issues of technical literacy and reintroduces debates over authorial and artistic integrity. For the time being, however, the open-endedness of "imperfect" systems is at least useful to those seeking to infer meanings from behaviours.

The method is presented here in outline and represents the first stage of a continuing process of development and refinement. Some of the data are presented in a somewhat perfunctory manner, since the aim has been to describe the basis of meta-interpretation, to exemplify some of the techniques that may be used, and to outline some of the considerations and principles informing the study. The next stage in developing this method envisages extending the range of readers and extending and refining the links between the structural analysis of the text and discourse and pragmatic aspects. A more detailed theoretical account of the linguistic features of interaction from a critical perspective, and a sustained analysis of interesting empirical aspects are two clear directions for research. With large hypertext structures it may also be possible to incorporate visualisation techniques to show the combined relationships between spaces and the reader's navigation. In *Creative Imagination*, Downey observed that:

> Even an inadequate survey of the range and nature of the variational factor in the response of individuals to art, should, it would seem, be of value to critic, teacher and philosopher (Downey, 1929).

It is in this spirit that I have used meta-interpretation, treating the responses of real readers as an expression of the ergodic aspects of the hyperfiction novel, and opening up analysis to the dynamic aspects of the text.

Acknowledgements

Notes

[1] Available http://www.cc.gatech.edu/gvu/user_surveys/. See Schmidt, 1997 for discussion of benefits of Web surveys.

[2] The method of calculation is complex and unnecessary to record here. For an example of a method than can be used, see my PhD thesis "Versions of Interactivity: A Theoretical and Empirical Approach to the Study of Hypertext Fiction". The Bakhtin Centre, University of Sheffield, February 2002 (unpublished).

[3] As with the figure for shared spaces above, the method for calculating shared threads across all five readers was a complex problem with this particular arrangement. See note 2.

[4] Data for reader 1 were not available and it is possible that the reader inadvertently hit a function key that de-activated the screen recording software.

References

Aarseth Espen J. (1997) *Cybertext: Perspectives on Ergodic Literature*. Johns Hopkins University Press, Baltimore.

Bernstein Mark (1998) *Patterns of Hypertext*. Available: http://www.eastgate.com/patterns/Patterns. html. 27 July 2000.

Calvi Licia (1999) "Lector in Rebus": The Role of the Reader and the Characteristics of Hyperreading. *Proceedings of the Tenth ACM Conference on Hypertext and Hypermedia: Returning to our Diverse Roots*, Darmstadt. ACM, New York, pp. 101–109.

Douglas J. Yellowlees (1994) "How Do I Stop This Thing?": Closure and Indeterminacy in Interactive Narratives. In George Landow (ed.), *Hyper/Text/Theory*, Johns Hopkins University Press, Baltimore, pp. 159–188.

Douglas J. Yellowlees (2000) *The End of Books – Or Books Without End?: Reading Interactive Narratives*. University of Michigan Press, Ann Arbor.

Downey June Etta (1929) *Creative Imagination: Studies in the Psychology of Literature*. Kegan Paul, London. Republished 1999, Routledge, London.

Eco Umberto, Richard Rorty, Jonathan Culler, Christine Brooke-Rose (1992) In Stefan Collini (ed.), *Interpretation and Overinterpretation*, Cambridge University Press, Cambridge.

Falco Edward, *A Dream with Demons*. Eastgate, Watertown, MA.

Firbas Jan (1979) A Functional View of "Ordo Naturalis". *Brno Studies in English*, 13, pp. 29–59.

Firbas Jan (1992) *Functional Sentence Perspective in Written and Spoken Communication*. Cambridge University Press, Cambridge.

Gardner Colin (February 2002) *Versions of Interactivity: A Theoretical and Empirical Approach to the Study of Hypertext Fiction*, PhD thesis (unpublished). The Bakhtin Centre, University of Sheffield.

Greenbaum Sidney, Quirk Randolph (1990) *A Student's Grammar of the English Language*. Longman, Harlow.

Greene J., D'Oliveira M. (1999) *Learning to Use Statistical Tests in Psychology*. Open University Press, Buckingham.

Hardman Lynda, van Ossenbruggen Jacco, Sjoerd Mullender K., Rutledge Lloyd, Bulterman Dick C.A. (1999) Do you have the Time? Composition and Linking in Time-based Hypermedia.

Proceedings of the Tenth ACM Conference on Hypertext and Hypermedia: Returning to our Diverse Roots, Darmstadt. ACM, New York, pp. 189–196.

Holland Norman N. (1989) *The Dynamics of Literary Response*. Columbia University Press, New York.

Joyce Michael (1990) *Afternoon: A Story*. Eastgate, Watertown, MA.

Joyce Michael (1995) *Of Two Minds: Hypertext Pedagogy and Poetics*. Studies in Literature and Science. University of Michigan Press, Ann Arbor.

Koskimaa Raine (1998) Visual Structuring of Hyperfiction Narratives. *Electronic Book Review* 6. Available: http://www.altx.com/ebr/ebr6/6koskimaa/6koski.htm.

Landow George P. (ed.) (1994) *Hyper/Text/Theory*. Johns Hopkins University Press, Baltimore.

Landow George P. (ed.) (1997) *Hypertext 2.0: The Convergence of Contemporary Critical Theory and Technology*. Parallax: Re-Visions of Culture and Society, 2nd edn. Johns Hopkins University Press, Baltimore.

Leech, Geoffrey (1983) *Principles of Pragmatics*. Longman Linguistics Library 30, Longman, London.

Liestøl Gunnar (1994) Wittgenstein, Genette and the Reader's Narrative in Hypertext. In George Landow (ed.), *Hyper/Text/Theory*, Johns Hopkins University Press, Baltimore, pp. 87–120.

McGann Jerome J. (1991) *The Textual Condition*. Princeton University Press, Princeton, NJ.

McKnight C., Dillon A., Richardson J. (eds.) (1993) *Hypertext: A Psychological Perspective*. Ellis Horwood, London.

Moulthrop Stuart (1997) *Hegirascope 2.0*. Available: http://raven.ubalt.edu/staff/moulthrop/hypertexts/HGS/.

Rau Anja (1999) Towards the Recognition of the Shell as an Integral Part of the Digital Text. *Proceedings of the Tenth ACM Conference on Hypertext and Hypermedia: Returning to our Diverse Roots*, Darmstadt. ACM, New York, pp. 119–120.

Ricoeur Paul (1985) *Time and Narrative*. Trans. Kathleen McLaughlin and David Pellauer. 3 vols, Vol. 2. University of Chicago Press, Chicago, Ill.

Rouet Jean-François, Levonen J.J., Dillon A., Spiro R.J. (eds.) (1996) *Hypertext and Cognition*. Lawrence Erlbaum, Mahwah, New Jersey.

Rouet Jean-François, Passerault J.-M. (1999) Analyzing Learner Hypermedia Interaction: An Overview of Online Methods. *Instructional Science* 27: 201–219.

Schmidt W.C. (1997) World-Wide Web Survey Research: Benefits, Potential Problems, and Solutions. *Behavior Research Methods, Instruments and Computers*, 29.2, 274–279.

Tosca Susana Pajares (1999) The Lyrical Quality of Links. *Proceedings of the Tenth ACM Conference on Hypertext and Hypermedia: Returning to our Diverse Roots*, Darmstadt. ACM, New York, pp. 217–218.

Trigg Randall (1983) A Network-Based Approach to Text Handling for the Online Scientific Community. Available: http://www.parc.xerox.com/spl/members/trigg/thesis/thesis-chap4.html.

Walker Jill (1999) Piecing Together and Tearing Apart: Finding the Story in Afternoon. *Proceedings of the Tenth ACM Conference on Hypertext and Hypermedia: Returning to our Diverse Roots*, Darmstadt. ACM, New York. pp. 111–117.

Westbomke Jörg, Wiil Uffe K., Leggett John J., Tochtermann Klaus, Haake Jörg M. (eds.) (1999) *Proceedings of the Tenth ACM Conference on Hypertext and Hypermedia: Returning to our Diverse Roots*, Darmstadt. ACM, New York.