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Affordance Theory and E-Books: Evaluating the E-reading Experience Using Netnography

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Disciplines

Business

Affordance Theory and E-Books: Evaluating the E-reading Experience Using Netnography

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Abstract

E-books have changed the business of book publishing and the reading experience of the general public. Dedicated e-readers and other smart devices are integral to e-books offering affordances to overcome the physical limitations of print book and to provide the functionality of information technology. Using netnography, comments by online readers to articles in *The New York Time*s and *Scientific American* were analysed and coded by themes identified in the literature of *e-books versus print books*. An Affordance Theory approach was used to provide insights into the readers' perceptions of *real* and *actual* affordances and the value delivered by these affordances. Comments by online readers of two diverse datasets confirm results found in questionnaires and surveys reported in the academic literature. It is the physical attributes and functionality of smart devices used in e-reading that provides the opportunity of affordance. Our study provides support for an affordance perspective of e-books and e-readers. It also highlights preferences for e-books and/or print books in various contexts. To our knowledge it is the first to consider e-readers as an IT artefact providing information processing capabilities.

Keywords:
e-books, affordance theory, e-reading, netnography, thematic analysis,

1.0 Introduction

The book publishing industry has been disrupted and fundamentally redefined as a result of digitization. New integrated business models within the publishing industry have emerged covering the entire span of the publishing supply chain: procurement, processing, printing and distribution. However the future of publishing and the book in terms of digital versus traditional media remains uncertain. With e-book technology approaching maturity, the digital paradigm is not the dominate one in terms of consumer preference. There is uncertainty in terms of consumer preferences for the digital medium and the traditional print medium. Recent sales figures show that e-book sales have continued to fall while the sale of traditional print books have increased [1] and that the sale of e-readers and tablets are in decline [2]. An important enabler of e-books and e-publishing is the e-reader and other portable smart devices. E-readers are an integral component of the business models of e-publishers as access to many books is only available through locked branded e-readers or apps. E-readers offer functionality previously only available in information systems and, of course, access to the internet thus opening the experience of reading (and learning) to a new interactive experience. The digitization of publishing and the potential of e-readers propose a new value proposition to readers and the experience of reading. It is this new value proposition of an e-book that is the point of difference and driver of the e-publishing industry. However, as evidenced by the sales figures, the digital paradigm does not dominate the market.

The attributes of e-readers and smart devices are part of the value proposition of e-books. Users are not constrained by physical limitations in terms of the number of books that can be carried at any one time; reading material is available to download anywhere anytime as long as an internet connection is available; readers can read anywhere anytime; readers can use online information resources to resolve any uncertainties that may arise during reading, such as, using an online dictionary and using a search engine to satisfy an immediate information need. However these attributes can also be a source of distraction for readers: temptation to check emails, text messages, social media during reading and distraction by other interests while browsing. Hamid and Holmes [3] lament the loss of the sense of solitude and flow one experiences in reading a hard-copy book and further lament the intrusion of these technology options in the reading experience while also acknowledging the advantages offered by e-readers and smart devices. In her recent book on reading in a digital world, the linguist Baron [4] questions the nature of reading: "Is it an individual encounter with a text or essentially a social experience?" Baron argues that if reading onscreen is more social and less of a solitary enterprise, then we need to ask what are (or will be) the consequences.

E-books and e-readers are an information technology (IT) innovation offering a new value proposition for readers; however, the evidence indicates that there is tension between the two current reading contexts: traditional and/or electronic and user preferences that are not well understood, with the extant literature focusing on adoption and the advantages/disadvantages of e-books. Therefore a gap exists in understanding the preference of readers for print books and e-books; publishers need to understand the value proposition of readers in order to maximize the mix between traditional printing and e-publishing with their related cost and price models. Further, motivation for understanding user reading perceptions and e-books is grounded in the hedonic pleasures of reading and satisfaction derived from the reading.

The purpose of this paper is to go some way to fill the gap in understanding the perception of reading e-books on smart devices in order to understand readers' preferences for either print or e-books from an IT artefact perspective. Guided by the literature on e-books we adopt an affordance theory lens. The literature indicates that this is an appropriate theoretical approach to explore the evolution of e-books and e-reading thereby contributing to

Information System theory as well as contributing to a broader understanding of human behaviour and reading on smart devices. Based on this theoretical perspective this paper attempts to explore the research question:

What are the affordances of e-reading and do they enhance the reading experience?

The contributions of this paper are twofold: (i) it theoretically advances the emerging technology of e-books and e-readers within the context of human experience by demonstrating that affordance theory can explain the perceived value proposition of e-books and e-readers as well as provide insights into explaining preferences for the two reading contexts: paper and electronic; (ii) it contributes to understanding the actualization of affordance theory in the e-book context.

We acknowledge that the motivation to read varies widely among readers. People read for pleasure to entertain themselves; to reduce uncertainty in terms of an information task that they may have at hand; to facilitate learning that may be self-directed or within a more formal systematic learning context. In this paper we focus on reading for pleasure and the findings are restricted to this domain.

This paper adopts the approach that e-books and the smart readers on which they are stored and read are IT artefacts. E-books are an application that can be executed on smart devices. Smart devices offer the readers of e-books the added functionality of accessing multiple information resources such as online dictionaries, online encyclopaedias, and other useful information resources. By enabling web access while reading e-books, the reading experience is enhanced, allowing the user to resolve questions and thereby enhance the reading experience. This new context of reading takes the content of books beyond the boundary of print books to an information system capable of resolving information need as it arises in the process of reading [5].

The following section is a review of related literature on reading of e-books for pleasure [6] and an overview of affordance theory and its application to the current research. This is followed by the method where the virtual ethnographic approach [7, 8, 9] is adopted for the application of thematic analysis and related coding. The emergent themes are then presented and discussed in the results and discussion sections; future research and limitations are also outlined.

2.0 Related E-book Literature

To facilitate the literature review terms searched included variants of e-books for substantive publications up to June 2017 in a number of sources, such as the *Web of Science, Science Direct, ACM Digital Library,* and the top journals of the Association for Information Systems (AIS). The search located over 200 publications related to e-books and e-textbooks in primarily academic environments and in mostly journal and conference papers. The papers were classified as: technological, educational, business-related, and miscellaneous – major or minor. Records were downloaded into Excel files and parsed into numerous fields to enable manipulation. Each publication was considered in terms of findings relevant to e-book adoption including: intention to use; use; reading behaviour; user preferences; theoretical perspectives; perceptions of smart devices used for reading e-books. Only the most relevant papers are discussed below. The majority of papers are in the Information and Library Science or Information Systems domains and relate to the adoption, use, and perceived advantages/disadvantages of e-books.

E-book studies directly related to the e-reading experience of the general public are seen in online national surveys in, for example, Sweden and the UK. The Swedish study by

Bergstrom and Hoglund [10] was based on over 1,600 (58%) responses to a mail survey in 2012 from a population aged 16 to 85. The aim was to follow the diffusion of e-book reading. The findings found that, although access to e-reading devices was high – PCs (90%) Tablets (22%) and Smartphones (56%) – only about 9% had read an e-book in the last year. E-book reading was five times higher for persons under 30 years old than in those over 65 years old; the higher the level of education, the more likely a person has read an e-book; and e-reading of fiction is higher among those with higher income. The earlier study by Gunter [11] in the UK was based on nearly 4,000 responses to an online survey from a population ranging in age from 18 to over 65 and consisting of 54% females. Although 85% of the total population were aware of e-books, only 49% had used them. Of these, 38% had bought at least one e-book, 13% had borrowed one from a library. Technical and non-fiction were among the most popularly bought and read. The main perceived advantages of e-books were convenience and cost.

Bridging the two primary disciplines of Information and Library Science and Information Systems is a recent paper which looks at factors affecting the adoption of e-books by *Information* specialists, using the theoretical lens of TAM, technology acceptance model. Aharony [12] conducted an empirical study to confirm that perceived usefulness, perceived ease of use, personal innovativeness and other personal characteristics are predictors of behavioral intention to use e-books. A further paper by Park, Sung and Cho [13] showed that "user acceptance of e-book devices was affected by hardware characteristics such as perceived mobility and viewing experience through the perceived ease of use and perceived usefulness." The authors explored user intention toward e-book devices as new devices, integrating reading engagement based on flow theory and readability constructs along with TAM. Participants included over 200 undergraduate and graduate students from a large private university; while e-book devices included Apple iPads, Samsung Galaxy Tab and Interpark Biscuit.

Within the Information Systems domain, scholars [14, 15, 16, 17, 18] predominantly applied causal models extending the Technology Acceptance Model (TAM). For example, Lai and Ulhas [15] and Lai and Chang [14] had similar findings in that perceived usefulness, convenience, perceived enjoyment, compatibility and media richness contributed to e-book acceptance. Read, Robertson and McQuilken [16] extended the TAM model with a new construct, emotional attachment to print books. Their model explained 64% of the variance in consumers' intention to adopt e-readers. Emotional attachment to print books was found to be weak and negatively associated with consumers' attitude toward using e-readers. Their qualitative findings suggested that e-reader adoption may not involve a binary choice between print and e-formats. Interestingly, Sun, Flores and Tanguma [18] found that e-textbooks enhanced student learning and that this outcome was mediated by students' involvement in the use of e-books in the classroom. For students with disabilities such as vision impairment and dyslexia, e-textbooks offered potential improved access. E-books also allowed students with manual-dexterity impairments who have trouble holding books and turning pages to overcome their disability. Bansal [19] investigated the antecedents of e-book usage intention. Findings of this study reveal that environmental consciousness lowers preference for printed books and that personal factors impact the preference for printed books and perceived design evaluation of e-books in different ways. Perceived positive navigational design enhanced attitude towards e-book usage whereas preference for print books decreased.

In addition to TAM theory, Park et al. [13] applied flow theory; Lai and Chang[14], Lai and Ulhas [15] and Lee, Han, Lee and Lee [20] applied diffusion of innovation; Williams, Slade and Dwivedi [21] applied subjective norms; and Antón, Camarero and Rodríguez [22] used hedonic perspective and self-congruence theory to study adoption of e-books. Furthermore, Stone and Baker-Eveleth [23] applied the expectation-confirmation model to examine university students' intentions to use e-textbooks. Lin and Ming [24] explored information

goods pricing and distribution theory to develop a game theory model of pricing for e-books. Similarly, Jiang and Katsamakas [25] applied game theory to examine how e-books affect strategic interaction in the market between sellers and consumers. Bounie, Eang, Sirbu and Waelbroeck [26] applied disintermediation theory to examine whether e-books cannibalize or increase print sales. Interestingly, Zhang and Kudva [27] applied media displacement and innovation diffusion theory to examine factors contributing to e-books adoption. They used data from nearly 3000 nationally representative US participants from the Reading Habits Survey of the Pew Research Center's Internet & American Life Project. The results of the study "support the notion that e-books are not yet positioned to replace print books" and that the major predictors of e-book adoption are the "number of books read, the individual's income, the occurrence and frequency of reading for research topics of interest, and the individual's internet use, followed by other variables such as race/ethnicity, reading for work/school, age, and education". Hsu, Chen, Chang and Hsieh [28] administered a web-based survey to randomly selected Taiwanese. The authors used an extension of the UTAUT (unified theory of acceptance and use of technology) model to examine key factors affecting users' adoption of e-book: environmental concern, perceived benefit, and 'benevolence trust'. The survey results showed that all three factors were significant determinants of e-book adoption with environmental concern having the greatest impact on e-book usage.

Anton *et al*. [22] administered an online survey through a variety of social media network groups and pages related to reading, bookshops, e-books and relevant new technologies. The aim of their research was to explore consumer perceptions of e-books and e-readers. Responses consisted of over 650 non-users: 63% females with ages of all respondents ranging from younger than 25 years old (51%) to older than 65 years old. The findings showed "that perceived enjoyment and self-image congruence complement perceived usefulness in forging a favourable attitude toward e-book readers and adoption intention, and that knowledge proves essential in the adoption process. Moreover, people highly involved with reading tend to perceive e-book readers as useless, which hampers their adoption."

Summary: The Information Science literature has focussed on use and perceived advantages and disadvantages in order to measure interest in reading and using e-books as well as identifying users' perceived advantages and disadvantages against print books. The Information Systems literature, on the other hand, is theoretically focussed with a number of common causal models being used. However the focus is on adoption, acceptance, engagement and intention to use e-books. Our purpose is to expand the theoretical landscape of the body of literature by applying an affordance theory lens to the study of e-books. Our reasoning for this approach is outlined in the following paragraph.

In order to assimilate and synthesize the literature to provide some insights to the theoretical perspective to be adopted in the current research, the key findings of the research were considered for emerging themes. On analysing the results we found that the bulk of the findings regarding advantages of e-books were rooted in the functionality and other affordances provided by the devices on which e-books are read rather than the content of the e-book. Intuitively this is parsimonious as the innovation of e-books is the smart devices on which the books are stored, accessed and read. These devices offer functionality that can enhance or detract from the reading experience. As we have identified that the IT artefact is the innovation that is being considered, we have adopted affordance theory as our lens for the remainder of the study.

3.0 Theoretical Background

Affordance theory continues to be of interest to Information Systems (IS) researchers with several perspectives emerging in recent years aiming to consolidate and generalise affordance theory to the IS context. Appendix-1 lists research papers in IS using affordance theory. This paper aims to continue this trend by considering the use of e-books and smart devices to gain insight into the readers' perceptions of affordances and the value delivered by these affordances.

Along with information systems, affordance theory has been used in other research areas including: biomedical informatics, artificial intelligence, engineering design, information science and social psychology among others [29, 30, 31, 32, 33]. Gibson [34] proposed the school of thought known as ecological psychology where the concept of "affordance" or the "opportunity for action offered by the real world" is proposed. According to Gibson "the affordances of the environment are what it offers the animal and the environment" [34, p.127].

Norman [35] has been influential in the development of the IS perspective of affordance. Norman observed that in order to understand the interaction between humans and objects it is important to recognise both an object's intended use (real affordances) and the affordances perceived by the user (perceived affordances). This view has been appropriated by the HCI community which has focussed on how different visual cues in IT artefact design [36] support real affordances of the artefact [37].

In this paper we use the word affordance in line with Gibson's perspective and consistent with more recent research in IS [37, 38, 39, 40]. Volkoff and Strong [37, p.822] outline how ecological psychologists have come to a consensus that "an affordance is a property of the relationship (between the user and the artefact) and is defined as an opportunity for action". In reconciling opposing views of constructivism and realism on the social impact of technology, Hutchby [41] argues that "affordances are functional and relational aspects which frame, while not determining, the possibilities for agentic action in relation to an object". He continues that users enter into relationships with objects and that in the relationships objects are "read" by the users and users produce readings of objects which best suit the purpose they have in mind for the object. Affordances are functional in the sense that they are enabling factors in a user's attempt to engage in an activity: reading a book; photocopying a document; sheltering from a storm. Certain objects, environments or artefacts have affordances which enable the particular activity while others do not. The relational affordance of an object may be different for one species than another or for one user than for another. Therefore realists argue that an affordance exists in the domain of the real [37, p.822].

Objects may offer multiple affordances in a single object–user view relationship. For example, a person may view a chair as offering a *sitting* affordance however may also view it as offering a *standing* affordance to help reach something otherwise out of reach. In this example both the associated goal and the actualising affordance are tied to the one actor; a resulting event or outcome in the actual domain is necessarily specific to the actor. While actual affordances exist within the actual of a specific individual we can refer to generic affordances in the real (the sitting affordance of a chair; the reading affordance of a book). This idea of a *generic* affordance allows for a structural range where actors exhibit a range in how the affordance is operationalised: actors can sit differently on a chair; a book may be read differently by any one reader.

Within the context of this paper we propose the importing of the idea of affordances from ecological psychology to IS research in the context of individual goals and actions. We

adopt the Volkoff and Strong [37, p.823] definition of affordance: "The potential for behaviours associated with achieving an immediate concrete outcome and arising from the relation between an object (e.g. an IT artefact [such as a smart device on which an e-book can be read]) and a goal-directed actor or actors [e.g. a user of the smart device whose goal is to read]."

In a review of the affordance theory literature, Bernhard, Recker and Burton-Jones [42] came to the following conclusions regarding affordances and IS research:

- There is a lack of consistency in the distinction of affordance perception and affordance actualization, even though psychology researchers have highlighted the precedence of these two constructs.
- Affordance is an immature area of IS research.
- There is a lack of consistent methodological approaches and a lack of survey methods.
- The characteristics of the user are not being appropriately addressed in IS research.

To address the above shortcomings and advance the understanding of affordances in IS Bernhard *et al.* [42] offer a general framework of affordance as shown in Appendix 2. This is a significant contribution as it is the first attempt to develop a nomological model of affordance perception and actualization that can be used for empirical research of affordances. Importantly, the model recognizes the characteristics of the IT artefact (object) and the user; the recognition that affordances must be perceived before they can be actualized and the outcomes of actualization may be positive and/or negative.

Pozzi, Pigni and Vitari [43] use the Bernhard *et al.* [42] model as a framework for organising the extant IS and interdisciplinary affordance literature. Pozzi *et al.* [43, p.4] achieved this by using the constructs of their figure 1 to classify the literature. A valuable contribution of this classification of the affordance literature is that it enables the analysis of the extant IS literature, particularly regarding methodology. The majority of the work has been theoretical and of those that report case studies the vast majority consider organizational information systems, not ubiquitous personal computing and artefacts. Bygstad, Munkvold and Volkoff [44, p.1] consider the issue of critical realist data analysis in critical realist IS research. They proposed an affordance based framework to identify and analyse casual mechanisms in critical realist research "helping the researcher to conduct a more precise data analysis in empirical research".

The current research aims to go some way in consolidating the issue of affordances in IS research. Firstly it offers the opportunity to identify the value proposition of IT artefacts through the perception and actualization of affordances by users of an object. Secondly, the approach in this paper can confirm the framework proposed by Bernhard *et al.* [42] by identifying the dimensionality of the constructs in the context of e-books.

We study the affordances through untangling the interaction between social actors (readers, users of e-books and smart devices) and a material artefact (e-books on a smart device). This is achieved by identifying perceived affordances of e-books and smart devices that are actualized by readers of e-books thereby enabling the understanding of what is valued by readers of e-books. We do this by following Volkoff and Strong [37] who state that "researchers seeking to identify affordances need to uncover the immediate concrete outcomes the actors experienced or expected to experience". The methodology described below illustrates how we were able to identify what the technology enabled users to do; what it made difficult; what the technology was used for; what happened once they used the technology and what they expected to happen.

4.0 Method

In order to contribute to a better understanding of readers' perceptions of the affordances of e-readers and e-books from a practical perspective, we examined two online discussions on e-books, e-reading and e-readers by users of e-books using a virtual ethnographic or netnographic approach [7, 8, 9, 45, 46, 47]. Netnography has emerged from ethnography in response to the phenomena of digital communities or, as more recently identified by Germonprez and Hovorka [46], digitally enabled social networks. With the emergence of digital communities appropriate approaches are required to study them and to address relevant research propositions. Germonprez and Hovorka [46, p.527] see digital enabled social networks "as provoking a response from the world through social engagement, connecting with people and their behaviours and reflecting concepts; norms and values defined by its members". Social networks and communities then are a rich source of data that has remained largely untapped by information systems researchers. In this paper we use netnography to identify communities of readers of e-books and users of smart devices and then adopt qualitative research methodologies to explore a specific research question [9, 49]. By analysing comments of readers to answer the question "*What are the affordances of e-reading and do they enhance the reading experience*" we are able to identify issues of relevance to perceptions of the affordance of e-books and e-readers, from both a positive and negative perspective; thus enabling us to identify issues of relevance to e-reading and users' preferences not currently captured in the research literature. Virtual ethnography enabled us to conduct our research, particularly in terms of data collection, in a context that is not affected, obstructed, or interfered with by the researchers' prior assumptions and understanding of a research domain [9, 45]. This renders the analysis sensitive to uncovering aspects that are not yet revealed by research but that are prevalent from a practice perspective [45].

Sadovyhk and Sundaram [48, p.8] propose that while netnography is a new approach based on ethnographic principles that provides rich insights into human society there are a few weaknesses that pose a limitation to its widespread use. To address these weaknesses and to ensure the generalisability, validity and usefulness of the method they suggest three mechanisms to extend and enhance the netnographic approach namely: longitudinal, iterations, and convergence. We have applied these three mechanisms in this study. The study is longitudinal as the comments were collected over a three month period in 2014 and over a two year period in 2015. We practice iteration by analysing two dataset from different sources and convergence was achieved in terms of the emerging themes across the two datasets.

To add to the generalisability of the findings two sets of data were used for this study. Set 1 is the debate that emerged in response to an article published online in *The New York Times* (NYT) on December 31, 2013 entitled "How Do E-Books Change the Reading Experience" [3]. Within a week 305 comments had been posted. Set 2 contains comments that were made by readers of a *Scientific American* article which was published on April 11 2013 [49]. The article explores the question: How exactly does the technology we use to read change the way we read? The article explores this question by considering the scientific evidence regarding retention and reading thoroughly. A total of 42 comments for the period of April 20, 2013 to June 11, 2015 were contributed. The comments from these two datasets provide a unique opportunity to investigate data from an online discussion about users' perceptions of e-reading that involved a substantial population. Table 1 summarises the empirical data included:

Table 1. Decriptives of Datasets

	Dataset 1	Dataset 2
Source	*New York Times* [3]	*Scientific American* [49]
Number of comments used	307	42
Number of contributors	288	36
Time period	January – March 2014	April 2013 – June 2015

In terms of the veracity of this approach we consider the literature on reader comments/debates in response to media articles. Reader comments in response to articles in the main stream media is a form of user-generated content [50]. Reader comments and debates that occur at the end of articles are referred to as "below the line comments" [51]. These comments are significant as they allow readers to discuss and debate news content with each other and the journalists thereby providing the potential to shape the practice of journalism. However there is limited research into "below the line comments" [51]. In a study investigating how "below the line comments" may be changing the practice of journalism as well as the quality of the comments (including participation, bias and influence by commenters) Graham and Wright [51] consider the following question (among others): to what extent do comment fields provide a space for deliberative talk? In answering this question they conducted a content analysis of 3,792 comments across eighty five articles that focused on the UN Climate Change Summit that appeared in the *Guardian* newspaper. The analysis identified four trends in the data: the comments fields were used as a communicative space for public debate; Q&A; degrading, praising and promoting political action. The discussion was not dominated by any one participant or group of participants. The authors acknowledge that these findings are contextual however they do indicate the value of such datasets and legitimises their use.

The comments were loaded into two Word files comprising 123 pages and 39,000 words for the *NYT* article and 13 pages and 6,181 words for the *Scientific American* article. Comments, or replies to previous comments, varied in length from short one-sentences to several paragraphs. The *NYT* and *Scientific American* moderate all comments ensuring a high quality of debate, evident in the complete absence of spam and inflammatory comments in the datasets. The *NYT* parses two subsets of the data by tagging comments in one of two ways: *NYT Picks* or *Readers' Picks*. The *Scientific American* did not tag the comments. The full complement of comments for both articles was used for this analysis ignoring the tagging by *NYT* or readers. For the *NYT* article, not surprising, most (86%) of the comments came from readers in the USA and of these, over one-third (36%) were from the Northeast; 11% came from 18 other countries and 3% of commenters gave no location. Nearly one-half (46%) expressed a preference for reading e-books; one-quarter (25%) stated reading both electronic and print books; 18% clearly preferred reading print books; and 11% indicated no preference for either format. For the *Scientific American* article no geographic data is available; 29% expressed a preference for e-reading; 32% preferred reading print; 7% preferred e-reading and print and 32% indicated no preference. Furthermore, we inferred that the 288 *NYT* individuals and the 36 *Scientific American* individuals who wrote the comments are: computer-competent; read and/or subscribe to the online version of the *NYT* and *Scientific American*; interested and/or passionate readers; and most likely, somewhat extroverted.

We adopted a thematic analysis of the empirical material and were particularly guided by Braun and Clarke [52]. Our approach was deductive, as indicated in the literature section, in line with previous analysis [5] demonstrating that themes emerging from the current literature were consistent with an affordance theory approach. The extensive literature review generated a set of initial codes as listed in Table 2.

Table 2. Initial Codes

• Accessibility • Portability • Environmental consciousness • Personal preference	• Overcome disability • Convenience Enjoyment • Navigation	• Reading/reading techniques • Media richness • Ease of use • Cost

After reading and familiarizing ourselves with the data (comments) confirming that it was consistent with the proposed deductive lens, initial coding commenced. The open coding was informed by the codes derived from the literature review and at the same time the coders were open to identifying additional dimensions not currently present in the literature. When individual comments raised multiple issues they were coded against all issues raised by a participant. The *NYT* data was split into three subsets and each subset coded by one of the authors. The focus was on issues of affordances offered by e-books and e-readers that participants addressed as important or critical. The *Scientific American* data was coded individually by two of the authors. After synthesizing the outcomes the data were coded as listed in Table 3. All codes apart from reading mode and retention, which emerged from the *Scientific American* comments, were common to the two data sets. This difference can be attributed to the focus of the articles and the nature of the respective audiences. *Scientific American* is a popular science publication and therefore has a readership with an interest in science. This is reflected in the article which focused on the scientific evidence of the effects of reading in different media. The audience's knowledge of science was evident in some of the comments. Coding however was restricted to those comments that were relevant to personal experience of reading in both media (print and electronic) maintaining the affordance lens of the analysis.

Table 3. Final Codes

• Convenience • Portability • Environment • Personal preference • Disability • Navigation • Media richness	• Storage • Fatigue • Distraction • Security • Privacy • Cost • Serendipity • Aesthetic	• Content • Dictionary/web • Accept technology • Reading mode • Retention

A spreadsheet was used to track and manage all analysis tasks as well as the inter-coder reliability [53]. Inter-coder reliability was tested with the percentage of items placed in the target theme. The average was 84% for the *NYT* data and 71% for the *Scientific American* data which indicates a good reliability coefficient as it compellingly exceeds the threshold level [54]. The next phase of the analysis included the identification of themes through the consideration of the relationships between codes, between themes, and between different levels of themes (i.e. main overarching themes and sub-themes). This phase was operationalized via a thematic map considering the relationships between primary codes and their dimensions. For example: two significant codes, convenience and portability, and their dimensions were mapped against each other resulting in the synthesis of the dimensions and the merging of these two codes into one theme, 'enabling reading', and the identification of another theme, 'device functionality'. Following Hine's [8] advice, the subsequent analysis conceals the nicknames used by the participants in discussions in order to help preserve the anonymity of their online identities; instead we used a numbering system. Numbers preceded with SA refers to comments from *Scientific American* and numbers alone are from

the *NYT* commenters. Numbered comments are quoted verbatim with minor corrections indicated in square brackets.

5.0 Results

Two overarching themes emerged from the analysis: (i) e-books and e-readers enabling reading and (ii) the functionality of the e-reader smart device. It is very clear from the analysis that participants in the debates all enjoy reading and that reading for pleasure is an important activity in their lives. Clearly there is a relationship between the participants and the artefact, be it an e-reader or a print book. The artefact clearly offers the user the affordances to pursue an activity that is important to their quality of life: reading. From a theoretical perspective the emerging technology of e-books and e-readers offer affordances that enable readers to read more and more often.

> *"Among many other ways in which my Kindle has enhanced my life is being able to read and download books while sitting for eighteen hours in a hospital emergency room or being able to download new things to read while visiting places with no English language bookstores. Or not having to s[c]hlep books in a suitcase. In my opinion, it's the best thing that's ever happened to reading."* (32)

5.1 E-books and e-readers enabling reading

Affordances that enable reading are affordances in the real: accessibility; portability and storage, while disability is experienced in the actual context of the user. The actual affordance is derived from the nature of the disability that is experienced by the user, i.e. ability to adjust font size assists sight impairment while compactness and weight can assist with dexterity issues.

Cost is not a real affordance, rather it is an attribute of the artefact that renders it accessible to users at a lower cost to that of the traditional print book.

Commenter 32 highlights the real affordances of e-books and e-readers that enable reading. Smart devices are portable and through their functionality provide access to book collections at any place anytime; Internet connectivity provides access to unlimited reading resources at any place anytime. The compact size of the device enables readers to have access to their reading material without the bulkiness of print-books. Convenience (including accessibility), portability, storage (affordances in the real) and cost are sub-themes of 'enabling reading'.

Accessibility: The online capability of smart devices offers the affordance of downloading e-books and provides readers unsurpassed access to books; that is, affordances of the device rather than the content.

> *"Bezos and Project Gutenberg have granted easy access to the classics that I'd never read and the books I would never have found by browsing in a bookstore or even a library."* (36)

> *"… the most positive thing about having an e-book reader is access to thousands of free out-of-print books."* (264)

> *"However I've noticed a new and different kind of marking the moment starting to emerge and it's due to the portability and accessibility of the e-book combined with the syncing of Kindle and Audible - where I can pick up where I left off in the e-book with the spoken word on my phone."* (290)

Portability is an important attribute of e-readers offering the affordance to read anywhere at any time.

> *"My kindle Paperwhite allows me to take twenty or thirty books along in a space smaller than a paperback book."* (137)

> *"… the idea of being able to carry an entire library with me wherever I go, …"* (166)

> *"The biggest advantage of e-books is that you can have hundreds of books in your suitcase when you travel ..."* (70)

> *"I read technical stuff, like Science magazine; news and literature, like the New Yorker; and some fiction, all on the iPhone that is usually in my pocket."* (SA42)

Storage: Readers have found that accumulating substantial book collections has placed considerable demand on storage space in their homes. E-readers enable readers to have substantial collections of books without the need to store them.

> "*I ran out of room for print books, and I like the books I buy too much to give them away. E-book is my solution to that conflict. I can hoard books without living in clutter and chaos.*" (8)

> *"Every time I move though, I rather wish more of my books were in electronic form."* (96)

> *"Digitization of created works preserves them independent of the media. Physical and analog media … are subject to deterioration but the pattern of zeros and ones which make up the creative work lives on."* (117)

Commenter (117) extends the affordance (e.g., compactness for easy storage) of e-books to that of preservation or extension of the life span of books through digitization.

Cost: E-books are generally less expensive than print-books and with immediate downloading accessibility, convenience to readers is more attractive.

> *"… works in the public domain cost virtually nothing when bought in pixels …"* (221)

> *"Actually, there is a $5 bill in every e-book. It's the difference between what you pay for the printed version and the lesser cost of the download."* (94)

> *"… the immediate gratification of having the book to read in seconds in your hand, at a price that ensures a steady stream of future books without breaking the bank."* (271)

Disability: A further dimension of the convenience of e-books and e-readers is the affordance of overcoming physical disabilities in some users that limit opportunities to read. This affordance relates to the physical attributes of the smart devices: compactness, light weight, easy to use (no need to physically turn pages), adjustable font size, and adjustable back lighting.

> *"Many of us are old or handicapped or arthritic and the Kindle and iPad and Airbook are godsends. You can read from an extremely light medium, easy to hold and easy to carry; you can change fonts and their sizes for maximum legibility."* (64)

"I resisted ebooks for a long time. But I have severe arthritis in my hands and could no longer hold books open. My Kindle, succeeded by my Kindle Fire HD, [has] restored books to me. Yes, I still miss elements of paper books, but am so happy to be able to read again." (233)

"I suffer from Cataracts and Glaucoma and the purchase of my Nook is a godsend." (146)

"If I am old, and lazy, and vision-impaired (I am all 3), I can quickly tweak the font size and color (white or gray on black is quite nice), and start auto-scroll. If unhappy with the line width, I can change it instantly." (SA39)

Summary: If we consider a root-cause approach in terms of the affordances (both real and actual) of convenience (which enables reading at any place and anytime) we discover that it is the innovation (the IT artefact) that delivers the affordances for the user. Primarily it is the physical attributes and functionality of the innovation that provides the opportunity of affordance. E-readers are smart devices and some are multi-functional such as tablet computers and smart phones. These devices are compact (smaller and lighter than a paperback book) and therefore they are portable and do not require storage space in homes. This portability allows readers to carry with them extensive book collections enabling them to read in circumstances that would otherwise not be possible, a real affordance. Additionally, e-books are generally less expensive than print-books and are immediately available for reading. Disabled readers also benefit from the affordances of e-books and e-readers and internet connectivity of e-readers provide access to unsurpassed reading resources.

5. 2 Functionality of the e-reader smart device

E-readers are artefacts with a number of functions and attributes that are perceived as affordances by users. Smart devices are analogous to information systems as they provide access to the internet and other information resources thereby enhancing the reading experience. Navigational functionalities of e-readers extend the reader's engagement and enjoyment of e-books; some of these are: hyperlinks (internal within e-books or external via the web), searching, browsing, dictionary look-ups, and general use of the web to complement or supplement e-books. From readers' experiences (as outlined below) the application of the functional affordances are applied in the actual, they are defined by the user's need and context.

*Hyperlink*s: Internal hyperlinks are equivalent to footnotes and/or references in print-books while external hyperlinks are links embedded in the text of e-books to information sources in the web. Unlike e-books in smart devices, comparable print-book links are available to readers only through extensive personal (and public) print-book collections.

"An added bonus is that footnotes are hyperlinked - one can tap the indicated number within the text and have the entire footnote appear; another tap brings you right back to the place you were reading." (73)

"[T]he usefulness of the internet with [its] immediate access to on-line reference and maps makes for a very complete reading experience and extends the time and pleasure, it takes to finish reading any book." (177)

"*There are some books, with imbedded links, video, or sounds, that lend themselves to the format."* (216)

> *"I love having embedded hypertext links to related material, but I don't want to follow those links while I'm reading or I will lose the "thread" as it were. I usually go back after completely reading and follow the links."* (SA10)

Related to internal and external e-book hyperlinks is the "X-Ray" function which is a reference tool incorporated in later models of Kindle e-readers, providing general reference information for certain e-books. Information files for frequently appearing names, places or events are preloaded into the Kindles allowing readers immediate access to brief encyclopedic information of interest without exiting the e-book to interact with the web.

> *"… the X-ray feature. It allows me to easily keep track of names and places used throughout a novel. For example, I reread Anna Karenina recently and this feature allowed me [to] cope easily with all of those Russian names, including patronymics and diminutives. Unfortunately, X-ray is enabled only on relatively recently published books."* (88)

> *"I don't know why this feature [X-Ray] of Ebooks isn't lauded more often. It really is like having a research library at you[r] fingertips."* (87)

Searching: Readers are keen to use the indexing/search function of their smart devices to enhance their reading.

> *"On the other hand, when reading a book full of major and minor characters, I appreciate that my iPad iBook format allows me to search for earlier references to an obscure character— …"* (139)

> *"E-books are particularly great for reference material (searchability is king), …"* (50)

> *"For me, the difference is all about note-taking and searching for specific material inside a book."* (297)

> *"Then I discovered how much easier research is on digital books--search for a word or phrase and find every passage instantly."* (208)

> *"I do most of my reading electronically these days. And the ability to search the text and google items in it is quite handy."* (3)

> *"I also find Search very useful--for example, to look up the first instance of a fictional character that has not figured in the plot for many pages, or of an acronym or abbreviation the meaning of which I did not pick up."* (SA42)

Commenter (3) combined both internal searching within the e-book and external searching using Google to search for additional or related information on the web.

Browsing: Often readers equate browsing of e-books with fast forwarding, rewinding, paging or flipping. Browsing can also refer to similar activities in 'electronic warehouses' of e-books or in bookstores with print-books. Comments related to browsing were both *positive* and *negative*; many found browsing print-books easier than browsing e-books. Commenter 237 (see below) came up with a *novel solution* to overcome some negative comments.

> *Positive:*
>> *"Apple and Nook and I really suppose Kindle have the ability to fast forward or rewind a book like a movie along a line and with a marker on the bottom of the page."* (161)

> *"Bezos and Project Gutenberg have granted easy access to the classics that I'd never read and the books I would never have found by browsing in a bookstore or even a library."* (36)

> *"I like browsing through Amazon's electronic warehouse--it's more like the experience of browsing through the bookshops I used to love."* (208)

Negative:
> *" … it is incredibly difficult to flip pages to revisit something read earlier, especially if it is more than a few pages back." (162)*

> *"But I miss the browsing or just flipping the pages [of print books]."* (172)

> *"There is something special about holding a book in my hands, marking a page, flipping back and forth, margin notes to myself. .... once read I place it in my bookshelves among hundreds I have finished. I love browsing my library sparking my memory of a story told and inviting friends to borrow a copy. Digital does not offer me this."* (296)

Novel solution:
> *"Yes, the set back in general is that when reading a narrative with numerous characters (e.g., Winter of the World, Anna Karenina), I often need to page back and forth to the beginning table--not especially easy on an e-reader. BUT, here too technology can help! I simply take a shot of those pages on my iPhone and voila, can look at both at the same time."* (237)

The comment by 237 is an example of an actual affordance of the device (in this case a mobile phone) enabling the reader to overcome (or interpose) a perceived limitation of the e-reader device – difficulty to navigate. The camera of the mobile phone is used to create and store a permanent record that can be used for future reference to resolve uncertainty that arises from complexity within the content.

Dictionary look-ups: The need to consult a dictionary is an information need that arises from the activity of reading. The functionality of the smart device allows for this need to be resolved immediately. The function of accessing an online or embedded dictionary is a boon for many readers.

> *"If I don't know a word, I can look it up then and there."* (164)

> *"Being able to instantly look up a word definition is a fantastic feature."* (153)

> *"… touch a word and the definition pops up. … thanks to the built-in dictionaries."* (88)

> *"Being able to look up words and references immediately enhances knowledge and a fuller understanding than when you read something on paper"* (SA8)

> *"I have definitions at the tip of my finger and can look up references in Wikipedia = awesome!!"* (63)

The last two Commenters (SA8 and 63) combine several affordances of e-books and e-readers: dictionary look-up, encyclopaedic information and embedded links to references within the encyclopaedia.

Summary: The functionalities of smart e-readers add to the user's understanding of the content of the e-book: hyperlinks, dictionary look ups, and searching within and outside of

the e-book. There are some traditional capabilities that are not easily transferrable from the print to the electronic environment , such as 'flipping' pages when browsing.

5.3 Other themes

In addition to the two dominant themes discussed above, several other themes emerged from our analysis. Two minor themes viewed e-books positively – *environmental sustainability* and *media richness*. Some users of ebooks are motivated by an intrinsic need to pursue their reading interests while not consuming paper, thus minimising their impact on the environment.   The real affordance of e-readers being free of paper provides an affordance for these readers that they value. Commentator 167 outlines that e-readers have the potential for further development into rich multi-media devices. They call for the design of affordances offering multi-media capacity.

Environmental sustainability:

> "*A kindle is the closest thing one can get to a 'real' book without having to chop down trees.*" (132)

> "*The e-ink technology is excellent on the eye and draws little power.*" (109)

> "*... It's a shame because I would like to spare some trees, so I try to read as much as I can in a digital form.*"   (SA11)

Media richness:

> "*… the reading screen, whether on an iPad or Kindle or my home computer, is best suited for visual imagery. Ebooks, I think, need to evolve into their own, into a new form. I've been doing a few experiments with this myself, in my own ebooks. Images, small blocks of text, links outside the ebook … As the ereaders evolve, we can add sound and video along with the words--not just tacked on, but designed from the beginning as an essential part of the whole experience. That's the trick: DESIGNED for the medium, not just a novel tacked onto the screen...* (167)

A number of other themes described e-books in a negative light: *distraction, fatigue, serendipity, aesthetics, security, privacy and content*.

Distraction: The functionality of being online does offer affordances as discussed above, however, on the other hand, it can be seen as detracting from the reading experience. Distraction is a negative perception of an affordance. The affordances of hyperlinks and Internet connectivity is perceived negatively by some users.   This is consistent with affordance theory where not all users of objects need to enact all affordances, where the actual outcome is specific to the actor.

> "*I do agree that it is too distracting to read on an iPad, but there is a solution for that: have a dedicated eReader like the Kindle Paper White. It is terrible for internet surfing, so you get the solitude you need to concentrate on reading.*" (40)

> "*… kindle fire. I had that thing for about two days before I sent it back, because the main purpose of that piece of junk is to be connected. I traded that in for the paper-white and since have read [from] nothing else.*" (166)

> "*…Magazine articles like this one, however, with the intrusive Like/Tweet/Share/etc. junk to the left and other linkages to right of the text, are very difficult for me to handle.*" (SA10)

One Commenter, however, found that a variety of *distractions* can also occur when reading print-books. It is up to the reader to be (or not to be) distracted.

> "*I understand the concept and the ease of distracting oneself when using an e-reader, but I find homes, bookstores, and libraries (I am a retired librarian) just as capable of distracting me when I read on paper as when I read on an e-reader. If I chose not to be distracted, it is perfectly possible to be as disconnected with an e-reader as with paper.*" (2)

Fatigue: Although positive aspects of e-readers, especially for disabled readers, have been discussed above, there are worries related to eye-fatigue from prolonged e-reading.

> "*I tire faster on the Kindle. Whereas with actual reading material, I can read for hours …*" (175)

> "*I wouldn't use a Kindle Fire or other tablet for reading, mostly because of the backlight, which is tiring on the eyes.*" (54)

> "*…reading on a screen is more tiring and is remembered more poorly than reading on paper.*" (SA1)

Serendipity or 'accidental discovery' is generally not an attribute of e-books.

> "*Shopping online for a book, regardless of media, is a far less satisfying experience than browsing in a bookstore. Happy accidental discoveries are much harder to come by online.*" (50)

> "*Once, when I was struggling financially, I found a five dollar bill in a book of Countee Cullen's poetry that I checked out of the local library. Such serendipity is not possible with an e-reader.*" (95)

> "*… the other Gone thing is learning how to benefit from an index. Some of the best "finds" are made coincidentally while searching a print index.*" (173)

Aesthetics, the human perception of beauty, is not generally attributed to e-books; rather e-books are designed to be functional, often single column with images placed within the text. Graphical enhancements are sparse (to date) and are supported differently on different smart devices. The layout of e-books changes with the e-reader used and with the e-reader's font and type size settings. The aesthetic affordances of print books are not present in e-readers, this is a matter for lament of some readers.

> "*… missing out on some delightful surprises (including the surprises of lovely old edges and affectionate dedications to previous owners—graphic and interpersonal history, right there in your hand!*" (121)

> "*… maps, charts, and photos suffer in translation to e-Ink…*" (60)

> "*When you read a physical book, every time you pick it up or put it down, you look at the cover. You see the title. You see the author's name. With an e-reader, it is too easy to forget even the title of the book you're reading, because you never see it once you start reading.*" (91)

> "*… awesome covers that can greet you like an old friend, that my Kindle merely jumps beyond as if they were not worth the viewing.*" (83)

> "*I love books, the way they feel and smell. I get a special feeling when I close the last page of a book that I have loved reading.*" (259)

Security or the impermanency of e-books worries readers. Likewise, not being able to pass on or exchange books with friends is often a concern. Security is a contextual affordance that some users miss. The virtual nature of ebooks leads some users to feel a lack of ownership over books.

> "*And when the servers go down, and your battery charge on your e reader is gone, where is your book? Digital books are in fact only rentals, not permanent. … E books are diet soda, compared to the real thing.*" (118)

> "*I've read between 20 and 30 p-books inherited from relations long deceased, books bought since the 1920s. Obviously some of these books must be available in e-format but certainly not many and some have pushed me towards authors I wouldn't have found otherwise. My wife has a Kindle with several hundred titles but the day she dies, I doubt very much that anyone will be fighting over that machine.* (134)

> "*They think of using an e-book, not owning an e-book," she says.) They have a 'license' to read the e-book. They can't lend it to their friends. They can't go to a library, or kiosk, or community center and exchange it for another 'used' e-book. They may not be able to read it next year or on a different device due to technology changes.*" (SA27)

Privacy: Privacy is a contextual affordance offered by print books. A number of search engines and online booksellers are able to track your searches for books and therefore track your reading habits. Some sense that their e-books are reading them and that their e-readers are collecting data (title-by-title) on their 'bookish' habits to answer questions such as: when and where reading stopped, notes taken, sections highlighted, passages re-read, and finally which e-books were read in their entirety.

> "*On her bookshelf, only visitors to her house will know that alcoholism is of interest to her. On her kindle, the NSA, every hacker in China and Eastern Europe and anywhere else in the world and every company interested in selling her more books will know.*" (19)

> "*I also fear the steady intrusion upon our lives and the erosion of privacy and solitude posed by the advance of technology.*" (158)

Content: Finally, the moderating theme *content* views the message (not the medium) as the most important affordance of a book. Some readers have the ability to perceive the content as inherently separate and independent on the device or medium on which it is read.

> "*The fact is that books don't happen on paper or in electronic media; they happen in the brain. Once they make that leap from the medium to the mind, it doesn't matter where they originated.*" (18)

> "*My (basic) kindle is my treasure trove. I read 3x more books than I used to. I love the availability - living in a place where there are no big bookshops - and convenience of reading several books at the same time (especially when travelling). Not being a native English speaker I very much appreciate instant dictionary access. The Search function is great. I no longer judge a book by its cover but through reviews only – which works in 99% of cases. Wireless is turned off so I'm not distracted (like Moshin Hamid) and I do not miss the possibility to project my personality because people don't see what I'm reading (Anna Holmes). In the end it is about taking in the author's words, the medium is irrelevant.*" (251)

The two codes of *reading mode* and *retention* emerged from the *Scientific American* article. The commentators of the *Scientific American* article distinguished between different types of reading. They consider that the affordances of reading on an e-reader are not conducive to reading for information seeking/learning. Interestingly they distinguish the context of reading and the actual affordances for learning and reading.

Reading mode

> *I still prefer hard copies. For instance, I went to digital for sciam for 2 years but I am back to hard copy magazines, I just prefer to read serious material on hard copy. I just use the digital sciam to look up past material.* (SA11)

> *"…when I read I read to obtain information, and usually by the time something is printed the information contained within it may have expired. So I read science blogs, and read periodicals like SciAm. … I read to obtain information, … e-reading, despite its shortcoming make the most sense to me if your objective is to obtain information."* (SA19)

Retention

> *"... I know that when I recall a passage, I can often find it quickly in a paper version as I have remembered roughly where the passage was. I cannot do this on my Nook reader, which I read the Washington Post and Financial Times on, but have found less satisfactory than a book."* (SA 28)

> *"My current favorite device for reading books and magazines is the iPhone, although my laptop is better for the large, complex illustrations that often appear in Scientific American. I honestly believe that my retention is just as good as with books."* (SA42)

6.0 Discussion and Conclusion

We have studied the affordances of e-reading and e-books by untangling the interaction between social actors (readers, users of e-books and smart devices) and a material artefact (e-books on a smart device). This was achieved by analysing below-the-line comments provided in response to two articles, one appearing in the *New York Times* and the other in *Scientific American*. We have uncovered the immediate outcome that actors experienced during their reading of e-books on an IT artefact, an e-reader. We have identified what the technology enabled users to do; what it made difficult; what the technology was used for; what happened once they used the technology; and what they expected to happen [37].

The findings of this paper addressed preferences and/or non-preferences for e-reading in various settings, for a variety of purposes, from digital native users to retirees having wide-ranging levels of computer literacy. The two overarching emergent themes, *e-books on e-readers enabling e-reading* and *functionalities of smart devices*, confirm that an affordance perspective of user's perceptions of e-readers is appropriate and consistent with the literature.

By answering our research question "What are the affordances of e-reading on smart devices and how do smart devices enhance the reading experience", we have made a threefold contribution:

> 1. Provided some understanding of human behaviour in the activity of reading e-books on smart devices. It is clear from our analysis that readers (actors) have a

relationship with the IT artefact, an e-reader (the object) and previously a print book as the object. E-readers enable readers to engage in an activity that is essential to their quality of life: reading. Through this relationship readers are able to engage in reading at any place at any time and have access to unlimited reading material. Readers interpret an e-reader by identifying and utilising affordance they perceive and putting affordances into action for the purpose they have in mind. The analysis also indicates that the relationship between the user and the IT artefact may vary from positive to negative (enabling or not enabling reading). From a behavioural perspective this research has contributed some understanding to human behaviour in the context of e-reading. This may be useful to publishers in discerning user preferences for e-books and print-books and enable them to develop demand-focused business models.

2. Confirmed the use of affordance theory to analyse the rich data gathered in the comments made online in response to a newspaper op-ed and an article in a popular science magazine enabling an understanding of designed and actual affordances by users of an IT artefact.

3. Advanced affordance theory as proposed by Bernhard *et al.* [42] by populating a topology of affordances and identifying the dimensionality of the constructs of a proposed causal model for the actualization of affordances. Theoretically, we have extended Volkoff and Strong's [37] definition of affordance as "the potential for behaviours associated with achieving an immediate concrete outcome and arising from the relation between an object (a smart device on which an e-book can be read) and a goal directed actor or actors (user or users of the smart device whose goal is to read)".

Our analysis leads us to conclude that there is a dichotomy of affordances as theoretically suggested by Hutchby [41] and Volkoff and Strong [37]. Generic affordances that enable an actor to engage in an activity (e.g., reading) are affordances *in the domain of the real*, while *actual affordances* exist within the actual context of specific individuals with outcomes that are specific to the individual.

We label the affordances of accessibility, portability and storage as affordances in the *real* as they enable users to read and read more often. These affordances are enabled by the designed physical attributes of the artefact. For example: portability and size provide access to e-books anywhere and anytime overcoming the physical constraints of print books; memory capacity (storage) of the device provides access to full individual libraries anywhere anytime; the technology attribute of internet connectivity provides access to unlimited content. These affordances are not tied to any one individual or to a few users; they universally enable the outcome of reading.

Disability is an *actual* affordance as it is tied to individual users who suffer from a disability that can be overcome by an affordance of the artefact of unique or specific use. For example the ability to adjust font size and screen background lighting are a boon to users with sight impairment; not having to turn pages and light weight are a boon to users who do not have full dexterity. Similarly environmental sustainability, reading mode and retention are tied to specific individual contexts that can be addressed or satisfied through *actual* affordances.

We see some affordances as conflicted rather than being clearly defined as affordance in the *real* or *actual* affordance. Internet connectivity that enables the *real* affordances of hyperlinks, searching, browsing and dictionary look-up also enable negative affordances of distraction, security and privacy. Theory however allows us to unravel this conflict: hyperlinks, browsing and dictionary look-up are designed *real*

affordances that do enable and enhance reading for some users. However for others, in their contexts, these *real* affordances are actualised as negative and detracting from the reading experience.

In terms of the two dimensional aspect of the e-book literature (Information Science and Information Systems), it is gratifying that comments made voluntarily for both a general essay in *The New York Times* newspaper and a more specialized article in the *Scientific American* journal confirm the results found in more structured studies (questionnaires and surveys) found in the academic literature. Our findings confirm the literature's advantage/disadvantage work perspective of the information science investigations with convenience of e-books and e-readers being the major theme to emerge from the analysis [5, 10, 11, 12]. The findings are also consistent with the information systems perspective with the two themes of convenience and the IT artefact being consistent with the findings of perceived usefulness, convenience and perceived enjoyment explaining the intention to use e-readers [14, 15, 16]. Additionally, there is an agreement with the findings of the linguist, Baron's four major affordances of reading onscreen: *media options* within e-books (e.g., dynamic graphics) and in e-readers (e.g., text manipulation); *search c*apability within e-books and throughout the web; *connections* between individuals (sharing "communal experience") as well as between individuals and other e-resources (e.g., hyperlinks); and *availability* of free (or nearly free) e-resources [4, pp.37-41].

We have successfully demonstrated the feasibility of identifying and acquiring data through a Netnographic approach. By applying an affordance theory lens to two sets of data we have extracted perceived affordances of the act of e-reading enabled through a smart device. To advance the use of affordance theory in information systems research we extended the use of the theoretical model proposed by Bernhard *et al.* [42, p.7] by providing an 'e-book' perspective to the proposed model. In Table 4 we illustrate the model *constructs* by drawing on our analysis in the *illustration* column.

Our approach has confirmed the emergence, perception and actualization distinction of affordances. Bernhard *et al.* [42] argue that the framework is longitudinal in application. However, we have demonstrated that through appropriate analysis these dimensions emerge through the divergent experience of the respondents; experience and usage does vary and this is reflected in the responses. Our approach also confirms that material properties plus information about affordances are perceived and actualized by users over time (improvised and emergent affordances are perceived and actualized as usage continuous over time). We also identify an opportunity for further development of the model. The Bernhard *et al.* [42] model measures affordance actualisation (here defined as the possibility for goal oriented action) as a single dimension. Our analysis indicates that affordances are at least two dimensional: in the *real* and in the *actual*. The antecedents of the two dimensions may vary; this potential is not recognised in the model.

This research is expected to make important contributions. Our study is among the first to examine the user behaviour in the context of e-reading with an affordance lens and provide valuable insights to this behaviour. In particular our findings do provide some support for an affordance perspective of e-books and e-readers as well as shed some light on the preferences of readers. The work is the first to consider e-readers as an IT artefact providing information processing capabilities. We hope that this may encourage further investigation of e-books, e-readers and e-reading in the information systems context. On the practical front our findings can help book publishers and retailers in understanding their market/clients and formulate successful business models to meet their needs.

Table 4. Framework from Bernhard *et al*. [42, p.7] illustrated by e-books and e-readers:

Construct	Dimensions	Description	Illustration in the e-book context
Object	Properties with causal potential to incur effects	An object employed by an individual in a goal-directed activity.	Properties of the e-book and smart device
User	Goal	An individual who employs an object to perform a gaol – directed activity	Goal: to read; goal may vary: read/ entertainment; relaxation; learning; keep-up-to-date; be informed; download reading material; browse
	Expertise		Expertise: experience with e-books and smart devices
Information about Affordance	Symbolic expressions	The communicative possibilities of an object for a user.	Smart device communicates its suitability for goal oriented activity through its design
	External information	Information about affordances from source other than object itself	Non-related functions/affordances of the device (e.g. camera on a smart phone or tablet); internet access; storage; peers; observation
Affordance Perception	Degree of correct/false perception	The perception of a possibility for goal-oriented action afforded by an object for a user.	(1) Weight of the device; adjust font size; text search facility OR (2) Use of book-marking for both text and audio output OR (3) Use of camera on phone to facilitate recall
Affordance Actualization	Cognitive absorption Deep structure usage	The actualization of a possibility for goal-oriented action afforded by an object for a user	Use of the affordances of the device for a desired effect
Actualization Effort	Cognitive load	The degree of difficulty related to actualizing an affordance.	Ease of use of the e-book and e-reader controlling for other factors: expertise; quality of design
Effect	Positive/negative use effects	The outcomes attributed to the actualization of an affordance	Enable reading anywhere, any time. Not a positive reading experience: device enables direct distractions; lacking aesthetic affordances of print books

7.0 Directions for future research

Our study does have some limitations. Although there are two different sets of data, both have been drawn from a single location, the web; thus necessitating the need to confirm our findings. Future studies should consider multiple sources or locations for gathering data. The study is also the first to consider an affordance perspective of e-books and e-readers; therefore, one should take caution in generalizing the results. Our findings support Read *et al*. [16] who suggest that e-reader adoption may not be a binary choice between print and e-formats. Our findings clearly indicate that users' preferences are complex and that

affordance of e-readers is only one factor in choosing a reading context. This insight should be explored in future research. As the participants are predominantly drawn from North America, future studies could consider populations from other regions thus reinforcing the validity of the results.

The depth of insight into the affordances of e-books and e-readers provided in this work will enable the development of richer scales for use in future quantitative studies. The current quantitative work can also be improved by considering the dimensionality of the themes that map to constructs, that we have identified. For example: the theme of convenience, a construct used in quantitative approaches, has a number of dimensions including *read anywhere anytime*, *access* and *portability*. The theme of the IT artefact and its sub-themes will also enrich quantitative work by enabling the development of constructs reflecting perceived affordances of the artefact that enhance or detract from reading. Bernhard *et al*. [42] argue that the best approach for testing the model is a mixed method design, combining quantitative data from experiments with qualitative case study insights. However our approach demonstrates that not only can the model be examined but the dimensionality explored and scales developed using a qualitative analysis of users experience with an artefact within a given context. This opens up opportunities to study the adoption and use of e-books using quantitative methods testing causal models as well as exploratory work on developing quantitative approaches for investigating affordance theory. The affordances of e-books identified in this study should be examined in terms of their dimensionality and scale development. The findings regarding affordance actualisation should be investigated with the purpose of developing constructs that are candidate dependent variables.

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Appendix-1: Information Systems Research on Affordances

Study	Area	Purpose or Research Question	Methods
[39] Markus and Silver (2008)	Objects' properties and their relation to affordances.	To explain IT artefacts with the help of functional affordances (ecological psychology) and symbolic expressions.	Conceptual
[55] Leonardi and Barley (2010)	Constructivist Studies of Technology and Organization.	How do affordances of and constraints in technology influence certain patterns of use and behavior?	Literature review
[38] Leonardi (2011)	Technology affordance in employees' goal achievements.	How do employees change routines or technologies based on the imbrications of human and material agencies?	Case study
[56] *Sutcliffe et al.* (2011)	Assessing social affordances of Facebook Wikipedia Blacksburg Electronic Village and World of Warcraft.	How communication is supported socially and how the technologies provide facilities to promote social relationships in groups and communities.	Conceptual
[57] Goh *et al.* (2011)	Co-evolution of routine and the affordance of new systems.	To investigate evolution of affordances through agentic action.	Case study
[58] Anderson (2011)	Health information systems and social interaction.	How do affordance range and threshold influence IS affordances?	Case study
[59] Malhotra and Majchrzak (2012)	Virtual workspaces situation awareness theory knowledge coordination.	How do the features of technology determine affordance?	Surveys and Interviews
[60] Seidel *et al.* (2013)	Functional affordances of IS in sustainable practices	How do socio-technical conditions influence properties of IS to create functional affordance?	Case study
[33] Volkoff and Strong (2013)	IT enabled organizational change and the role of affordance theory with critical realism	To investigate the role of affordances as generative mechanisms in organizational change processes.	Case study
[61] Strong et al. (2014)	Electronic health record (EHR) system implementation in a multi-site medical group.	To develop a mid-range affordance-actualization theory for EHR.	Grounded theory methods
[62] Majchrzak *et al.* (2013)	Social media affordances on online knowledge sharing	How is engagement in knowledge sharing in the workplace leveraged by social media?	Conceptual work

Appendix-2: Model of Affordance Perception and Actualization from Bernhard *et al*. [42]

Object
-Properties with causal potential

Information about affordance

Actualization Effort

Affordance existence

Affordance perception

Affordance Actualization

Effects

User
-Goal
-Expertise

Legend

construct

Several instances of a construct

Temporal causal relationship