

Examining Users' Repertoire of Internet Applications

Jon Rimmer¹, Ian Wakeman¹, Louise Sheeran² & M. Angela Sasse²

¹ School of Cognitive and Computing Sciences, University of Sussex, Falmer,
Brighton BN1 9QH, UK.

² Department of Computer Science, UCL, Gower Street,
London WC1E 6BT, UK.

jonr@cogs.susx.ac.uk

Abstract: The language within user interfaces should match the language of the user. However, there has been very little work on how to capture this language and in particular, the lexicon of the user. In this paper we describe how the tools from discourse analysis can be used to capture these lexicons, and show how they vary according to the function of the text. We conducted semi-structured interviews and questionnaires to collect texts for analysis. Analysis showed a variety of repertoires used to describe typical network applications, such as email and web use. We present these repertoires and describe how they can be used in the design of the user interface.

Keywords: discourse analysis, repertoire, conceptual design, internet interfaces, email, Web.

1 Introduction

According to New Media, Inc there will be one billion Internet users by the year 2001 (Emerge Incorporated, 1998). With this influx of new users of varying experience, and the majority of use being associated with email and web applications, it is important that these applications are well designed to be highly usable. Since networks are prone to breakdowns in interesting ways, applications should also educate users to employ appropriate recovery strategies. This can only be done by communicating a pertinent model of the network to the user through the interface, training, and help facilities. For this education to be effective we must use the language of the users.

This requirement is emphasized in heuristic evaluation. This evaluation technique is the most popular of the usability inspection methods, carried out as a systematic inspection of a user interface design. The goal of heuristic evaluation is to find the usability problems in the design so that they can be attended to as part of an iterative design process. (Nielsen, 1994). The second of Nielsen's 10 Heuristics is:

Match between system and the real world The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system- oriented terms. Follow real-

world conventions, making information appear in a natural and logical order.

However, there has been very little work on how to discover exactly what this language is. Most designers guess what language is appropriate, and then adjust the language (if at all) when evaluating and testing against users. In this paper we describe a methodology and theoretical framework for capturing and analysing and creating lexicons of actual user language about specific applications.

Some studies of discourse have been carried out in the field of Human Computer Interaction, but most concentrate on how language is used to get tasks done in order to understand communication patterns, rather than the actual content itself. Good examples of such work are those carried out by Clark & Shaefer (1989), and McCarthy et al. (1991). However, the closest related work to this study is in the field of mental model elicitation. Norman (1986) explains how the designer has a working model of the system she has designed, and that the user learns to use it through interaction (and possibly instruction too), forming a working model of that system. Problems are likely to occur when the working model is inappropriate increasing the probability that the error rate is high and recovery rate poor. These mental models are internalized cognitive representations and therefore

not directly observable. They are inferred from a range of observable behaviours displayed by the user. A description of users' models will be a researcher's externalized conceptualization of user's internalized models (Sasse, 1997). Over the last decade there have been numerous studies and books published in the field of cognitive science that have examined for the existence of mental models and how they can be used, adapted and influenced. Sasse (1997) carried out an extensive review of this work and was critical of over reliance on performance data as an indication of models. The few studies that have analysed verbal protocols offer no clear description of how models are inferred from them or give any indication as to how transcripts were analysed.

This paper deliberately does not define what mental models are in the context of network applications, as we are interested in the examination of users' language using the method of discourse analysis proposed by Potter & Wetherell (1987). We shall explain our methodology through example, which we feel can be put to use in many other contexts. Having carried out this study, we firmly believe that the process of conceptual design would benefit greatly from use of discourse analysis, and this will become apparent throughout the paper.

A definition of discourse has been debated by psychologists, linguists and researchers from other disciplines. Potter & Wetherell (1987) discuss the broad term 'text', which can cover anything that is put into words, and as such becomes discourse. Discourse analysis is concerned with the content of the text, its subject matter and with its social rather than linguistic organization (Edwards & Potter, 1992). This paper takes the position that discourse analysis treats the social world as a system of 'texts' that can be systematically 'read' by the researcher whether it be talk or writing. In fact it is believed that it can be taken even further, to analyse the 'design language' of any artefact or interface. For example, Bannister (1994) carried out discourse analysis on a children's toothpaste packaging which had both words and pictures, as well as shape and form.

Design language denotes the visual and functional language of communication with people who use an artefact. Design language is like a natural language, both in its communicative function and in its structure as an evolving system of elements and of relationships among those elements (Winograd, 1996). Design language is the basis for how we create and interact with things in the world (Rheinfrank & Evenson, 1996).

Language, both natural and design, only

works because people share a 'complex symbolic representational system' which is inevitably involved in our thinking and reasoning as well as our communication with others. The interpretative repertoire is basically "a lexicon or register of terms and metaphors drawn upon to characterize and evaluate actions, events, and other phenomena. A repertoire is constituted through a limited range of terms used in a particular stylistic and grammatical constructions. Often a repertoire will be organized around specific metaphors and figures of speech", (Potter & Wetherell, 1987).

We are using the tools of discourse analysis to expose the interpretative repertoires found when people discuss network applications. By building lexicons from the interpretative repertoires people employ within their natural language, we are offering the raw material from which the design language of the interface can be built.

One of the benefits of the discourse approach to categorization is that it has directed attention away from the cognitive processes assumed to be operating under people's skulls and on towards the detail of how categories are actually used. It is not surprising that categories are so important, because they are the nouns from which we construct versions of the collectives in which we live (Potter & Wetherell, 1987). In this study, we have aimed not to hypothesize about cognitive processes, but instead to create a concrete resource from users' texts for use within the design process of interactive network applications.

In the next section we present our methodology and then our results. These describe various repertoires used to explain networked applications. We discuss how these results can be used in the design process and conclude with future directions for this methodology.

2 Methodology

2.1 Considerations

For this particular study, we chose not to look at the repertoires of very inexperienced computer users after examining the results of our pilot study in which we have talked to participants who had little or no knowledge of email and the web (many of whom refused to even guess a response to the scenarios). Many of the new users of the Internet will already have some degree of computer literacy even if based on knowledge gained through cultural experiences of media, interaction with similar devices/existing interfaces, communications with friends and colleagues, education, and training.

2.2 Participants

The data for this study was collected from texts elicited from 32 participants, and consisted of 19 semi-structured interviews which were then transcribed, and 13 written responses to an informal questionnaire asking the same scenario questions. The people who participated in this study were system administrators for two organizations, postgraduate students, administrative office assistants, medical doctors, as well as Internet Service Provider HelpDesk staff. Experience of email use ranged from 3 months to 8 years and web usage from 2 weeks to 6 years — see Figure 1.

Participant	Age	Internet usage Hours/ week	Email Experience Years or (months)	Web Experience Years or (months)
1	22	1.5	2	2 (weeks!)
2	53	10	6	6
3	38	12	6	3
4	27	2	7	3
5	31	1	8	2
6	53	1	2	1
7	29	5	2	2
8	26	0.5	3	2
9	49	3	1.5	1.5
10	22	1	9 (months)	9 (months)
11	18	2	8 (months)	8 (months)
12	27	10	2	2
13	24	2	10 (months)	10 (months)
14	34	10	1	1
15	45	1	1	1
16	24	1	3	0.5
17	21	2	1.5	1.5
18	38	2	1.5	1.5
19	25	2	2	2
20	23	5	5	4
21	32	5	0.5	0.5
22	30	4	1.5	1
23	28	1	3	3
24	25	1	4	4
25	45	2	5	3
26	22	10	3	3
27	24	5	4	5
28	25	10	6	6
29	36	5	3 (months)	3 (months)
30	30	8	3	2
31	29	10	2	4
32	32	7	3	3

Table 1: A summary of the study participants' details.

2.3 Design

Two scenarios were devised to elicit a user's description of how email and looking at a web page works. These were then posed to the participants either verbally (semi-structured interviews), or in writing (simple informal questionnaire). The semi-structured interviews were based on the techniques described by Draper & Stribley (1991) who claim that this method of information elicitation has become one of the most important in social science. It allows discussion on the topic in whichever way seems natural and relevant to the interviewee, allowing exploration of the response by the interviewer. This method is far less limiting than the qualitative questionnaire, but more time consuming in that each individual interview has to be transcribed. A questionnaire has the advantage that it can be given to several people to complete at any one time and is returned as a ready made transcript, but misses out on the possible richness of exploratory follow up questions.

2.4 Scenarios

The scenarios were devised in an attempt to elicit a full response to the workings of email and web use. The content of each scenario posed had to ensure that country boundaries were crossed rather than, for example, sending a person a message who may be on the same network/intranet.

Email I want to send an email to my friend in Jamaica; what do you think happens to the message when I have composed my email and press the send button?

Web I want to look at a web site based in Alaska that has details on grizzly bears. What do you think happens after I have entered the site's address; from the moment I press return, to when I receive the web pages on my screen?

The questionnaire had an additional question asking the participant to describe a search engine:

Search Engine What is a search engine and how does it work?

2.5 Analysis

Two people working independently carried out separate analysis on the same data. Each person went over the transcripts several times using the technique of discourse analysis based on the methods suggested by Wetherell & Potter (1988).

The texts for this study were quite concise from the outset; three specific questions were being

asked, which inevitably produced answers relating to those questions. The process of coding the text was, therefore, more straightforward than many other studies of discourse. The first stage of coding, consists of each analyst identifying 'rough repertoires'. This can only be achieved by reading and analysing the text several times. In doing so, one can begin identifying patterns and organizations of words and highlight the metaphors employed. This enables the analyst to gradually build them up into more concrete themes that can be categorized, noting clusters of words that were associated with each repertoire. Finally the two analysts went over the transcriptions together in order to compare findings and check similarity. These were discussed and pooled together, producing a listing of the word clustering within the passages and noting the commonalities and exceptions.

3 Results

The repertoires were very distinct, and there were particular words that would almost always appear in a particular repertoire e.g. *Server* in the Computer Based repertoire. Below is a summary of the results showing the words listed in the Lexicon Used — see Figure ???. We do not want to claim that these lexicons are complete since in many ways this is chasing a moving target. However, they are exhaustive based on our texts. The words are listed in order of frequency of use.

Unfortunately, the word *message* was used in the email scenario. This may have influenced users. However, *message* was rarely used within telephony-based repertoires, and was found in instances of computer-based repertoire in both web and email scenarios, so we are reasonably confident that *message* is part of the computer-based repertoire.

In order to further explain the method of analysis and demonstrate results, we shall provide examples of each repertoire in use. In the following examples, repertoire words are highlighted in **bold**, whilst exceptions are *italicized*.

The computer-based repertoire is characterized by descriptions of 'networks' of 'servers' which 'route' 'messages' 'hop' by 'hop'. Sometimes, the description is enhanced by breaking the message into 'packets' or 'chunks'.

Computer Based Repertoire P32 "My machine sends a **request** to my **server** which sends it to the **server** where the site is stored (unless the pages are in some sort of **cache** somewhere on **route** or on my computer's **hard disk**) and eventually **components** of the page get sent to

my machine after it requests them."

In a telephony repertoire, the emphasis is on the telephone line and the attached visible modem, and the communication of information is via one phone call after another. The focus is often on the physical wires connecting the computers, and computers are often referred to as 'centres' or 'exchanges'.

Telephony Based Repertoire P6 "I should know this but I am aware that I don't really. When I press the send button it then goes to my local **centre** from which I have my email address, so it is a **local call**, 'phone call to my **centre** where *messages* are collected up and then **transmitted** to the foreign country wherever it is on there, across the **telephone cables, wires**. Via the **telephone**, put it that way . . ."

In the next example, the user is attempting to justify the time taken by email delivery. Whilst computers and telephone connections are fast, the postal system is slow, so they fall back on a postal repertoire. The mail is 'collected' and 'forwarded'. It is noticeable that the agent doing the work is not identified, possibly since identifying the agent as a computer would cause a contradiction between fast computers and slow delivery.

Postal Repertoire (as description) P20 "I guess it first goes to some place where all the '**out-going**' mails are **collected**, and then the **address** will be considered and **forwarded** to the appropriate place — some are instantaneous, some are not."

When the user is describing a process which they believe requires intelligence, the explanation is characterized by reference to some unidentified 'it', which performs the actions. This is particularly pronounced when used to describe the functioning of the web and search engines.

Agent Repertoire P10 "I think your **computer is searching** for the site first. I don't know why it doesn't come up straight away — it depends on **their connections** and **their modems**. When you press return, **it** searches for it, when **it** finds it, you can see it on your screen."

The specialist repertoires from electronics and computer networks are employed when the user can describe the underlying physical processes of the communication system. The emphasis is on using jargon from a particular technical field, most of which would be unknown to non-specialists. Obviously most users would not be able to employ these repertoires.

Use of Repertoire	Repertoires Identified	Lexicon Used
Description	Computer Based	message, packets, address, file, routes, server, databases, connection [†] , connect [†] , tags, matches, header, links, chunks, downloaded, request, trawls, packages, reassemble, access, cache, ping, zipped, cables [†] .
Description	Telephony Based	telephone line, dials up, modem, connection [†] , connect [†] , 'phone, directory, yellow pages, telephone socket, 'phone call, exchange, call, centre, transmission, switching telephone conversation, busy, connection, cables [†] .
Description	Agent	emphasis on the word 'it', searching, look up, finds, guide.
Description/Analogy	Postal	postal system, post office, letter, forwarded, mails, pigeonhole, collected.
Analogy	Transport	traffic, road, travel, aeroplane, scenic route, rush hour.
Analogy	Library	bookmarked, guide, subject index, library, catalogue.
Description	Electronic	electronics, modem, modulate, demodulate, digital, analogue, signal, on-off.
Description	Computer Network	Domain Name System (DNS), Network Interface Card (NIC), Point to Point Protocol (PPP), Internet Protocol (IP), bandwidth, routing table, buffer, port, protocols, packets, labels, hops, reassembled, dial-up.

Table 2: Identified repertoires and associated Lexicons. [†] Denote instances where a word can be seen as common to both the Telephony and Computer Based Repertoires.

Electronics Repertoire P2 “It is converted into **electronic pulses** in your software and it goes into your **modem** which converts it into — **modem** being **modulator**, **demodulator**, so it is **modulated** by **modem** and it goes down as a series of **digital**. . . sensitive to an **analogue signal** which can be **transmitted** down the **telephone line** . . .”

Computer Network Repertoire P4 “The physical **IP address** of the **server** which will deal with the email **request**. So you get your **ISP**, wherever it is in London say, so you will get your **message**, it will be all the **internet packets** will then, all the **packets** with the **message** will be **labelled** with a **destination address** looked at from the **domain name server**. Then they will all be sent to the router on the **ISP's network**. That **router** will then have a huge great big **routing table** and it will look at the **IP address** of the destinations of all these **packets** which your **email address** has been split up into and will work out the next **router** which has the least number of **hops**.”

The analogy repertoires are employed to enhance explanations given in a primary description repertoire. The repertoire changes are flagged by use of words such as ‘*like*’.

Transport Repertoire P17 “When you press send, it goes off to our **server**, which is called the **SMTP server**, and it looks for a **route** to Jamaica across the servers on the way. It's a bit *like* **catching a plane** and having to keep

changing at every county. So it **hops**. And then it sits on her friend's **server** until she switches on her machine and she presses check mail.”

Library Repertoire P21 “A **guide** to help get you to a range of sites, using limited information (i.e. you don't need a particular address). *Like* a **subject index** in a **library** computer system.”

Postal Repertoire (as analogy) P9 “You type your **message**, goes to the **outbox**, when ready press **send/receive**. It's a bit *like* the **postal system**. So it goes to a **server**, the **post office**, and your **letter** may **bounce** around **servers** until the person **logs on** in Jamaica and gets it. It would probably take six hours to arrive, depending on how much **traffic** is on the servers.”

Below is an example of repertoires being used for different purposes. The user begins by using computer repertoire (‘hops’, ‘computer’). But when trying to explain how the message will sometimes take a long time, the user brings in a transport metaphor, implying that the message goes down many diversions from the direct path. From this point, the repertoire becomes much less computer based, with generic terms such as ‘pass’ rather than ‘send’, ‘jump’ rather than ‘hop’, ‘pick up’ rather than ‘download’ and ‘system’ rather than ‘network’, until the transport reference is returned to explicitly for use as an analogy.

P18 “Depending on the systems, number of **hops** — it doesn't go direct from our computer to their computer either, it tends to go the **scenic route**. We may not know who's this is, but we know who will, so

we'll pass it to them, and they'll pass it on. I've seen it go 1 or 2, or 5 or 6 **jumps**. I've seen taken, within the XYZ system, I've sent an email to a customer and they've **picked it up** straight away. Anything from a couple of minutes to half and hour to an hour. It depends on how busy the **system** is. Friday afternoons are really bad. People **on-line**, people using the **system**. Another analogy: It's *like* the **roads**. If you go on the **M25**, it's lovely, unless you go on a Friday afternoon in **rush hour** then it's going to be really busy. The standard one is, when America comes **on-line**, because it's so big with the **Internet**, it slows the whole **system** down. But within Britain ... Monday morning when everybody comes in to check their email. And Friday afternoon, people are **sending** their email before they go home."

When repertoire are used inappropriately, the user becomes confused in their explanation. In this example, user P6 attempts to transfer the telephony based repertoire used to describe email (above) to describing the web, and becomes tied up in moving from multiple phone calls lasting finite time to a near-instantaneous connection.

P6 "Now you would get that, I know you would get it fairly instantly ... I don't understand the fact why that is so direct, but it is. Is it not dependent on **radio**, I mean on **telephone** ... It doesn't go to my **local**, it goes direct I understand — I actually don't know."

4 Discussion

Analysis of the text was surprisingly straight-forward due to the conciseness of the initial questions. The high degree of consistency between the analysts' interpretations made it easy to analyse and to agree on the themes of each repertoire identified. Within the descriptions of the email scenario, the user was more likely to use a Telephony Based Repertoire ('phone line), whereas within the web scenario the user is more likely to adopt an Agent Repertoire (searching and retrieving) or a Computer Repertoire (packets and servers). We can hypothesize that this may be because email is a person to person(s) behaviour, and such behaviour translates well to a telephone description.

P23 "Telephone lines able to reach out across the world to individual users"

It is also possible that home email users who would have a context of 'dialling-up' to send and receive messages offered these descriptions. What is interesting, however, is that the Telephony Based Repertoire used to describe email was not carried over to describe web usage (apart from the confused example above).

From a pure psychology perspective, it can be argued that the questions in themselves could possibly prime the user repertoires. However, we believe that whilst not all texts are equal in value, they are all valuable in revealing repertoire at work. A more influential factor in priming repertoire may in fact be context. For example, does being confronted by an application's interface change the repertoire compared to when the user is sitting comfortably in an armchair? We have not explored this issue in this study, and hope to explore this in future work.

Repertoires are not static. People continually re-invent the language they use, drawing upon examples of use in conversation, from the media, and from the applications and tools they use. For example, it was very noticeable that the staff from the Internet Service Provider HelpDesk employed a very pronounced procedural stereotype of the email scenario, presumably echoing the lengthy training they would have completed before dealing with customers. The design language of Outlook Express with 'Outboxes' and 'send/receive' labels on its buttons is very apparent in the example below.

P10 "When you click on **send** it gets placed in the **outbox**, and the next time you **connect** to the **server** and you press send/receive, it goes to the **server**. If you're **sending** it to Jamaica then it'll go and sit on his **server** until he presses **send/receive**."

The lexicon produced from capturing and analysing the repertoires can be used to inform the design process. Designers can ensure that the lexicon used within the application are from real repertoires, and are thus understandable to the user. Designers can avoid using specialist repertoire when designing for general use. The designers can also ensure that they are using language from a single and appropriate repertoire, and are not confusing users by intermingling repertoires. However, this is a resource for designers; they can still use words from outside the lexicon to describe new features, since the designers' work is part of the evolution of repertoires.

Discourse analysis not only reveals the lexicon of the words and phrase; it can also provide a description of the common metaphors and analogies within and across repertoires. These metaphors and analogies can then be used to inform the conceptual design process, ensuring that the concepts in the interface are rooted in the language of the user.

Interfaces affect the evolution of repertoire as well. Through careful engineering of the interface, designers can affect the repertoire that users will describe their actions. For example, this has obvious implications for ensuring that HelpDesk staff can provide understandable help to users, and in aiding the education of users as to how their applications function.

5 Conclusions and Future Work

We have presented a methodology for capture and analysis of texts. In particular, the analysis techniques can be applied to any text, such as books, manuals, email or even existing computer applications. When designing an application for use within specific contexts, these techniques offer ways to capture application and context specific repertoire, which can then be used to increase understanding of the application and ensure consistent and appropriate language use within the interface.

Users have a range of interpretative repertoire, which are separate and distinct in their usage. We have demonstrated that for texts from a range of individuals describing networked applications, descriptive repertoire can be classified as Telephony Based, Computer Based, Agent Based, or Postal. These are supplemented by a number of analogy repertoires. We have identified Postal, Transport and Library from our texts, and acknowledge that there may indeed be many more. We have also shown the existence of expert repertoire, associated with specialist electronics and computer networks knowledge.

We plan to use this methodology to build further lexicons for networked applications and demonstrate its use in the conceptual design of real applications. We shall also be exploring the variability of repertoire across conditions such as location, network breakdown, and user goals. As well as this, we aim to look at potential differences that could be associated with context — do such repertoires change when describing an application during use? Does a repertoire change depending on the perceived background of the listener by the speaker (expert and novice for example)? Finally, a more detailed analysis needs to be carried out looking at the 'design

language' of interfaces.

Acknowledgements

EMMANATE is funded by EPSRC under the Information Technology and Computer Science Programme.

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Author Index

Rimmer, Jon, 1

Sasse, M.Angela, 1

Sheeran, Louise, 1

Wakeman, Ian, 1

Keyword Index

conceptual design, 1

discourse analysis, 1

email, 1

internet interfaces, 1

repertoire, 1

Web, 1