Where My Books Go: Choice and Place in Digital Reading

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ABSTRACT

Digital reading is a topic of rising interest in digital libraries, particularly in terms of optimizing the reading experience. However, there is relatively little data on the patterns of digital reading, including issues of where and what users read, and how they organize, plan and conduct their reading sessions. This paper reports the first data on mobile reading, combining insights from three different studies of users, including diary studies, interviews and ethnomethodological work. The data reveals that reading often depends on highly developed and rehearsed practices, especially when the reading is related to study or research. From this, we are able to identify a number of opportunities for further digital library research to better support the needs of users.

Categories and Subject Descriptors

H3.7. Digital Libraries: User issues;

General Terms

Design, Human Factors.

Keywords

Digital reading, digital libraries, tablet PCs.

1. INTRODUCTION

We know that readers read print in a variety of contexts: travelling, in the library, in bed, and on the beach [19, 20, 30]. Print is, in many ways, suited to a diversity of reading: it stands up reasonably well to the elements, it is relatively cheap to replace, it is easy to mark one's place, and to annotate. In contrast, much recent research notes the rising importance of reading on mobile devices (phones, tablets and ereaders) [7], asserts it as an axiomatic truth [6], or focuses on specific issues of tool design [6,24], there is a relative dearth of evidence about the detailed context in which reading occurs. A better understanding of the physical, social and temporal contexts of reading on mobile devices would better enable us to better design effective systems for mobile reading: from underlying digital library infrastructure to the interface of reading applications and software.

Like work-related reading [1], the mobile reading environment is a complex tapestry of different types of reading, and involves a wide variety of content. It could be disputed, indeed what constitutes mobile reading: is email, twitter use or even social networking 'reading'? Our focus is on the reading of magazine article length or longer, which is more typical of DL content.

Besides questions of material length and type, the issue of how readers use different devices is of increasing interest. While particular attention has been paid to the rise of ereader devices [30] and tablet PCs [24], the increasing size of mobile phone displays, and the shrinking size of laptops, all serve to mean that reading on the move can involve a choice of devices at any one moment. Readers choose not only what material to read, but also on which device and in which context. Such devices *are* used within the home [8], so 'mobile' does not simply imply on-the-move, but also often occurs when seated in a café, or on the sofa. How influential device features, place, and context are on device choice, is an open question.

We draw on three sets of data in this paper. One dataset captures the repertoire of reading undertaken by British university students, including their leisure reading; a second draws on observations of students in a university library in Australia; and the third covers the work-related reading of academic researchers in the humanities, and was gathered over a ten-year period.

A number of common themes and distinct differences emerge, not only along the lines of the reader's background, but also across devices and physical places.

As we shall see, digital reading proves to be highly bounded with social, practical and technological constraints. Choices of what to read when, and on which device, suggest that there are marked differences in behaviors that set markedly different design constraints and goals for practical technology. In turn, digital libraries now face a reassessment of which needs each DL aims to serve, and the likely reading context its technology must serve.

The structure of the paper is as follows: we first briefly recap the broader history of DL research on reading; then we describe the study methods for the three investigations, before reporting the findings, drawing on common themes across all three studies; we then enter the discussion, comparing our insights with existing literature, and draw out our contribution; finally we reflect on directions for future work, and lessons for DL researchers and developers to consider when creating new DLs.

2. BACKGROUND

Reading has long been established as a key topic of research in digital libraries. Previous work spans the range of examining the high-level needs of particular reader groups [5], through investigating particular types of reading [14], to detailed

technological interventions to enhance reading [17, 23]. From the perspective of libraries in general, reading has also proved a long-standing interest, drawing on logs of both ebook reading [21] and borrowing behaviors [13], studies of the impact of library space on reading [32] and interviews with library patrons on their reading needs [32]. With the rise of the mobile reading device, researchers in human-computer interaction have returned to the topic with a level of interest last seen in the early 1980s, when the personal computer emerged as a potential reading tool.

Despite this broad span of investigation, many key gaps remain in our knowledge. Despite advances in digital reading technologies, readers still tend to print digital texts for close study [29], and paper retains a pivotal role in reading. However, there are many reasons why digital reading can be the medium of preference, including the oft-mentioned search [3, 13, 16, 20], cost [10], continuous access [10, 26], and mobile device portability [10, 11] particularly in comparison with books. At present, we have only a limited understand of how these decisions are made by users.

There are other, enduring contexts and issues of reading where we lack a detailed understanding. Reading occurs in different styles: from the close reading of academic scholars [29], through engaged leisure reading of novels [27], and the casual reading of magazines [19], to triage, when a potential reader assesses the relevance of a text [14]. Each of these may provide a reason for selecting a different reading medium. Perhaps more interestingly, these same differences likely occur in different reading contexts of physical and social place, physical space and time. While we have some localized insights into how reading locations are chosen in libraries [32], and indeed how physical library spaces have evolved over time [25], and various essayists have written about their design of their own formal libraries [15], the selection of personal reading spaces, particularly in the context of digital reading devices, is very thinly covered.

3. METHODOLOGY
In this section, we report the method for the three separate studies in turn, noting particularly techniques used in each to elicit insight into how users read. We characterize the participants in each part of the research, and set the context that led to each investigation.

3.1 The reading practices of academics
Humanities academics are regularly noted as voracious and sophisticated readers of long, complex material (e.g. [5,29]. In recent years, there has been an explosion of quality source materials in electronic form, e.g. from the HathiTrust, Google Books and LION. Following the User-Centred Interactive Search project [5], we have gathered three phases of interviews on the information practices of humanities scholars in 2004, '09 and '14.

These academics were recruited from a number of institutions in three countries: New Zealand, the United Kingdom and Canada. Two participants from the original 2004 study, and three from the 2009 study, have been re-interviewed for the current 2014 group. The initial cohort consisted of a total of 19 participants, with 17 in 2004 (three being second interviews), and 16 in 2014 (two being third, three being second interviews). Thus we have a total of 44 respondents, who are presented here as R1-R44. The year of interview is, for second interviews, added in parentheses.

We interviewed participants on a range of topics related to their reading, including the acquisition of documents, digital document access and use and organizing collections in the initial phases, which was analyzed using a grounded theory approach [5]. This coding scheme has been subsequently extended in response to

data from the later phases. New themes included ereader devices, reading on the move and the effect of location. These changes reflect the increasing availability of both contemporary research output and period source documents in digital form, and the ready availability of digital reading technologies.

In contrast to the undergraduate diary study (Sec. 3.2), we have not sought to capture the wider reading behaviors of our respondents, but occasional reference will be made to respondents' reading behaviors, as reported by them.

3.2 Reading behavior of university students
We recruited fifteen undergraduates at a British university. Each participant maintained a diary of their reading across one week, supported with both entry and exit interviews. The diary recorded their daily reading, including the time, location, materials and devices used. Reading on paper was not directly asked for in the diaries, however use of paper alongside the devices was captured. Further context, including the use of paper, was elicited in exit interviews. The diary was informed by our previous work on search behaviors using mobile devices [2], and was piloted with two students for validation. As only minor adjustments were found to be necessary following the pilot test, we moved directly to the main study after making adjustments in light of the pilot.

In the entry interview, we took demographic details, the course of study the participant was currently following, their current range of reading devices and materials, and their intended reading goals for the week, if any formal ones existed. The exit interview was used, in contrast, to clarify any diary entries that were difficult to interpret, or to add additional detail in the most incomplete entries. We also invited the participants to reflect on any insights into their reading habits that they had gained from their work on the diaries, and to comment on their reading in general.

Participants were met two days after induction. In that discussion we reviewed their current entries with them, and provided guidance as to the level of detail we expected, and addressed any practical problems encountered by the participant. In three cases further contact was made to ensure that issues from the follow-up session were resolved. Participants received no financial reward.

All data was subsequently analyzed using the qualitative inductive coding method, using no a-priori codes or themes. The coding was conducted by one researcher, who first constructed an initial coding scheme, before proceeding to coding an initial sample and then a complete analysis. Both the coding scheme and the (10%) sample were inspected by a second researcher, the scheme being verified and the sample validated with an agreement rate of over 95%. As is typical for an initial sample on a novel topic, we did not aim to code to the complete exhaustion of themes, but rather we fully coded the most dominant themes found in the data.

3.3 Reading in the Library
The final study in this paper is a longitudinal ethnomethodological investigation of how patrons use academic library space.

In this study we counted, over the course of a semester from initial classes to exams, the number of patrons (mostly students) physically present in a busy academic library in Australia. The library is spread over five levels: the top two are dedicated to silent study and house the majority of the book collection, level 3 has significant social space with moveable furniture and an area of fixed computer desks, level 2 includes the entry and service point, the newspaper table, and fixed computer desks, level 1 includes a large area of fixed computer desks, a dedicated group study area.

Rather than simply counting patrons, we also noted which floor they were on; whether they were using laptops, tablets and books, and made special note when they were using only books. We developed an interest in group-work, thus ended up counting group size, what technologies were in use in groups (including paper) and what kind of seating groups were using over a shorter period. Next we developed a group typology, which included groups that were creating a shared artifact together, groups that were reading together, groups rehearsing talks, informal study groups and social groups. Finally, we conducted anonymous observations of these groups noting particularly their spatial arrangements, negotiations over work, and access to documents.

Our findings on the interactions of groups and space are reported elsewhere [23]. While this study was not dedicated to reading, the use of books and their combination with other devices can give us some insight into the reading ecologies of these students. Further to this our observations of groups provide additional insight into the nature of academic reading in the library. Data from this study is used to enhance and expand understandings gained from the other two studies presented here.

4. RESULTS

In reporting our results, we combine the insights from each of the three studies within the major common themes that emerged: time, material, location, and devices. For the two studies of individual people, we report on selected individuals, who are briefly described in the text. For identification, participants in the student diary studies are referenced by Pn (e.g. 'P6') while academic interviewees are indicated as Rn (e.g. 'R21').

4.1 Reading matter

Within the diary study, we gathered a total of 169 reading episodes from the 15 participants. Table 1 shows the breakdown of device versus reading matter.

Table 1. Device choice and reading activity

Device	Work-related	Pleasure
Mobile phone	6	48
Tablet PC	22	33
Laptop PC	31	22
ereader	0	7
Total	59	110

Only two of our respondents used an ereader device, hence its low apparent use. The data shows mobile phones were only occasionally used for study-oriented reading, but were frequently used for leisure reading, while in contrast laptops were relatively frequently used for work, but less regularly for pleasure. Excluding the few ereader cases, a chi-squared of relative frequencies produces $p<0.0001$ ($X^2=26.39$ df=2), indicating a strong interaction between device type and reading purpose—an issue discussed in the next section.

We are not able, with the academics, to discern such a clear division between devices, and of course the pattern has changed over the ten-year span of the study. Mobile reading devices were almost unknown in 2004, and laptops were the only cited technology then in use. Three respondents reported a reading device in 2009, including R26 already noted above, while by 2014 ten of our sixteen respondents said they now had one—four, like R26, having both an e-Ink device such as a Kindle, well as an iPad or similar LCD device. With this change in technology has

flowed a change of material used—in 2009 no-one regularly read journal articles on their device, by 2014 it was universal.

Changes in convenience played a key role here, as one frustrated (2009) Kindle user stated that they "couldn't be bothered with the hassle" with uploading material to their device, and even R26, an enthusiastic use of her Sony Reader for novels, dismissed the idea of using it for reading journal articles due to screen size and the practicalities of installing the files onto the machine.

However, among the humanities researchers there are repeated patterns of allocation of reading particular types of material to chosen locations, either due to a co-incidence in time (e.g. R31's early evening reading of longer material was always at home), or due to more direct preferences of particular places for certain material. One example was the senior literature professor R22 who, while having a well-loved domestic library, preferred to read journals that he was reviewing in a nearby café.

In the library observations, there was a common trait in group reading for different, if related, materials to be read at the same time. An assignment handout (in digital or printed form) would often be read alongside content such as lecture material, textbooks or web sources. Leisure reading was almost exclusively limited to web browsing and occasional newspaper reading: even though the library does retain novels and other leisure material in a dedicated section next to the entrance.

For all three studies, and as amply demonstrated by Table 1's data on undergraduates, there was an interaction between reading purpose and the chosen device, and we now turn to that concern.

4.2 Reading throughout the day

One pattern that was particularly pronounced in the undergraduate diaries was the allocation of reading to particular parts of the day.

Five participants demonstrated a regular pattern of setting aside reading time within an overall plan for the day: e.g. reading in the morning before commuting, then undertaking further reading en route to university, but then reverting to leisure reading later in the day. For example, P2 read a PDF both on his laptop at home and on his iPhone during the commute to university in anticipation of a meeting with his tutor soon after arriving.

However, there were patterns that were more specific to parts of the day. P2 was also one of seven participants who regularly read first thing in the morning (36 entries). Typically this was brief leisure reading. In contrast to the 85 minutes P2 spent on their academic paper, before and during his commute, the morning spell of reading for pleasure seldom exceeded 10 minutes.

In contrast, the evening saw a repeated reading period for work (for 11 participants) and leisure (for ten), though this was usually interrupted on occasional days by social events. P6 was a typical evening reader, ending each day by reading a novel on her iPad.

Among the academic interviewees, reading was more often spread across the day, and in blocks defined by work or home commitments. R27, an English academic, did read at home in the evening, but this was constrained by having a young family. At work he has developed a regular pattern of reading across the week, but this varies from short periods in the morning to a "three hour marathon" on Wednesday afternoons. In contrast, his colleague, R31, regularly read each morning immediately after arriving at work as this was when she was least likely to be disturbed, and read again in the early evening when she returned home. Her morning reading was more focused on reviewing and reading journal articles, whereas she assigned the evening session for reading books and (long) manuscripts.

4.3 Reading location

The location of reading was a recurring and significant trend across all three investigations. We begin with our undergraduate diary studies, before reporting in detail the insights from our interviews with researchers and drawing on the ethno-methodological examination of a working academic library.

4.3.1 Reading at University

For the undergraduates, the university was a key base for their study-related reading. The library and student common rooms were two major locations, and there was almost no leisure reading on site (the one incident occurred when waiting to meet friends). Laptops, tables and mobiles were used with equal frequency, and the choice was often determined by the context of the exact moment of reading. When entirely controlled, laptops and tablets prevailed, and most of the documents had been previously downloaded and stored for reading at university.

Researchers' personal offices were similarly the focus of their academic reading. R23 explained "despite the occasional interruption, it's still the place I'm least likely to be disturbed".

In the 2005 cohort, reading of digital material was limited, and mostly circumscribed to (rare) professional digital transcriptions, supplemented by transcribed material from personal notes of printed texts. A personally maintained collection of print material in the academic office, including borrowed library books, photocopied papers and the researcher's personal collection of print books was their primary pool of reading matter.

R26, a professor of mediaeval history, demonstrated a particularly systematic approach. She noted that "all my writing really happens here"—despite sharing her home with another academic—and her office was carefully arranged with a large number of books, and three filing cabinets of indexed paper. She reported a tight process of managing the material kept in her office, insisting that "every book and paper has to earn its keep". Reading time was scheduled in her diary, in order to ensure that a regular of volume of new text was studied each week. She kept a specific notebook to use while reading at her desk, accompanied by a highlighter pen, pencil and two pens, all placed on a neat pile of current reading. This image of a well-regulated reading routine, carefully planned for with available supporting materials for writing and annotation was exceptionally visible in a thoroughly organized office, but the underlying preparedness was common.

For R26, digital content was—in 2009—an issue of rising importance, especially as her own research involved digitized material. Her own practice in her office with digital material was almost entirely of on-screen reading from her laptop; mostly of digital journals, but also of online scans of mediaeval material. This proved less satisfactory to her : "the online stuff…it's hard to keep organized; if you download it, it becomes a mess, and if you don't, you often lose track of here you got it from… which site you were reading". Thus, while the physical reading space was a well-oiled machine, the digital experience was more chaotic and was proving a source of frustration. As a result, she had developed a practice of printing important material so that it was more easily stored in the physical resources over which she had a better sense of control.

As R23—a U.K. based early career researcher in German literature—noted at the time "you need to be on campus to get the digital stuff" and so the office was in many cases the most convenient place to obtain digital material. In these situations—as was almost unanimously reported by that cohort—reading of secured material was accompanied by note-taking on their desktop or laptop PC, with in a few cases the use of a traditional notebook as well. Neither was particularly satisfactory: As R28 (modern historian) complained "you switch between Word and the web all the time" or "you jot stuff down just to type it in again later".

The office was, however, only part of a wider repertoire of place, and the connections between places varied, and also the type of reading done, in terms of both devices and content, also contrasted between venues. Printed books were reported as primarily residing in either the office or at home, but not often being moved around because of their physical size and weight.

4.3.2 Reading at Home

The second most common location for reading was at home. For the undergraduates, this was the predominant location, in which 68% of all reading sessions occurred. In contrast to university, at home leisure reading predominated, particularly early in the morning and last thing at night.

As with university, there was an equal distribution between laptop, mobile and tablet use. When work reading was done, mostly in the early evening, this was often from material downloaded when at university, or downloaded from the online learning environment when at home. As with reading at the university, paper was used in connection with digital reading, often in the course of textbooks, personal notebooks and occasional class handouts. Paper and electronic documents formed two different resources that were read together for an underlying task (e.g. revising the content of a particular lecture).

All bar two scholars reported reading at home, and for a sizeable minority, it was the primary location for reading. R35 reports one common story: "the office is too busy for me to work there, and I find it too… sterile a place to write, so I tend to read most of my reading—or my most productive reading—at home".

A domestic 'office' was reported by all bar five participants, though it varied from a 'cubbyhole' to an extensive library. R22, a senior English scholar, made a particularly clear distinction between office and home, scarcely reading in his work office, whereas his library "is my real office—the office at the university is only to read with or talk with students". As with R26's work office, the home office could be highly organized (as was the case with R22). However, it faced significant barriers with reading online material during 2004 and 2009, though in 2014 these were reported as being much less (a problem for 5 of 16 participants).

Twenty-eight researchers reported having a personal computer at home, rather than using a laptop that belonged to the university. Using a laptop—be it personal or a 'work' machine—was strongly associated with having different places to work around the house. While R22 kept almost strictly to his library, using a desktop, R24, a drama scholar, provided a more typical case. In addition to having a library-style office upstairs, she also used her living and dining rooms depending upon mood. The library was associated with more intense reading: close reading of plays, reviews of journal articles etc. ; while the living room was used for an occasional 'change of scenery' but more often for an initial reading of an article or book without taking longer notes. The dining room was even more turned towards more general reading.

This distinction between places at home for different reading purposes was mirrored in almost every researcher's reporting: one key reading 'station', well-equipped and organized, is supplemented by other sites for lighter reading or as a necessary retreat when other family members were noisy. R11's articulated another side to this story : "somehow my own home office can be hard to read at, when I just want to get an overview—it's where I

can concentrate, but it's .. it can be too much to read there when I just want to read over something". Hence, rather than there being a single 'ideal' style of reading place, there is a need for a variety of places that are associated with different reading work.

This overlaps, in 2009 and 2014, with a move towards new technologies. R24 was an early adopter of ereading devices, and now possesses both a Sony Reader and iPad. She explained "I loved the Reader for getting about … and the iPad has been better as I can put it on my easel and read from it while I type on my iMac". In this case, R24 had set up the site beside her iMac to optimize reading paper material, but then had co-opted that as a support for her iPad, treating the new device much like a large pad of paper. For R38, just like R24, the iPad occupied a place similar to paper: "I've always tended to read over photocopies and journal printouts on the sofa. More often I tend to that with the iPad now, though I do print to make any detailed notes and to scribble comments on once I know what I'm doing..".

R38 used his laptop in his upstairs office for final detailed readings that would lead to writing, and this was an almost ubiquitous pattern of the PC emerging as the reading device of choice as writing drew near.

Both iPads and laptop computers were reported as being common tools for transporting digital documents from work to home. R40 mirrored R38 and R24's practices, and those of five further tablet owners: "I download things onto the iPad at work now…then I take them home and read on it whenever I have time". One common problem encountered was managing the device's storage as R38 said "you can end up with so much" and "the filenames mean nothing—some number or other .pdf"—which mirrors again the problems with electronic material noted by the highly systematic R26. R39 showed the display of her preferred iPad reading software, exclaiming how "stupid" and "meaningless" the filenames were, and complaining about the fact she frequently had to "hunt out" what the latest document she had added was called.

The home is not a single space, but represents a patina of different devices and places, each providing better or weaker support for different styles of reading. Considerable effort was recorded in bringing the needed combination of print and digital material together to ensure the different content needed is present and usable at the moment of reading. The reading of materials flows from and returns to the academic office, from which most of the digital material is originally sourced. Devices are used both to transport material for reading, and to enable associated work once reading commences. We will address the choice of device once the moment for reading arrives later in this section.

4.3.3 Reading in third places

The home and office provided the two common points for our academics. For most, one or other location was their primary place for reading, but there was a recurring theme of other rehearsed sites that were regularly used. R21, an early career researcher in the social sciences, was one clear example, using a local café which "isn't that noisy, cheap, and they leave me alone". She contrasted the "bright" location where she sat with her small, north-facing, home office where "sometimes the darkness just…it kills me…particularly now, in mid-winter".

While in her case, physical shortcomings in her home proved a key factor in going elsewhere, for R27 and R41, getting away from distractions and noise was the primary reason, both having young families. R27, a new faculty member in 2009, had extended this practice by 2014, depending more on it, but also "I now find that I do my best work outside of the house—in the summerhouse

in the garden, or down at the caff" while the home was now used for more functional reading and writing, such as reviews.

R27 again demonstrates the close association between reading and writing, but there are more subtle contexts at play: different resources and tools were to hand at the different locations. R27 kept her personal library at home, but with a dedicated stash of books in the summerhouse, complete with notebook and post-its, mirroring the reading pile in R26's office at work. There was also a separate bag that held materials that rotated between home, work and other locations, with a further notebook, pen and, in 2014, an iPad. R24, the drama academic, had created a similar toolset, as indeed had almost all the 2009 and 2014 cohorts.

The small, focused collection of most immediately valuable books follows the concept of the "handapparat" in (German) library science: a small collection of media brought together for individual use. While this was an established and visible resource in the respondents' working space, three interviewees in the 2009 and eight in the 2014 cohorts had developed a digital equivalent, including either an ereader or tablet PC. R24 initially used her Sony Reader as a mobile pool of original novels, but by 2014 had migrated to using their iPad to store not only novels, but also articles related to her ongoing research work. Two further academics used their laptop as their main digital reading device, having amassed a considerable volume of material over many years. The remainder of the group reported only occasional 'serious' digital reading, usually in a fixed place of work.

However, six of the eight who used tablets and ereaders reported problems in managing the content of their reading devices— noting that it was "easy to keep adding material willy-nilly until you can't…find what you're after". While digital files were easier to transport, the volume of material proved harder to master, and marshaling even smaller sets of documents was noted as being more difficult. R33, a mid-career literature faculty member explained: "with books and paper it is easier to bind and lock things together; to see where you are. With my [i]Pad, it's ordered for me, but in the wrong way"—in her case, the alphabetical ordering system of her preferred reader software could be circumvented by the use of folders and renaming of files but "I just don't have the time for that".

This digital material also had to co-exist as a set with printed and physical documents. All eight reading device users reported that concurrent reading of printed documents and books was a predominant part of their working practice. However, those using laptops would often use either paper on its own, or their laptop on its own, often due to the physical constraints of the weight they carried, or the physical bulk of the laptop in their working environment. Those using reading devices also reported such issues, but their treatment of their tablets was synonymous with the paper practice of their laptop-based colleagues, and the use of a paper 'handapparat' of working documents.

There were also connections between specific handapparat sets and location. Some sets resided in particular locations, such as a summerhouse or, more often, commonly were taken to regular reading locations like R21's café. R24's use of her iPad serves as a case in point: it being used in her kitchen with a set of 19th century novels, but also travelling in her satchel that contained material for a journal article she was completing which typically accompanied her to a favored café and her office. Between these venues, the material being read on the iPad changed, but each location emphasized a particular piece of work.

R33 had a satchel set that was reserved for use on a train, where she regularly worked on an ongoing project. This practice was

shared with just over a third of the interviewees in 2009 and '14, who reported that working on trains was a regular, planned space for reading—and one where ereader and tablet users identified their devices as particularly useful. Similar notes about trains were found in the undergraduates, who did 18% of their reading while commuting. However, most of their reading was for leisure, drawing on pre-loaded ebook fiction and online reading of news and culture websites. Four explicitly stated that they would not use laptops on trains due to security concerns, and none recorded their use there. This may also mark a difference between long-distance travel and commuter trains as a working space: with the students reporting use during commuting, while the academics planned reading was rarely during commuting.

4.3.4 Reading in the library

Libraries have themselves been termed 'third places'; and are, of course, understood as places to read within. Over half of our undergraduate diarists reported using their university library as a reading location. In contrast, the academic researchers seldom reported using their university's library as a regular reading space (1 respondent in 2004, 2 in 2009 and none in 2014). However, specific libraries could be adopted as a regular 'roaming' location, either very occasionally (e.g. R3, a New Zealand mediaevalist reported using specific libraries in Europe on each sabbatical), or on a recurring basis (e.g. R30, a specialist in Welsh history, used the National Library of Wales at least once a month).

In the context of our library space study, there was similarly a relationship between different reading tasks and the choice of different places to read. In part this was due to library design choices: the 4th and 5th floors of the library had been set aside as quiet study areas, and were therefore rarely used by groups. However, the remainder of the library contained a variety of PC desks, in different shapes and configurations, group study rooms, informal lounge seating, regular free-standing desks, fixed booths and other types of seating and desk. The same type of desk could be found in different contexts, with variation in lighting, amount of free space, proximity of books or other resources, and, most importantly, the provision of different technology.

Across all our methods of data capture, we discovered marked patterns at both macro- and micro-scale. From the wider perspective, we observed a considerable volume of shorter, work-related reading in the library, mirroring the patterns described by the undergraduate students in their diary studies when reporting their reading activity when on campus.

The observations also hinted at some groups having established favored locations—one social group being particularly visible by their daily presence in an informal seating area. However, some areas were more used for reading than others. Even for groups, areas with a higher footfall were avoided, and groups also avoided long, thin PC benches that spread the members out in a line.

Most of the reading that could be seen in the library was digital, with a variety of supporting paper material (discussed later).

4.4 Device selection

As we have just seen, for undergraduates there was a clear pattern of association between particular devices and either leisure or work-related reading. Responses from our participants in the exit interviews underpinned both the general patterns and counter-points we have just identified.

P9 explained why they read a long PDF on their mobile: he said he was "able to quickly download wile suck on the train" —so the selection of study-focused reading on the mobile was, in this case,

the product of circumstance. P8 noted that it was "easier" to read on the laptop "because of the bigger screen", and the greater ease of undertaking writing and other tasks while reading (e.g. P4 wrote in their diary that they chose a laptop for work reading as "it's much easier and faster with keyboard and mouse to multitask."). Those who used tablet PCs unanimously noted the advantage of a laptop keyboard for typing versus a tablet touchscreen, especially for taking notes or annotating the text being read.

In contrast to the task-focused selection of laptops, and the mobility-oriented use of phones, the selection of tablet PCs often was cited as being about location: e.g. P13 noted in their diary that they used a tablet "whilst sitting on the sofa … [it] has a big enough screen to view websites on", in contrast to their mobile phone; while P9 noted that tablets have "a good screen to read off from and easy to move about."—raising a recurrent theme of the relative comfort of reorienting a tablet versus a laptop.

Device choices for reading either in the early morning or evening—usually in the student's bedroom or bed—very often focused on the form factor: with choices ranging from a netbook, through tablets to larger mobile phones. Tablets proved popular "because it is easy to use whilst in bed", but those without this option did not report using anything larger than a netbook. Laptops and other devices were entirely absent from these times of day.

4.4.1 Reading Matter and Device Choices

In the undergraduate diaries, we discovered relationships between reading matter and the devices chosen. In the case of the reading of novels, all but one participant reported using an iPad or ereader device. The single exception, P15, used an iPhone for almost all their reading to avoid "using multiple devices", and she did much of her reading while commuting. The broader pattern, however, was for novel reading to be conducted at home late in the evening: a typical comment being that "I read it to relax before I went to sleep", and diary and interview data combined revealed that this reading always ended in bed.

The two users of ereaders combined both these patterns, reading during commuting and at night. Both had acquired their Kindles as dedicated book reading devices. In contrast, the iPad owners restricted their novel reading to the evenings, and used their devices for a wider range of functions across the day.

Web-page reading, for both leisure and work, was spread across the day, and across a range of devices. This material emphasized a general trend, where participants reported a strong influence of context on device choice. This contingent selection of device was reported by 4 participants in their diaries and 8 in the exit interviews. P11 noted in his diary that "I used my phone because it was already on and I had already shut my Netbook off". The immediate status of his personal devices influenced his choice, due to the startup time of the PC. As in this case, choice of device was most often a phone versus PC or tablet. The influence of context followed a few common trends, with more than half of the respondents reporting a series of factors including device status (as with P11), physical constraints and concerns about the security of larger devices. The broad pattern was to compromise effectiveness and select a smaller mobile device when a larger one was less convenient. However, there were three isolated cases of participants adjusting their context in order to make a larger device more practicable, and then switching from mobile to a tablet or laptop. Furthermore, P15 reported in her exit interview that "sometimes if I am at home and it's in the morning, as I said the battery life of the iPhone is really bad and I leave it to charge

so I use the Samsung galaxy tab instead", so battery management can also result in a shift from mobile to a larger device.

The library study also casts a clear light on the use of devices at university. We noted that laptops were treated as primarily private property, even if they were regularly turned to others for short spans of shared reading. Where a shared screen was used to read together, students almost invariably used a university PC, including some PCs with large screens. In contrast, though tablets were relatively rare—perhaps because of security issues raised by our undergraduate diarists—when they were present, they were regularly used as shared devices and would be passed regularly between members of a group. Paper was also used for sharing around, but it was also commonplace to see paper being used for notetaking by group members: indeed this was almost universal amongst the twenty groups in our close observations.

As noted briefly in our consideration of reading matter, in the academic study, the changes from 2004 to 2014 have been significant, with more than half the 2014 cohort owning either a tablet or ereader. Device selection for them is not so clearly influenced by security and ownership, no doubt due to having their own office. Their reading devices sit alongside paper as part of established reading 'handapparat' toolsets. Tablet PCs are used for the convenience of portability and relatively high quality of display, while ereaders are more often credited with even greater portability and being pleasant for reading for long periods of time. These devices were frequently used alongside laptop and desktop PCs, and for referencing digital texts while working with paper documents. This compositional use of different technologies brings us to the consideration of using multiple devices at once.

4.5 Use of multiple devices

Concurrent multiple device use was seen in all studies. In our observation of the library, the use of books on their own was far behind the rate at which books were used alongside a laptop, desktop or tablet. While that pattern combined both paper and digital media, we also saw the contemporaneous use of tablets and laptop computers, and laptops being used alongside large-screen PCs. For many reading tasks, two displays, be each display paper or digital, greatly assists the user.

4.5.1 Dual Device Use

In our undergraduate diary study, three participants reported incidents of using two devices at the same time, in order to better support the reading of more than one item at a time. Revision was a common theme to all three participants where, say, a textbook would be used alongside lecture notes or even two views of the same report. P9 reported in his diary a case of reading articles on both his phone and laptop: "I was reading another article on the same topic on my laptop and wanted to cross reference between my phone and laptop for quick switching and reading".

One common format for these reading sessions was with typing being done on the reader's laptop, which was also used as the primary focus for reading. The second device—phone or tablet—then provided a supplementary view for supporting material. This echoes the comments reported earlier of the preference of users for laptops when they needed to type while reading. However, this format could also be reversed, with the laptop used for quick referencing and note-taking, while reading a textbook either on paper or in as an ebook with iPad or reader; or paper would be used for note-taking as the student worked with digital text.

Dual device use was regularly seen during the library study. On the silent floors of the library (where book use was most prevalent) 66.3% of all observed book use was in conjunction with some kind of electronic media—laptop, desktop or tablet. Tablet use overall was low, accounting for only 3.5% of all patrons of the library, making this population quite different to the one observed in the UK-based study of students. The use of ereaders was not observed at all. In close observation in the library mixed device use was seen particularly when groups were mixing the production of an artifact with reading to support their activity. In one group observation, both members of a pair were reading from a shared tablet PC while doing some other reading on a shared laptop screen. The same pattern could be seen with individual members across study groups, and as personal tasks within group reading and writing work. Furthermore, small groups and sub-groups demonstrated short-term use of two devices, often with one person turning their laptop screen for another to see, which led to the other student reciprocating with their display. In each case, the use of two devices facilitated the comparison of different material at the same time, especially where the parallel reading continued beyond a few short seconds.

The humanities interviewees who owned reading devices also reported many cases of using them alongside a PC. R24's placing of an easel by her iMac permitted her to use her iPad as a document display device while she took detailed notes on her computer. R38 regularly took his iPad to use alongside his laptop on work trips, saying that this option saved him bulk and weight, as well as allowing him to carry a large library of documents. When probed about how he used them together, he replied "not that often, because I like, often, to read and then write, rather than both at once. However, when I'm really looking at the text in detail—then it's a godsend."

As with the undergraduates in our diaries and in the library, for R38 it was the ability to place two texts opposite each other—he continued with an example "having the biography [of a poet he was researching] to hand as I pick apart the prose" simplified the work of his analysis. For his work on this task, biography and poems were interdependent sources across several months.

4.5.2 Device Choice Strategies

As noted above, there were interactions between place, task and device. The undergraduate diarists reported a number of individual approaches, but two common strategies divided "users" from "choosers". The "choosers" prioritized the use of the device that they felt was most appropriate to the reading task (e.g. in terms of display size). The two Kindle owners showed one form of this: selecting their Kindle exclusively as their book reading device. P5 had a more common example: while sitting on their sofa at home they found a useful paper—a PDF—and switched from their phone to their tablet as "my phone screen isn't that big"

In contrast, "users" simply continued with what was at hand; P11 wanted to read a longer article but continued on their phone as "If I had a choice I would have read it on my Netbook, but due to laziness I already turned my Netbook off and put it in my bag by the time…my phone was ready in my hand". Other reasons included reading starting on a device (and hence continuing on it to avoid disruption), but generally "using" was, in contrast to "choosing", seldom given an explicit justification. Eight participants showed a mixture of both strategies, while three were mostly "users", and four "choosers".

A second pairing of strategies contrasted "homers" with "movers". "Homers" kept their digital tools at home. P13, kept his tablet PC in his house, as "it's convenient… I don't like to take it out because I feel quite vulnerable…[if on] holiday then I might take it with me but only to keep in touch with the folks back

home." In P13's case, the issue of security was a major concern; this caution led to most of his reading being done at home. Three further participants predominantly read at home, either in the evening or in the morning, and very rarely read elsewhere. Only two of the four "homers" reported reading even once, on their mobile phone, while away from home. In both cases, this was a quick check of content they had been made aware of when away.

The other eleven participants—the "movers" used their mobile reading devices across the day, albeit with different devices being used in different locations. Tablets were more often used in stationary positions, whereas mobile phones predominated during commuting. Early evenings most often saw laptop use at home, moving gradually to tablet PCs and ereaders as the night drew in.

The scholars showed some of these patterns, but those who regularly used digital reading devices had developed a strategy that enriched the general thrust of the undergraduate "mover" and "chooser" behavior. They had developed similarly clear associations between context and device, but had developed connections that ran between context, content, device and time. With a greater influence over their physical environments, and also higher demands on their reading work, they combine what might be dubbed 'nomadic' and 'horticultural' planning to increase their effectiveness. In 'nomadic' mode, they create sets of reading material and equipment that can travel with them and be used both on the move and at temporary 'homes'; in 'horticultural' mode, they establish alternate 'homes' that contain resident resources. These approaches are not in conflict, but rather are composed together to enable the researcher to sustain the high level of reading that is demanded of them. Furthermore, the places and spaces chosen for reading are also part of an established pattern for other reasons: they represent in the majority of cases reported to us, venues that have been nurtured and adapted to across years of repeated practice.

In the library, we examined the interaction between physical space and task effectiveness. As already noted, groups would try to avoid particular areas that poorly suited their purposes, but there were patterns of individual behavior within groups that also demonstrated an ability to adapt to and shape the current context. One common pattern, observed in groups that were studying individually, but in the same location, was to sit on alternating sides of the desk; this hid the content of one member's screen from the next. However, privacy did not appear to be the sole issue: similar behaviors were seen in groups, where screening off material would reduce distraction from other sources. Students were thus not only using space to reduce the visibility of their material to their neighbors, but also to reduce the intrusion of other's screens into their own view. The construction of effective reading places is not the preserve of experienced scholars.

4.6 Summary
In the diary study of students, we found that individual devices are often 'based' at one or more locations. Laptops move between home and university, particularly when reading is more 'serious' and is accompanied by writing. Mobile phones dominate when commuting, and for quick reference or distraction when the phone is the 'to-hand' device. Ereaders and, to a lesser extent, tablets, are chosen for longer reading. In both cases, the thin form factor make then a preferred device for longer reading, particularly at night. For both students and academics, ereaders are strongly preferred for book reading—work or leisure—while tablets cover a wider range of reading, including the web and academic PDFs.. Place, device and content all play a role when people start to read.

5. DISCUSSION
Our results demonstrate clear associations between device choice, selection of location, material being read, time management and reading task or goal. We now reflect on the significance of these insights for digital libraries, attending to the consequences for ebook use, reading devices, and library systems design in turn.

A major theme in our findings was the contrast between 'users'—using a technology for its momentary convenience—and 'choosers'—who selected the tool they considered best for the job at hand. While the undergraduates did adopt a more 'using' strategy for leisure reading, particularly when commuting, the work-oriented reading of researchers and students alike was more oriented around making optimal choices of device, location, and reading material.

We saw mobile devices being selected for reading in a number of contexts, which is notable given the data in the present literature. A significant minority of academics still print journal articles [29], many also prefer print books to ebooks [11,28]. This is also true of students, who print articles and often prefer print books [30].

Taking the case of choosing ebooks, recent DL research has investigated ebook loaning and borrowing behaviors [3] and the factors that influence ebook adoption [13]. The evidence on ebook adoption identified wealth and necessity as forces that lead to ebook use. However, in our studies, economic factors were little reported. Instead, physical factors took a central role in the choice of ebooks and PDFs. In short-term of use, this was seen in the perceived advantages of portability and in longer-term use the lower space cost of storing larger repositories of potentially useful texts was pivotal, for both students and researchers.

The students and researchers both used electronic documents because they were simple to carry, particularly in volume. In terms of storage, digital content's minimal demand on space had an influence on researchers' highly prized personal collection practices. R26 stated that "the [physical] book has to earn its keep" while digital "sits invisibly in the corner", explaining why she had a burgeoning, if hard-to-manage, digital collection in comparison to her regularly pruned print library.

Paper, however, also plays a pivotal role. Print was used when annotation was needed; when reading was at length, or when it was retained and at hand in a location. Print thus had a 'home', while digital content was chosen for nomadic use. Print was also the mark of content being valued. The more work-oriented and useful a text was seen to be, the more frequently it was kept in paper form, and the more transient or trivial a long document, the more often it was digital. The use of paper as a working medium is in sharp contrast, being the ultimate in disposable material, but it is seen, as regularly reported, as being better for annotation.

Across print and digital text, however, in working practice readers use and combine these media in sophisticated ways. From a number of perspectives then, choosing print or digital thus fits into the broader device choice context. Both can be natural choices for different types of text. Each can serve as a 'display', and a reading task is very unlikely to be restricted to one medium. However, continuity and organization of the work is most demanding on the user where the material is digital; and acknowledged weaknesses of digital texts are still restricting its use. Enhancing the experience of digital text with better user experience could still significantly improve DL design and use.

Those constructing prototype ereaders have run short-term studies of use. Chen et al [6] ran a longitudinal study with graduate students, who were each given several prototype e-Ink ereaders Multiple slates were used for concurrent reading of different texts, but as our studies show, this behavior is already well established in the wild, and is another intentional part of technology choice.

Thayer et al [30] are the most systematic study of actual reading device use. Echoing their findings, we found a reluctance to use ereaders, for tasks that involved annotation. We also shared their observation that reading was an activity that combined different media and resources. However, we extend that insight, noting that space and (chosen or made) place also plays a key role in reading.

This influence was hinted at in Colombo and Scipioni's [8] recent study of children's reading with tablet PCs. That study found that children's reading is predominantly done at home, often in their bedroom or in the living room. As with our students, the evening was the predominant time period used for reading. It may be that the patterns exhibited by young adults closely reflect the patterns they established in childhood. However, their work-related reading, and that of the academics, draws a much richer picture of place. Our data is, to the best of our knowledge, the first report of adult mobile reading and device use that is based on observation (direct and indirect), rather than logs or survey data.

Choice is thus about content, device, space and time: "choosers" paint very different pictures at different moments, and an effective DL will enable and support work across and between paper, digital and different devices.

How could DL designers enable effective bridging between the different choice-sets that DL users construct to read effectively?

Re-interpreting both reading 'place' and 'space' through the lenses provided by Harrison and Dourish [9] seems to be a potentially fruitful angle through which to understand both single- and multi-device interactions with documents: location can be understood both geographically (space) but also in a more semantic manner (place). Both these aspects interact. For the humanities researchers specific configurations of material, devices and resources are turned to a particular goal, and the tools and purpose can be understood as providing a 'place' of work. For rehearsed locations, space and place are tightly coupled. Thus, task creates an implicit connection of available resources, which is reconfigured in different moments to continue ongoing work.

This connection has repercussions for those designing reading DL tools and ereader devices: embracing and enhancing the role of space/place could lead to improved user support and experience. However, current devices were noted by both undergraduates and researchers as impeding effective practices of place. They were also criticized for being clumsier for composing working sets (or 'handapparats') of reading material. Progress has been made on supporting other aspects where digital text has fallen short of the benchmark of paper—e.g. annotation [6, 17, 24]—and so the composition of working sets, complete with an effective environment, is likely a tractable challenge for future work in digital library research.

One key problem we discovered was controlling and choosing reading material on reading devices. The difficulties that our respondents found in discriminating similar filenames from each other (often downloaded from DLs) were a consistent barrier to them choosing ereaders for journal articles. This mirrors problems with document titles in early DLs [3] and with contemporary ebook collections [22].

Building personal libraries and working sets were two other pivotal moments of choice, particularly for the academics. There is a strong tradition of research on personal digital libraries (e.g. [12,28]), and for long-term storage, such tools may work well.

However, there is a different challenge in building short-term working sets that underpin a reading task across different times and places. These sets are not held within one library, and so within-DL tools are not a solution. Neither do personal DLs, with their focus on a central repository, address the need. These sets, if in digital form, are often distributed between laptops, tablet PCs and ereaders. What appears to be required is not so much a classical centralized repository, more a digital satchel or workspace that interconnects related material. Drawing from the traditions from which DL work has developed, this suggests that effective solutions would be more informed by hypertext than databases, and come optimized for discovery and flexibility, rather than retrieval and long-term storage. In contrast to the construction of permanent collections, the support of semi-fluid personal worksets is an area where DL research has yet to mature.

6. CONCLUSIONS

This paper has provided the first concrete evidence of how users select reading devices. Two default hypotheses seem temptingly "obvious": that they use whatever is to hand, or that they choose whatever device is most suited to the material.

Using data from three separate studies we reveal a much more complex landscape: device choice sits at an intricate nexus of location, context, material choice and convenience for both students and academics. This picture is made more complex by the frequent use of multiple devices. Understanding how and when readers use specific devices could allow us to enhance DL design by adapting services and interfaces in response to context.

Within this varied landscape, we identify clear patterns: laptop based reading is almost exclusively in fixed locations; there is a distinction between those who use devices to hand and those who fit device to purpose, but the latter is more often a product of context than inherent preference. Academics use a highly selective *handapparat* or document library of current reading, and other information professionals probably have similar techniques, but digital technology erects barriers to this sort of planned use.

While this paper identifies some clear patterns, further work is needed to understand some of the more subtle questions raised: what makes a "user" or a "chooser" of available devices, for example? The changing nature of reading and emergent technology in this field will ensure it is a rich space for research for some time to come.

7. ACKNOWLEDGMENTS

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