JPMTR 080 | 1603
DOI 10.14622/JPMTR-1603
UDC 070.1 | (054) | (0.034.2)-028.25

Case study
Received: 2016−02−02
Accepted: 2016−06-13

Experimental comparison of the user experiences of different digital and printed newspaper versions

Janne S. Laine, Tapio Leppänen

VTT Technical Research Centre of Finland Ltd,
Tietotie 3, Espoo, P.O. Box 1000, FI−02044 VTT, Finland

E-mail: janne.laine@vtt.fi
tapio.leppanen@vtt.fi

Abstract

A laboratory experiment comparing the user experiences elicited by five different newspaper publication versions (four digital versions and the printed tabloid format newspaper) was carried out. The study had the parallel goals of testing and developing user experience measures for evaluating news reading experiences evoked by different publication designs and to learn of the different styles of news reading and reader preferences regarding the design and layout of the content. The results show considerable differences between the user experiences evoked by all five publications versions, and provide information on the usefulness of different measures in measuring relevant aspects of news reading experiences. The participants could be roughly divided into two main clusters based on their preferences of different publication versions. The most significant difference between the two groups seems to be the attitude towards reading news articles in the form of continuous streams as often found on different web sites. One group preferred the printed newspaper and digital versions that can be understood to stem from the tradition of the printed newspaper. The other group preferred the web style of news presentation and saw no need for digital versions mimicking the printed paper.

Keywords: user experience, news reading, questionnaire, experience mapping, eye tracking

1. Introduction and background

The ongoing digital transformation is strongly affecting the news reading habits of consumers. Media companies are increasingly offering different types of digital newspapers and digital news services. While the long tradition of printed newspaper making has resulted in a solid practical understanding of what kinds of designs work for printed newspapers, these design rules do not necessarily apply as such in the digital world. Thus there is a need for understanding the user experiences of digital newspapers, what kinds of experiences are preferred and how different design choices affect them. It is also useful to understand how the user experiences of various kinds of digital editions compare to the conventional printed newspaper.

Newspaper design or design of other kinds of publications or media services more generally, is an evolving craft with connections to and a potential to benefit from the advances in a number of different fields of research and scientific study. The Gestalt laws are a well-known traditional example of visual design rules having been derived from the findings in the field of perceptual psychology: based on the fundamental human visual perception, in their modern form they still offer a useful general basis for informing visual design in a wide range of application areas (Graham, 2008).

With the advent of digital news reading, starting with the first news web sites, news reading and the design of news publications have entered the realm of human-computer interaction (HCI). As a research field and professional discipline, HCI has evolved from its human factors roots in seeking to improve the performance of systems involving computers and human users, evaluated with measures such as time on task and number of errors, in various tasks and work contexts to encompass also aspects such as usefulness, ease of use, emotional impact and perceived value of interaction to the user. The concept of usability arose with the recognition that instead of seeing users only as potential sources of delays and errors, to be instructed and trained in the proper use of the given software, the overall system performance and also the acceptance of technological solutions could be better served by also taking various perceptual and cognitive human factors better into account in the interaction design, allowing users to carry out tasks relevant to reaching specific goals with relative ease. Most conceptual usability frameworks, as well as some questionnaires designed for measuring perceived usability in practice, include usefulness (in reaching relevant goals) and ease of use as dimensions of usability or aspects related to it, with overall user satisfaction with the sys-

tem also often incorporated as a dimension of usability (e.g. Lund, 2001). Other aspects of usability that are sometimes treated as separate sub-dimensions include learnability, controllability, efficiency, and effectiveness (e.g. Kirakowski and Corbett, 1993; International Organization for Standardization, 1998).

Usability research and testing allows one to identify and subsequently correct the possible problems that certain design choices might pose to the effortless use of the publication. Good usability can be considered as a prerequisite for good user experience (Hartson and Pyla, 2012). User experience, however, is understood to consist also of a number other psychological dimensions, such as those related to emotional impact and perceived value of use, in addition to strictly usability-related aspects (Hassenzahl, 2010). While the significance of user experience to the success of interactive systems has been widely recognized and has been studied from numerous perspectives, the concept of user experience remains somewhat vague, with a large number of different definitions reflecting different approaches and goals of user experience researchers and practitioners (Lallemand, Gronier and Koenig, 2015). Generally, and for the purposes of the current study, user experience can be understood as a holistic view, containing classical usability but also looking more widely at all thoughts, feelings, and perceptions arising from interaction with a product or service, before, during, and after the interaction. This kind of loose definition naturally leaves open the question of which aspects of user experience are relevant in a given case or field of application, and how to use them in practical design processes.

Hassenzahl's conceptual model of user experience (Hassenzahl, 2003; 2010) provides a theoretical basis that has relevance also in examining news reading experiences and the effect of design variables on those experiences. In Hassenzahl's model the attributes of a product or service, as perceived by the user, are divided into pragmatic and hedonic qualities. The pragmatic qualities relate to achievement of so-called do-goals (e.g. finding a specific item in an online store, or reading news of a specific event), while the hedonic qualities relate to the ability of the product or service to support the achievement of the user's so-called be-goals (such as being competent, being stimulated, or being related to others). Whereas the pragmatic qualities reflect the usability of an interactive system in carrying out particular tasks, the hedonic qualities have to do with motivational aspects, the reasons why the user is using the product to carry out certain tasks. AttrakDiff questionnaire was developed for measuring the pragmatic and hedonic aspects of user experience in practice (Hassenzahl, Burmester and Koller, 2003; Hassenzahl, Schöbel and Trautman, 2008). It uses semantic differential scale items anchored at opposite ends by pairs of adjectives such as comprehensible/incomprehensible and controllable/incontrollable for evaluating pragmatic quality, and pairs such as exciting/dull and impressive/nondescript for evaluating hedonic quality. A third set of adjectives measures the overall appeal of the product or service to the users, with the assumption that both pragmatic and hedonic qualities affect the overall appeal. Variations of the AttrakDiff scheme, with the number and content of items adapted to fit different contexts, have been reported (Schrepp, Held and Laugwitz, 2006; Chorianopoulos and Spinellis, 2004).

It seems likely that also in regard to news publications, there are relevant perceived attributes of different levels, related to a number of different underlying goals, whether conscious or not, that the users might have for reading the publication. Presumably, the publications or services that best support the users in achieving the relevant goals are the ones that the users perceive as the most appealing and valuable to themselves, and that these are the publications that they prefer to use. The goals of use are likely to vary from one user and context to another, possibly ranging from things like keeping informed of the relevant events in a specific area of interest to relaxation, entertainment, and inspiration.

While Hassenzahl's model of user experience, as well as a number of other models and frameworks, contain components apparently relevant also to news reading experiences, until the recent years there has been a scarcity of studies examining the concepts of these frameworks from the perspective of news reading, or from the perspective of using and experiencing media products and services more generally, and how and if they can be applied in practice in order to measure news reading experiences and to inform the design of news publications. Shortly put, the grand challenge is to identify the user experience dimensions that are relevant to news reading experiences and to find appropriate methods to measure the perceptions and experiences evoked by news services of interest along those dimensions: in other words, to find out the relevant qualities of news reading experiences and the measures for quantifying them. Questionnaires developed in the field of HCI for a number of different purposes and application areas are good candidates for tools to be used in measuring news reading experiences. However, they may not be appropriate as such for the domain of news reading and may not be sufficient to cover all the relevant aspects of news reading experiences. Experimental studies are required to increase the understanding of relevant news reading experience dimensions and how to measure them.

Some recent studies have provided valuable knowledge needed to progress on the path to meeting the challenges discussed above. Particularly, Aranyi and

coworkers have carried out a series of experiments and analyses to create and test a model of user experiences evoked by news websites (Aranyi, 2012; Aranyi, van Schaik and Barker, 2012; Aranyi and van Schaik, 2015; 2015). They measured and modeled the relationships between user experience variables derived from an exploratory study based on concurrent think-aloud of participants while they used a news website (Aranyi, van Schaik and Barker, 2012), and from theoretical background of Hassenzahl's user experience model discussed above (Hassenzahl, 2003 and 2010), as well as from the technology acceptance model (TAM) (Davis Jr., 1986; Davis, 1989), and the components of user experience model (CUE) (Thüring and Mahlke, 2007). In their experimental study with a between-subjects design and two news websites browsed on a desktop computer in laboratory conditions, Aranyi and van Schaik (2016) found that the user experience components of their model, measured with questionnaires and including hedonic quality, perceived enjoyment, positive affect experienced during interaction, perceived usefulness of content, and pragmatic quality, were strong predictors of the overall user satisfaction with the news website. The user experience components in turn were significantly related to the perceived artifact characteristics of the model: perceived aesthetics, adequacy of information, and perceived disorientation. Further, perceived trustworthiness, identified by Howard Chen and Corkindale (2008) as one of the main drivers in the adoption of online news services, was found to have a significant positive relation with overall user satisfaction.

Lu, Wang and Ma (2013) studied the user experience and design implications of reading news from devices with different screen sizes in a laboratory experiment with a desktop computer, a tablet computer, and a smartphone. They found that advertisements were experienced as more distracting on the smaller screens of the mobile devices. For desktop users, efficient use of space was not a major concern, some of them preferring more abundant and variable content on the front page of the news website to make it more appealing. Mobile users further expected to be able to carry out tasks with fewer and simpler actions, and to have more control over the appearance of the page, i.e. being able to adjust the text size and to pinch zoom to read text.

In contrast to laboratory experiments, Pesonen and coworkers (Pesonen, 2014; Pesonen, Jumisko-Pyykkö and Väätäjä, 2015) conducted two one-week field studies of digital news reading experiences, using questionnaires and user diaries for data collection. Three different browser-optimized versions of the same newspaper content with different layout designs were used by participants on iPad tablets in the first study, while in the second study digital replicas of three different printed newspapers were used by the participants on their own laptop or desktop computers. A general trend of improving user experiences over time was found in both cases, possibly as a result of increasing familiarity with the design. According to their results, designs resembling printed newspapers were generally preferred and printed newspapers were still used parallel with the digital versions in the daily lives of the participants. Like printed newspapers, digital versions were typically read once a day, usually in the mornings. In contrast, Ihlström and Lundberg (2002), in their earlier study of real-life news reading habits in Sweden, found that users tend to read online newspapers more often, especially reading updated news during the day.

Friedrich et al. (2014) emphasize the practical importance of open user experience evaluation methods, instead of relying solely on pre-defined measures and experience dimensions, in understanding the user experience in specific areas like news reading in a wider context. In a case study where a digital edition of a newspaper was tested in rural areas of Finland over a period of six weeks, they used online collaborative discussions with users to derive user-defined attributes for describing real-life reading experiences. For example, some participants, living in remote areas where printed newspapers are delivered later in the day, considered it a privilege to be able to read the day's newspaper early in the morning, and even reported changing their daily rhythms as a result of having access to the digital edition, waking up earlier to have more time in the morning with the newspaper. Other perceived benefits of digital newspapers, not directly related to user interaction with the publication but still part of the experience in a wider perspective, included being perceived as environmentally friendly and helping to keep the user's home tidy (by not creating piles of old newspapers). These results highlight the context- and user-specific nature of user experiences, and the importance of contextual analysis in the user experience design and evaluation process.

Other longitudinal studies of digital news reading include those by Tewksbury and Althaus (2000), Vaughan and Dillon (2006), and d'Haenens, Jankowski and Heuvelman (2004), focusing more on task performance and news recall differences between digital and printed news rather than user experience, however. Vaughan and Dillon (2006), based on their results of improved user comprehension, usability, and navigation with repeated exposures to a given design, stress the importance of designs that provide consistent structures that allow users to build mental representations of the information space: with evolving conventions of presenting online news, attention is needed in incorporating emerging conventions into news website design, in order to draw repeat users. d'Haenens, Jankowski and Heuvelman (2004) found no consistent differ-

ences in the consumption and recall between the readers of online and print versions of two newspapers in Netherlands. In contrast, in an earlier study Tewksbury and Althaus (2000) found that online readers of New York Times read less news of certain topics than the readers of the print version, and were less likely to recognize and recall events that occurred during the exposure period. They suggest that by reducing and reorganizing story salience cues, online news formats can alter the knowledge that readers acquire about public affairs.

In-depth discussion of newspaper design is beyond the scope of this text. It is, however, useful to briefly consider some general design aspects and their possible relations with the user experience. While views have been presented that emphasized "separation of content and container", it is currently well recognized in the user experience field that the visual form in which media content is presented, referring to the layout and visual design in its widest sense, including the design and positioning of all elements visible to the reader, plays a significant role in how the content as well as the product or service, and ultimately the brand, is perceived and experienced. Perceived aesthetic properties have been found to affect the perceptions of usability and how well the product is liked, for example (Lidwell et al., 2010). As an interesting example of the immediate effects of visual aesthetics, the users have been found to form a consistent impression of the visual appeal of web sites in a time interval of only 50 milliseconds (Lindgaard et al., 2009). Further, Albert, Gribbons and Almadas (2009) found that users could form opinions about trustworthiness of financial and health-care websites based on equally brief flashes of images of the web sites. Beyond classical aesthetics, the visual design plays a central role in the user experience of media products in many other ways. The visual design helps or hinders the user's process of making sense of what kind of content is available and of understanding how to navigate within the available content. As an example, visual hierarchy is a central concept in the design of media products such as newspapers, whether printed or online. It refers to visually emphasizing and organizing the content so as to allow the reader to effortlessly use the publication. A related design aspect is abundance, referring to how much information is shown, at the given instant, to the user. Design variables such as these, along with other aspects related to implementation of navigation in the publication, for instance, are assumed to be central in the process of designing enjoyable news reading experiences.

In the field of user experience research there has been general discussion of whether it is reasonable to aim to actually design user experiences. Strictly speaking this would mean understanding the relationships between design variables and the relevant dimensions of user experience so well that one could tune the experience of a user in a predictable manner by adjusting appropriate design variables. Since experiences are bound to vary from user to user, and from time and context to another, it is generally not seen as possible to design individual experiences. To emphasize this, some practitioners talk about "designing for experiences" rather than "designing experiences" in the context of experience design. What user experience research generally aims to achieve is to inform and guide the design process, providing information about the users and their experiences at different phases of the design process (Hartson and Pyla, 2012), seeking to iteratively improve the experiences provided by products or services.

Digitalization provides a wide range of new kinds of opportunities for the design of news publications. At the same time, as mentioned above, there is still very little information on what kinds of design choices work in the digital world. There is also an insufficient understanding of and scarcity of research approaches for efficiently identifying and reliably measuring the relevant dimensions of news reading experiences, and methods for communication the user experience evaluation results in a manner that would be useful from the design perspective.

The general goal of this study was to produce knowledge that would be helpful in informing the design of digital newspapers. We compared the user experiences of different digital and printed newspaper versions, in order to find out the effects of certain kinds of design choices on the user experience, with the further and more specific aims of better understanding how different design choices suited different reading styles among readers and to see if a single digital newspaper design, of those included in the study, could sufficiently well serve different reading styles and preferences. Testing and integrating different user experience measurement and analysis methods within a single experimental setup was also an important aspect of the study. As discussed above, despite the contributions from a number of studies in the recent years, there is currently no single generally applicable and widely validated set of methods available for measuring and analysing the user experience of media services. This study sought to increase the understanding of how well certain research approaches, individually and when used in combination with each other, are able to yield meaningful and useful information on the user experiences evoked by different publication designs. We combined top-down approaches of measures derived from theoretical models and literature with bottom-up approaches of analysing user experiences based on open comments from users, thus aiming to increase the understanding of the relevant dimensions of news reading experiences and appropriate measures of them.

In the current study we carried out a laboratory experiment that compared the user experiences of the current five Helsingin Sanomat newspaper publication versions: four digital versions and the printed tabloid format newspaper, as they were offered in the summer of 2013. While necessarily restricted to publication versions from a single publisher, the results of these experiments were expected to provide more generally useful understanding of user experiences and preferences concerning news reading. A specific question we sought to answer was whether any single digital version would reasonably well satisfy different reading styles, suggesting that it would be appropriate to cut down the number of considerably different digital layout versions currently offered in favour of aiming for a more consistent publication design and reading experience across digital platforms.

In section 2 we describe the experimental setup and devices and methods used in collecting analysing the data. In section 3 we present the results of analysing the data, discuss the results in section 4, and make conclusions in section 5.

2. Materials and Methods

2.1 Participants

Fourty persons participated in the laboratory experiments. The participants were recruited by various means: by contacting people who expressed their interest when answering a web survey aimed at the library patrons using a new e-book loaning system, and by e-mailing and directly contacting people working at the VTT premises in Espoo, Finland in various positions, as well as their family members and other acquaintances, and through contacts within the Next Media research program.

The sample of participants was convenient for this study, and, while not a random sample, was comprised of persons with relatively varying backgrounds. Nineteen of the participants were women and 21 were men. The ages of the participants ranged from 19 to 64 years old (Figure 1). The average age among the participants was 40 (with standard deviation of 9 years). Due to the requirements of the eye-tracking device used in the experiments, only participants who were able to read without wearing eyeglasses were recruited (contact lenses were allowed). The participants received two movie tickets as compensation for their time and effort.

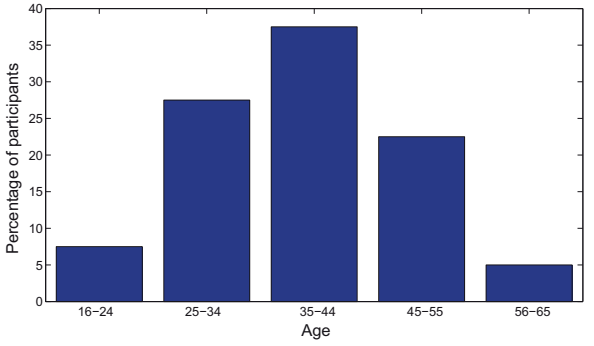

Figure 1: Age distribution of the participants

2.2 Newspaper versions

The five publication versions of Helsingin Sanomat newspaper shown in Figure 2, with current daily content, were used in the experiments. Helsingin Sanomat is the largest newspaper in Finland and well known to all participants. The different publication versions essentially share the same content, but there are considerable differences between the versions in the layout and the overall design. The four digital publication versions were all used with a black-framed Apple iPad 4 tablet.

2.3 Outline of the experimental sessions

After general introductions to the proceeding of the experimental session, the participant filled a digital survey form concerning the participant's background information (basic demographic information, and questions on news reading habits and the use of media technology, as well as questions measuring the personality traits of the respondent). The core part of the experiment consisted of the participant browsing and reading each of the five publication versions (presented in randomized order) for five minutes. The participant was instructed to imagine herself in a situation in which she had around five minutes to spare (e.g. waiting for an acquaintance to arrive in a cafeteria) and that she had decided to spend that time to take an overall look at the contents of today's newspaper (perhaps to read particularly interesting articles in more depth later), browsing and reading the publication in any way she wanted. The participants were instructed on how to use each version just before they were given that version for browsing. While reading the publication the participants wore SensoMotoric Instruments eye-tracking glasses, re-calibrated before reading each publication version and connected to a recording unit which recorded the eye movements of the participants while browsing the publication as well as a video of the scene they were seeing in front of them (i.e. the publication being browsed). The eye tracking device and analysis tools are further described in section 2.4.

Immediately after finishing reading the publication version, the participant answered a digital questionnaire containing statements related to the publication and its layout, as well as how it felt to use the publication. The questionnaire is described in section 2.5.

Figure 2: Publication versions used in the experiments; printed newspaper is not to scale

After finishing the questionnaire, the respondent was shown a video recording of their five minutes browsing the publication, with a cursor showing their gaze path augmented on the video. They were asked to retrospectively comment, while viewing the video recording, on their browsing session: How they used a publication? What they thought and felt about the publication and its design and layout – from their point of view, how well did the publication present its content to the reader? When needed, the instructor probed the participant with additional (unstructured) questions during the retrospective commenting, in order to extract more detailed information of the aspects of the reading experience that the participant brought up, taking care not to inadvertently guide or bias the participant's commentary by introducing aspects that did not naturally catch the participant's attention. Figure 3 shows a participant retrospectively commenting his experience with the publication version B. The review conducted by Hyrskykari et al. (2008) suggests that the gaze path stimulated retrospective think-aloud method produces more expressive comments and that the data are more informative and of better quality, as the drawbacks of concurrent think-aloud have been avoided.

After browsing all five publication versions, and providing the answers to the questionnaire as well as the retrospective comments for each version, the participant was asked to rank the publication versions in order of preference: Which publication version would they use if they could only choose one of them to use from now on in their daily lives? Once the most preferred version was chosen, that version was removed and the participant was asked to choose the preferred version to use from the remaining ones. This was repeated until all five versions had been chosen. The participant was asked to comment on his preferences while making the choices. What were the pros and cons of each version for him and what made it suitable, or not suitable, for his style of news reading?

2.4 Eye tracking

The SensoMotoric Instruments eye tracking glasses is a mobile binocular eye tracking system, which follows the movements of both eyes of the user and in real time calculates and stores the gaze position in the video of the scene that the user sees. The scene video is also captured by the eye tracking glasses. The benefit of such mobile eye tracking system is that it allows the participants to move relatively freely, as opposed to remote eye trackers which require the participant to sit relatively still in front of the screen. For natural use of the tablet and especially the printed newspaper in this study, the mobile eye tracking system was an obvious choice.

The drawback of the mobile system is that, unlike with a remote eye tracker connected to a display, in the analysis stage there is initially no information beyond the captured scene video of what was displayed on screen at any given moment. Calculation of descriptive fixation and gaze path statistics from this kind of data

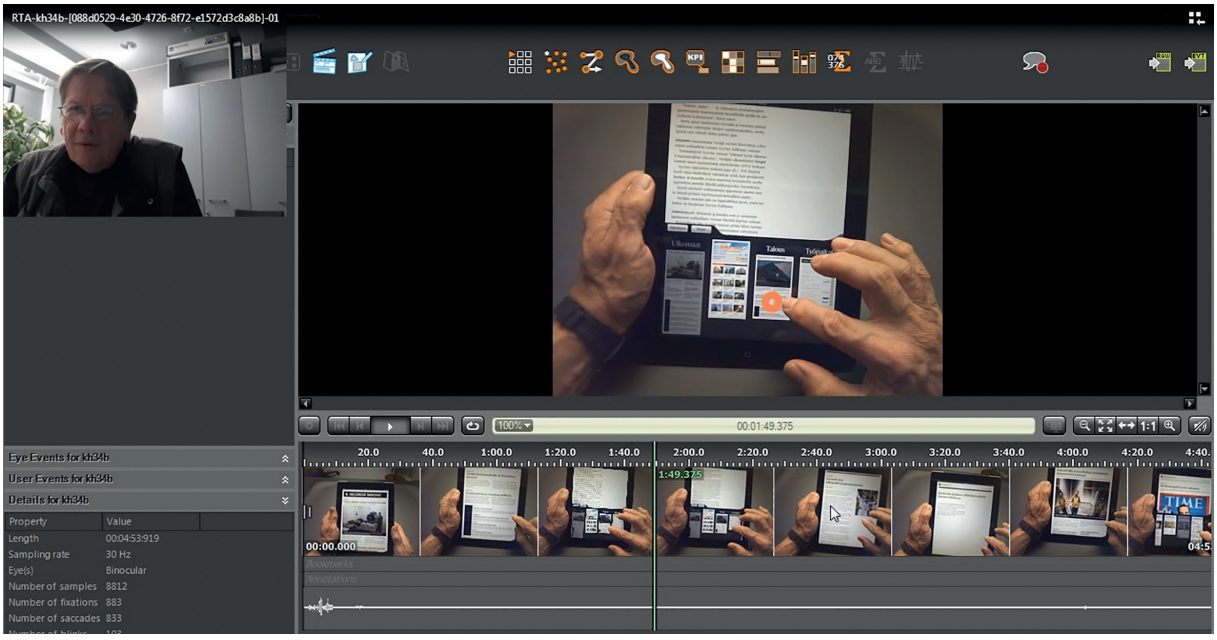

Figure 3: A frame from a video recording of the retrospective commenting session, using the SMI BeGaze analysis software, where the participant (top left corner) comments on the iPad app version, in this case, and his experience of using it, while viewing the freshly recorded video which shows his view during the session, and the orange gaze cursor indicates the point of his visual focus

would require a vast amount of manual work. In this case it was not considered worthwhile to carry out such manual encoding. Instead, the captured scene video, with the gaze path visualization and the recorded retrospective commentary of the eye tracking video by the participants was afterwards qualitatively summarized by the researchers, describing the actions and the flow of attention of the participants during the session, with further interpretations and other points added based on the retrospective commentary. The gaze paths were visualized, retrospectively commented, and analysed in the SMI BeGaze software.

2.5 User experience questionnaire

Immediately after finishing reading the publication version, the participant answered a digital questionnaire containing statements related to the publication and its layout, as well as how it felt to use the publication. The questionnaire contained, in random order, the relevant statements from the Next Media MX Questionnaire (Helle et al., 2011), as well as additional statements from The User Engagement Scale (O'Brien, 2010). In total, the questionnaire was comprised of 92 items. Included in the MX Questionnaire, and also adapted for the questionnaire used in this study was the scale for perceived visual aesthetics of web sites (Lavie and Tractinsky, 2004). All the items of the questionnaire used in this study are can be seen in Table 1. The Likert-type items were in the form of statements, and the participants responded to the items using a 9-step slider from 1 ("completely disagree") to 9 ("completely agree").

Apart from the scales mentioned above, the MX Questionnaire draws from a wide range of earlier research and questionnaires proposed for measuring different aspects of user experience. Major sources and influences for the usability related items included the After-Scenario Questionnaire (ASC) (Lewis, 1991); the System Usability Scale (SUS) (Brooke, 1996), reported extensive analyses of SUS (Bangor, Kortum and Miller, 2008 and 2009; Lewis and Sauro, 2009); the Computer System Usability Questionnaire (CSUQ) (Lewis, 1995); the Usefulness, Satisfaction, and Ease-of-Use Questionnaire (USE) (Lund, 2001); the Software Usability Measurement Inventory (SUMI) (Kirakowski and Corbett, 1993); and the Website Analysis and Measurement Inventory (WAMMI) (Kirakowski and Cierlik, 1998; WAMMI, 2016). These and other usability measures are described and discussed by Tullis and Albert (2013).

The concept of spatial presence has been much studied in the field of digital media such as games, but is potentially relevant also in the wider context of media use, including news reading. The related concepts of presence, immersion, and engagement have to do with focused attention of the user: media that successfully capture the attention of their users and evoke the feelings of engagement, presence, or immersion are likely to become more popular. The ITC Sense of Presence Inventory (Lessiter et al., 2001) and the MEC Spatial Presence Questionnaire (MEC-SPQ) (Vorderer et al., 2004) were used as sources in designing the spatial presence (attention allocation) items of the MX Questionnaire.

The concept of flow experience, related also to the concept of focused attention, was introduced by Csikszentmihalyi (1990). The sources for designing the flow-related items in the MX Questionnaire include Novak and Hoffman (1997), Novak, Hoffman and Duhachek (2003), and Poels, de Kort and Ijsselsteijn (2006).

Self-assessment manikin (SAM) (Bradley and Lang, 1994) is a commonly used graphical instrument for measuring emotional responses. The valence scale consists of nine graphic depictions of human faces ranging from sad to happy expression and the arousal scale contains nine graphical characters varying from a calm state to a state of high visceral. Alternatively, emotions can be measured using conventional textual Likert scales, as was done in the current study. Adjectives like frustrated or enthusiastic, in the vein of the Positive Affect Negative Affect Scale (PANAS) (Watson, Clark and Tellegen, 1988), are also included in the MX Questionnaire items for measuring emotions.

The existing playfulness self-evaluation scales (Barnett, 2007) were used as a basis to MX Questionnaire items for measuring the playfulness experienced during media use, a presumably significant dimension of media experience in some cases. Other sources include those concerning brand experience (Brakus, Schmitt and Zarantonello, 2009) and trustworthiness (Gefen, 2002), both of which are considered particularly significant for news reading.

It should be noted that rather than a fully validated tool for measuring media experience, the MX questionnaire is better understood as a framework from which relevant parts may be adapted for the purposes of specific research. While based on wide range of literature and the work of a multidisciplinary team of scientists and media professionals, the questionnaire has not been fully validated. Indeed, one of the goals of the present study was to apply and test the MX Questionnaire in measuring the user experiences of news publications.

2.6 Multivariate data analysis methods

Factor analysis (e.g., Nunnally and Bernstein, 1994) was used to analyse the correlation structures of different items and dimensions of the questionnaire data. The

factors were rotated using the so-called Varimax criterion in order to make the factors as orthogonal as possible in an attempt to separate different user experience dimensions to different factors.

The experience mapping approach was used to further describe and compare the user experiences elicited by the different publication versions. Experience mapping, described for example by Mensonen et al. (2012), is based on principal component analysis (e.g., Jackson, 2003) of multivariate observations (here: questionnaire items related to different aspects of user experience) of multiple samples (here: different publication versions), and is intended for visualizing and describing the most significant experiential differences within a given set of products, services, or concepts, as well as depicting the correlations between different perceived attributes and experience dimensions for the given set of samples.

Dendrogram visualization of preference judgments was used for analysing the differences and similarities between the publication version preferences among the participants. Dendrograms are used in hierarchical cluster analysis in fields such as biology and market research for categorization and segmentation purposes (Aldenderfer and Blashfield, 1984; Mérigot, Durbec and Gaertner, 2010). Support for creating dendrograms can be found in software packages like Matlab and SPSS, and on the open source statistics platform R. In this case the preference judgments were mapped to the space of first two principal components, calculated with principal component analysis, in order to extract only the most significant differences between the participants. The dendrogam diagram was plotted, based on the Euclidean distances in the space of first two principal components, to depict the similarities and differences between the participants. The height of the connecting line in the tree-like diagram, the "branch" of the dendrogram, indicates how similar to or different from one another two participants, or groups of participants, were in their preference judgments: the greater the height, the greater the difference.

3. Results

3.1 Comparison of the experiences evoked by the publication versions based on questionnaire responses

The Experience Map in Figure 4 was calculated based on the responses to all 92 questionnaire items, averaged over all participants. Only attribute vectors corresponding to selected questionnaire items are labelled in the Figure 4 for clarity and in order to give a preliminary visualization of some of the most significant differences in the user experiences evoked by the different publications. The vectors pointing in the general direction of the given publication version indicate attributes that were most strongly associated with the given publication version.

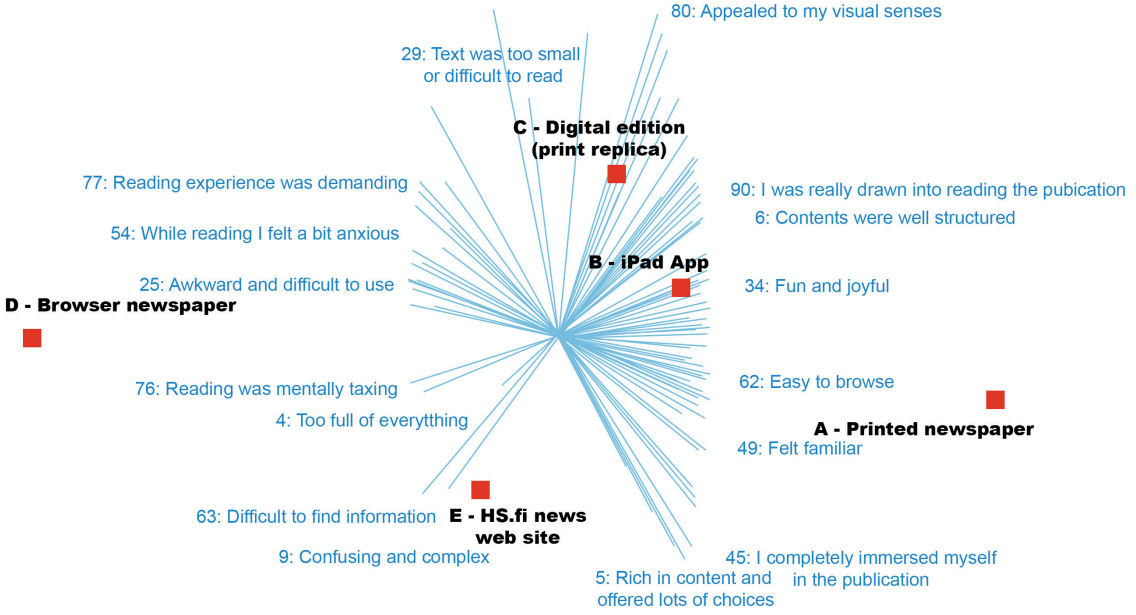

Figure 4: An Experience Map based on 92 questionnaire items visualizing the experienced differences between the publications, for results averaged over all participants

Table 1: Questionnaire items 1–92 and their factor loadings, with Abbreviations used in the "Preliminary dimensions" column of the tables (assumed main dimensions to which the items are related, followed by possible other related dimensions): AE: Aesthetics and presentational factors; A: Spatial presence (Attention allocation); USE: Usefulness; B: Brand; ENT: Entertainingness; F: Familiarity; USA: Usability; PV: Perceived value; Un: Unexpectedness; Ia: Interactivity; P: Playfulness; T: Trustworthiness; E: Emotions; INT: Interestingness; SP: Sensory perception

Item nr.	Statement	Preliminary dimensions	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Specific variance
AESTHETIC AND PRESENTATIONAL FACTORS										
Beauty (visual appearance perceived very quickly)										
1	The layout was good.	AE	0.45	0.56	0.34	0.16	−0.23	0.31	−0.08	0.19
2	The publication was colorful.	AE, SP	0.06	0.47	0.36	0.14	−0.08	0.18	0.05	0.58
3	Colors of the publication looked natural.	AE, SP	0.12	0.40	0.13	0.16	−0.21	−0.00	0.19	0.71
Abundance (The richness and variation of the options offered on a page)										
4	The publication was too full of everything.	AE	−0.42	−0.26	−0.03	−0.07	0.55	−0.06	0.12	0.43
5	The publication was rich in content and offered a lot of choices.	AE, Ia	0.14	0.27	0.24	0.16	−0.04	0.29	0.54	0.44
Hierarchy (Journalistic and visual order of the content by different levels of importance)										
6	Contents of the publication were well structured.	AE, Ia	0.53	0.59	0.16	0.12	−0.13	−0.01	−0.01	0.32
7	The main articles were well presented, they stood out.	AE	0.39	0.40	0.21	0.07	−0.10	0.13	0.15	0.60
Navigation (Visual aids for user orientation in the content)										
8	Sometimes I had the feeling that I was lost.	AE, USA, Ia	−0.75	−0.09	0.00	−0.11	0.30	−0.12	0.03	0.31
9	Design of the publication was confusing and complex.	AE	−0.61	−0.35	−0.11	−0.04	0.43	−0.18	0.09	0.27
Adapted from an aesthetic scale for websites (Lavie and Tractinsky, 2004)										
10	The layout was clean.	AE: classical	0.25	0.68	0.14	0.19	−0.12	0.26	−0.11	0.32
11	The layout was clear.	AE: classical	0.63	0.50	0.16	0.22	−0.14	0.12	−0.02	0.25
12	The layput was pleasant.	AE: classical	0.44	0.55	0.34	0.15	−0.22	0.39	−0.18	0.14
13	The layout was aesthetic.	AE: classical	0.01	0.55	0.55	0.10	−0.12	0.13	−0.04	0.36
14	The layout was balanced.	AE: classical	0.39	0.58	0.27	0.11	−0.24	0.16	−0.01	0.34
15	The layout was original.	AE: expressive	−0.02	0.24	0.64	0.09	−0.15	−0.04	0.08	0.49
16	The layout was stylish.	AE: expressive	0.18	0.73	0.35	0.14	−0.17	0.07	0.03	0.26
17	The layout was fascinating.	AE: expressive	0.24	0.35	0.59	0.28	−0.09	0.23	−0.00	0.32
18	The layout was creative.	AE: expressive	0.16	0.28	0.72	0.03	−0.10	0.08	0.12	0.35
ENTERTAININGNESS										
19	Reading the publication was entertaining.	ENT, P, E, USE	0.23	0.27	0.39	0.28	−0.20	0.57	0.05	0.27
20	The publication was quite dull.	ENT, P, E, USE	−0.25	−0.30	−0.33	−0.17	0.34	−0.38	0.03	0.45
21	Reading the publication was good pastime.	ENT, P, E, USE	0.34	0.31	0.26	0.21	−0.20	0.60	0.12	0.27
USABILITY										
22	In this publication it was easy to find what I was looking for.	USA, Ia	0.76	0.29	0.20	0.11	−0.11	0.12	−0.03	0.25
23	The articles in the publication were easy to read.	USA	0.46	0.19	0.24	0.12	−0.43	0.40	−0.02	0.33
24	The publication was easy to handle while reading.	USA	0.69	0.16	0.24	0.04	−0.16	0.03	0.08	0.41
25	The publication was awkward and difficult to use.	USA	−0.77	−0.13	−0.14	−0.07	0.25	−0.18	0.06	0.27
26	Glare or gloss of the publication distubed the reading.	SP, USA	−0.13	−0.15	0.08	0.00	0.43	−0.03	−0.06	0.77
27	The newspaper / device felt too heavy in my hands.	SP, USA	−0.15	−0.20	−0.00	0.06	0.30	−0.03	−0.03	0.84
28	I was able to use the publication the way I wanted.	USA	0.84	0.13	0.21	0.06	−0.15	0.13	0.13	0.17
29	Text was too small or difficult to read.	USA	−0.24	0.08	−0.06	0.06	0.42	−0.07	0.11	0.73
30	The length of row in the text was suitable.	USA	0.27	0.25	0.17	0.14	−0.27	0.08	0.25	0.68

Item nr.	Statement	Preliminary dimensions	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Specific variance
UNEXPECTEDNESS										
31	The publication offered surprises.	Un	−0.11	0.03	0.63	0.24	0.13	0.04	0.01	0.52
32	The publication was exactly as I expected.	Un	0.62	0.09	−0.05	−0.02	−0.01	0.07	−0.02	0.59
33	The publication repeated the one and the same thing.	Un	−0.20	−0.31	0.01	−0.09	0.38	−0.27	−0.28	0.55
PLAYFULNESS										
34	The publication was fun and joyful.	P	0.19	0.13	0.54	0.32	−0.02	0.28	−0.08	0.47
35	The publication also had a playful attitude.	P	0.12	0.06	0.61	0.29	0.03	−0.05	−0.02	0.53
36	There was imaginativity in the publication.	P	0.17	0.13	0.75	0.10	−0.03	0.06	0.07	0.37
TRUSTWORTHINESS										
37	The content of this publication appeared reliable.	T	0.28	0.55	−0.18	0.22	−0.22	0.34	0.22	0.32
38	This publication was made by professionals.	T	0.38	0.57	0.13	0.13	−0.15	0.22	0.39	0.28
INTERESTINGNESS										
39	The publication attracted and invited to read.	INT	0.37	0.31	0.49	0.25	−0.23	0.35	−0.03	0.28
40	This issue of the publication was as interesting as the previous issues.	INT	0.39	0.35	−0.02	0.07	−0.00	0.35	0.02	0.60
SPATIAL PRESENCE (ATTENTION ALLOCATION)										
41	The reading experience was captivating.	A, INT	0.37	0.28	0.51	0.38	−0.14	0.31	0.07	0.26
42	I devoted my whole attention to the publication.	A, INT	0.10	0.12	0.11	0.82	−0.07	0.07	0.00	0.28
43	I concentrated on the publication.	A, INT	0.33	0.18	0.02	0.58	−0.29	0.27	−0.05	0.36
44	The publication captured my senses.	A, INT	−0.00	0.09	0.42	0.66	0.04	0.02	−0.02	0.38
45	I completely immersed myself in the publication.	A, INT	0.06	0.12	0.26	0.84	0.06	0.10	0.10	0.18
BRAND										
46	The publication was of high quality.	B, V	0.30	0.60	0.14	0.24	−0.15	0.30	0.26	0.29
47	I valued the publication.	B, V	0.46	0.48	0.12	0.30	−0.13	0.35	0.19	0.28
48	This publication had its own strong personality.	B	0.25	0.32	0.52	0.11	0.02	0.07	0.23	0.49
FAMILIARITY										
49	This publication felt familiar.	F	0.46	0.32	0.21	0.00	−0.04	0.23	0.01	0.58
50	I found the publication close to me.	F	0.37	0.31	0.38	0.27	−0.10	0.26	0.06	0.46
EMOTIONS										
51	While reading the publication I felt pleasant.	E: valence	0.56	0.32	0.26	0.28	−0.23	0.23	0.16	0.31
52	While reading the publication I felt aroused.	E: arousal	−0.37	−0.11	0.04	0.12	0.49	−0.09	0.04	0.58
53	While reading the publication I felt frustrated.	E: -v, +a	−0.71	−0.14	−0.13	−0.03	0.43	−0.21	−0.10	0.22
54	While reading the publication I felt a bit anxious.	E: -v, +a	−0.54	−0.12	−0.11	−0.05	0.57	0.06	−0.10	0.34
55	While reading the publication I felt tense.	E: -v, +a	−0.50	−0.13	−0.07	0.01	0.58	0.02	−0.13	0.38
56	While reading the publication I felt a bit bored.	E: -v, -a	−0.25	−0.25	−0.10	−0.04	0.45	−0.43	−0.16	0.45
57	While reading the publication I felt depressed.	E: -v, -a	−0.22	−0.13	−0.05	0.04	0.44	−0.25	−0.10	0.67
58	While reading the publication I felt enthusiastic.	E: +v, +a	0.21	0.16	0.62	0.43	0.07	0.23	0.12	0.29
59	While reading the publication I joyful or happy.	E: +v, +a	0.22	0.05	0.65	0.31	0.05	0.09	−0.03	0.42
60	While reading the publication I felt completely relaxed.	E: +v, -a	0.51	0.18	0.23	0.23	−0.36	0.11	0.25	0.40
61	While reading the publication I felt satisfied.	E: +v, -a	0.48	0.30	0.36	0.28	−0.19	0.36	0.12	0.29

Item nr.	Statement	Preliminary dimensions	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Specific variance
INTERACTIVITY										
62	The publication was easy to browse.	Ia	0.77	0.16	0.24	0.10	−0.10	0.05	0.17	0.28
63	It was difficult to find useful information because there was too much information.	Ia	−0.52	−0.20	−0.07	−0.08	0.45	−0.14	0.19	0.41
64	I was in control of the situation while reading and using the publication.	Ia	0.77	0.18	0.13	0.04	−0.25	0.17	0.09	0.26
65	While reading the publication, I could quickly jump from one page to another.	Ia	0.68	0.17	0.23	0.04	−0.08	0.05	0.14	0.42
OVERALL MEDIA EXPERIENCE										
66	The overall reading experience was good.		0.59	0.35	0.35	0.21	−0.22	0.40	−0.08	0.15
USER ENGAGEMENT SCALE ITEMS – Adapted from O'Brien (2010)										
Focused attention										
67	I was so involved in the publication that I lost track of time.	A	−0.10	0.15	0.38	0.72	0.14	0.04	0.12	0.28
68	I blocked out things around me when I was reading the publication.	A	0.01	0.07	0.12	0.86	−0.03	0.08	0.04	0.24
69	While reading the publication, I lost track of the world around me.	A	−0.06	0.18	0.16	0.87	0.15	0.07	0.04	0.15
70	I was absorbed in reading the publication.	A	0.09	0.08	0.24	0.84	0.01	−0.00	0.07	0.22
71	While reading the publication, I let myself go.	A	0.27	0.14	0.47	0.41	−0.24	0.24	0.05	0.40
Perceived usability										
72	I felt frustrated while using the publication.	USA, E	−0.71	−0.20	−0.08	−0.05	0.46	−0.15	−0.10	0.21
73	I found this publication confusing to use.	USA, E	−0.67	−0.19	−0.06	0.00	0.41	−0.18	0.05	0.31
74	I felt annoyed while using the publication.	USA, E	−0.63	−0.19	−0.09	−0.09	0.47	−0.09	−0.14	0.31
75	I felt discouraged while using the publication.	USA, E	−0.66	−0.12	−0.11	−0.06	0.46	−0.20	−0.00	0.29
76	Reading this publication was mentally taxing.	USA, E	−0.61	−0.21	−0.20	−0.07	0.58	−0.11	−0.10	0.18
77	This reading experience was demanding.	USA, E	−0.77	−0.10	−0.04	−0.11	0.43	−0.07	0.00	0.18
Aesthetics										
78	The publication was aesthetically appealing.	AE	0.27	0.71	0.33	0.09	−0.19	0.09	0.05	0.25
79	I liked the pictures and graphics of this publication.	AE	0.11	0.52	0.43	0.11	−0.12	0.23	0.24	0.39
80	The publication appealed to my visual senses.	AE	0.29	0.60	0.50	0.12	−0.17	0.04	0.02	0.26
81	The layout of this publication was visually appealing.	AE	0.30	0.64	0.41	0.09	−0.28	0.11	0.01	0.23
Endurability										
82	Reading this publication was worthwhile.	USE, PV	0.44	0.38	0.14	0.22	−0.14	0.57	0.18	0.22
83	I consider my reading experience a success.	USE	0.71	0.24	0.31	0.23	−0.17	0.31	0.02	0.16
84	The reading experience did not work out as I had planned.	USA, USE	−0.51	−0.18	0.02	0.02	0.24	−0.20	−0.03	0.61
85	The reading experience was rewarding.	USE, PV	0.48	0.27	0.43	0.26	−0.11	0.37	0.18	0.25
86	I would recommend this publication to my friends and family.	PV, USE	0.60	0.36	0.33	0.18	−0.15	0.21	0.18	0.27
Novelty										
87	The publication sustained my curiosity.	INT	0.40	0.36	0.27	0.23	−0.22	0.52	0.17	0.24
88	The publication incited my curiosity.	INT	0.35	0.39	0.32	0.21	−0.19	0.55	0.12	0.22
89	I felt interested in the publication.	INT	0.38	0.45	0.30	0.18	−0.20	0.37	0.31	0.25
Felt involvement										
90	I was really drawn into reading the publication.	INT, A	0.37	0.34	0.37	0.38	−0.27	0.27	0.05	0.32
91	I felt involved in reading the publication.	INT, A	0.30	0.13	0.33	0.59	−0.11	0.29	−0.08	0.33
92	The reading experience was fun.	ENT, P, E	0.36	0.17	0.50	0.36	−0.11	0.25	−0.12	0.38

In order to better examine the possible underlying user experience dimensions and to tentatively test the validity of the preliminary assumptions concerning the relevant dimensions and questionnaire items suitable for measuring them, factor analysis was carried out for the responses to the questionnaire items. The responses to all 92 questionnaire items concerning a single publication version by a single observer were treated as one multivariate observation. These observations were placed in the rows of a data matrix, resulting in a 200-by-92 data matrix, with the 200 rows (5 publication versions × 40 participants) corresponding to observations and the 92 columns to variables (questionnaire items). Factor analysis and rotation of the factors using the so-called Varimax criterion was carried out for the data matrix. While none of the tested factor structures could fully describe the variance inherent in the variables of this rather complex data set, the factorization into 7 factors yielded a factor structure that best separated the different item responses into different factors and provided the most intuitive interpretation of the data.

The factor loadings of this 7-factor model of the data are shown in Table 1 for all 92 questionnaire items. Loadings with an absolute value greater than 0.5 are emphasized by bold font and grey shading of the table cell. The factorization shown in Table 1 is further discussed in section 4. Here we note that the factorization model maps the different items relatively well to individual factors, as indicated by the fact that for the most of items only a single factor loading is higher than 0.5 or lower than −0.5. However, the fact that for many items the item-specific variance not mapped to the factors is relatively high indicates that there remains considerable variation in the responses that is not described by this factor structure, hinting at dimensions or specific aspects of user experience not mapped to these factors. Still, this factorization allowed us to better interpret the data, and together with investigating correlations between individual items lead us to a set of 21 relevant user experience dimensions. The dimensions and the questionnaire used to measure the dimension are listed in Table 2.

Figure 5 shows an experience map calculated with the experience dimensions of Table 2. The following sections build on these results by looking at the reading experiences from the perspective of other data obtained from the experiments. The results are further discussed in section 4.

Table 2: User experience dimension and the corresponding items used to measure them, derived based on the factor structure and item correlations of the full questionnaire data, where the items marked with asterisks (*) are reverse-worded and these item scales were inverted when calculating the value for the corresponding experience dimension as the average of the given item responses.

Dimension	**Items**					
Information overload	4					
Rich in content	5					
Visual hierarchy	7					
Navigation	8*	9*				
Classical aesthetics	10	12	14			
Expressive aesthetics	15	17	18			
Entertainingness	19	21				
Usability	22	24	25*	28	62	64
Playfulness	34	35	36			
Trustworthiness	37	38				
Attention allocation	41	42	43	44	45	
Pleasant feeling	51					
Frustrated and anxious feeling	53	54	55			
Enthusiastic and joyful feeling	58	59				
Relaxed feeling	60					
Focused attention	67	68	69	70	71	
Perceived usabillity	72*	73*	74*	75*	76*	77*
Aesthetics	78	79	80	81		
Endurability	82	83	85	86		
Novelty	87	88	89			
Felt involvement	90	91	92			

Table 3 lists the user experience dimensions for which the mean value of ratings, averaged over all participants, were significantly different in the case of each pair of two different publication versions. On each row, the dimensions on which the publication version indicated on the left hand side column had a significantly higher mean rating than the publication version corresponding to the column, indicated by the top row of the table, are listed. For example, publication version B had a significantly higher "Playfulness" rating than version C, while version C had a higher "Information overload" rating than B. The table provides information on the relevance of different dimensions in differentiating the experiences evoked by different publication versions.

3.2 Distribution of preference judgments

Considerable variation in preferences was evident among the respondents. The histograms in Figure 6 sum up the overall variability in the preference rankings of the five different publication versions. The first group of bars on the left side of the graph indicates the percentage of respondents that ranked the given publication version in the first place in their order of preference. The highest bar corresponds to version A, indicating that 42.5 % of respondents ranked the printed newspaper first in their order of preference. While this was by far the favourite choice compared to the four other publication versions individually, it should be noted that the majority of participants would still prefer to use some digital publication version, rather than the printed newspaper, if they had to choose only one version for their daily news reading.

Looking further at the graph of Figure 6, the second group of bars indicates the percentage of participants that ranked each publication version second in their order of preference – i.e. the percentage of participants that would choose a given publication version if their most preferred version (the one they ranked first in their order of preference) was not available to use in their daily news reading. Similarly, the following three groups of bars indicate the percentage of respondents that ranked specific publication versions on the 3rd, 4th, or 5th, respectively, in their order of preference.

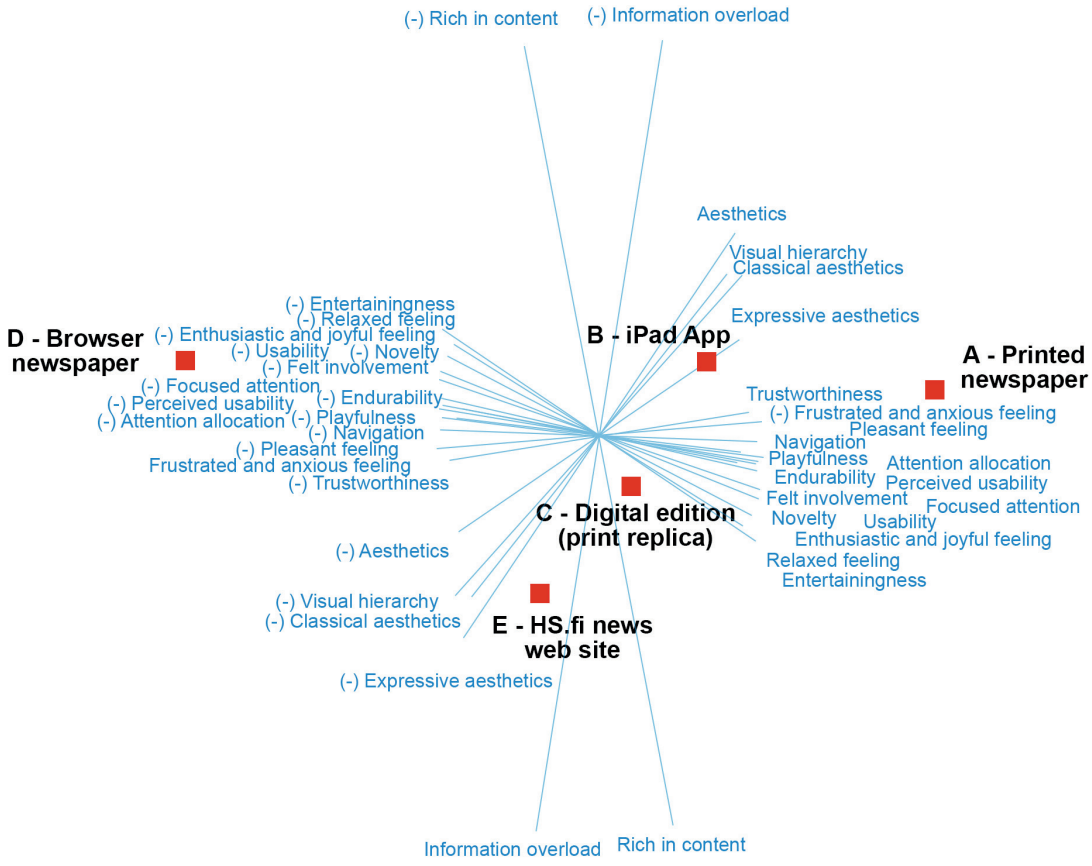

Figure 5: An Experience Map based on 21 derived relevant user experience dimensions, visualizing the experienced differences between the publications, for results averaged over all participants, where the dimension labels with the (−) prefix indicate the negative direction of the given dimension: for example, publication version D, located in the direction of (−) focused attention, evoked a low level of focused attention compared to the other publication versions

*Table 3: Statistically significant difference, at 95 % confidence level, between the publication versions in mean values of different user experience dimensions, averaged over all participants. ***: $p < 0.001$, **: $p < 0.01$, *: $p < 0.05$*

	A – Printed newspaper	**B – iPad App**	**C – Digital edition (print replica)**	**D – Browser newspaper**	**E – HS.fi news web site**
A – Printed newspaper		Navigation***, Usability**, Perceived usability**, Endurability*, Relaxed feeling*	Perceived usability***, Relaxed feeling**, Usability**, Endurability*	Usability***, Perceived usability***, Endurability***, Navigation***, Relaxed feeling***, Pleasant feeling***, Entertainingness***, Novelty***, Trustworthiness***, Felt involvement***, Playfulness***, Classical aesthetics**, Aesthetics**, Enthusiastic and joyful feeling**, Attention allocation**	Navigation***, Classical aesthetics**, Trustworthiness**, Usability**, Aesthetics**, Perceived usability**, Endurability**, Novelty*, Pleasant feeling*, Visual hierarchy*
B – iPad App	Frustrated and anxious feeling*		Playfulness*	Playfulness***, Felt involvement**, Usability**, Endurability**, Perceived usability**, Pleasant feeling**, Enthusiastic and joyful feeling**, Aesthetics**, Entertainingness*, Expressive aesthetics*, Novelty*, Classical aesthetics*, Relaxed feeling*	Aesthetics**, Classical aesthetics*
C – Digital edition (print replica)	Information overload**, Frustrated and anxious feeling**	Information overload*		Usability**, Trustworthiness**, Endurability**, Novelty**, Felt involvement**, Entertainingness*, Navigation*, Enthusiastic and joyful feeling*, Rich in content*, Perceived usability*, Pleasant feeling*, Classical aesthetics*, Playfulness*	Trustworthiness*, Classical aesthetics*
D – Browser newspaper	Frustrated and anxious feeling*	Frustrated and anxious feeling*	–		–
E – HS.fi news web site	Information overload**, Frustrated and anxious feeling*	Information overload**, Rich in content*	–	Usability**, Relaxed feeling**, Rich in content**, Playfulness*, Perceived usability*, Entertainingness*, Endurability*	

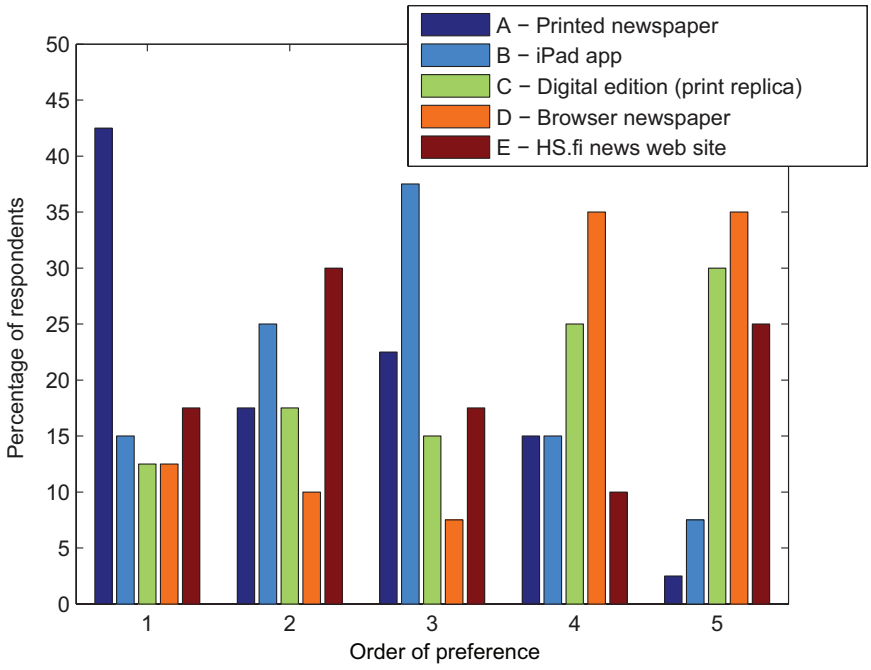

Figure 6: Histograms showing the overall distribution of preference rankings of the publication versions among the participants of the experiment

3.3 Clustering of participants based on preferences

Looking further at the differences in the preferences among the participants, multivariate data analysis revealed two distinct clusters of participants. The clusters are depicted in Figure 7. The diagram known as a dendrogram, described in section 2.6, connects two observers by a line whose height indicates the distance of their preference judgments in the space of first two principal components of preference judgments. The preferences among the participants were similar within each cluster but differed considerably from the preferences of the other cluster. Nineteen of the 40 participants were classified as belonging to the first cluster (the one on the left side of the dendrogram), and 12 participants formed the second cluster (the one to the right from the center of the dendrogram). The remaining 9 participants were left outside these two clusters due to their different preferences, and did not form a third cluster of like-minded persons either.

The mean preference rankings for each publication version in the two participant clusters are shown in Figure 8. The main difference between the two clusters appears to be the preference for web style of news reading in cluster 1 (news web site, version E, highly preferred) and the preference for more conventional style of newspaper-like news reading in cluster 2 (version E least preferred, printed newspaper, version A, most preferred). While the printed newspaper was rather highly ranked in both clusters (higher in cluster 2), in cluster 1 the participants apparently saw no need for a digital version replicating the printed newspaper (version C less preferred). In contrast, in cluster 2 this rather straightforward transformation of the conventional newspaper into a digital format was appreciated (version C more preferred).

3.4 User-defined attributes

The video recordings of the eye tracking videos with retrospective comments and the audio recordings of the comments from participants during the preference judgments were reviewed by the main researcher in the study. Notes of the main events and comments in the eye tracking videos were made, and the comments made during the preference judgments were fully transcribed.

Attributes associated by the participants with different publication versions when they justified why they preferred one version over another were extracted from the transcripts. The 47 attribute categories seen in Table 4 were derived by reviewing all the extracted attributes. The frequencies of each attribute being associated with each of the publication versions were then noted by the researcher. The researcher and the administrator of the experiments reviewed, discussed, and agreed on this coding in collaboration. Table 4 lists the percentage of participants that associated a given attribute with a given publication version. Due to the degree of subjectivity involved in the cod-

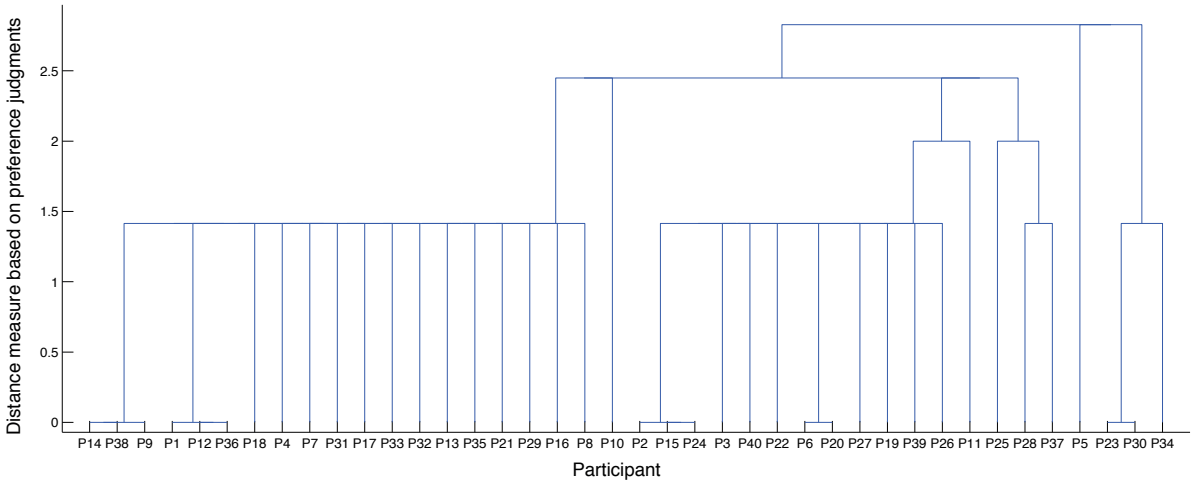

Figure 7: Dendrogram depicting the distances and clusters of participants based on their publication version preference judgments

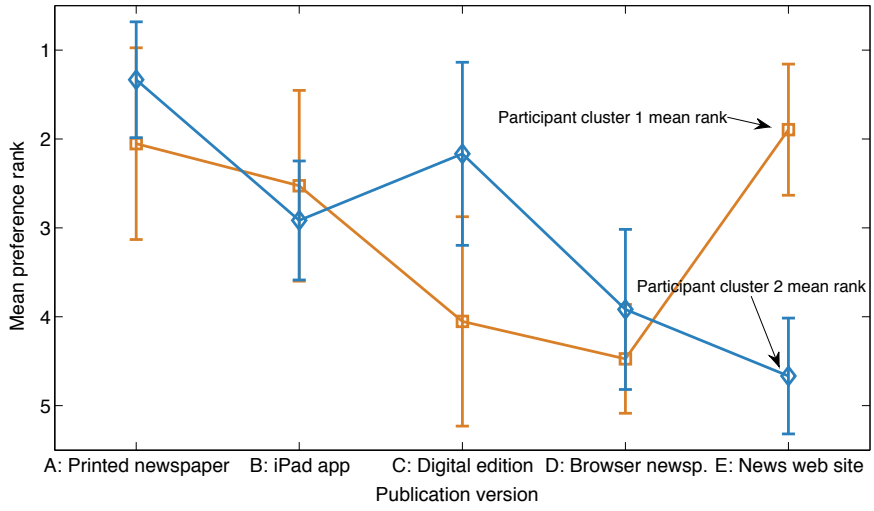

Figure 8: Mean preference rankings of the five publications versions for the participant clusters 1 (orange squares) and 2 (blue diamonds), where the error bars indicate the standard deviation of the rankings around the mean for each publication version in each cluster; notice that the ranking value decreases (preference increases) towards the top of the graph: for example, in participant cluster 1 version E (news web site) was the most preferred choice while in cluster 2 it was the least preferred publication version

ing process, the percentages should be taken only as roughly approximate indicators of the relative frequencies different attributes. The main point of Table 4 is to qualitatively identify the attributes that the participants themselves used in describing different publication versions, their experiences in using them, and why they considered each version more or less suitable for their daily used.

3.5 News reading styles

When the participants justified their preferences, they typically also described their daily news reading habits and told what made given publication versions more or less attractive for them. Based on reviewing these comments the researcher derived the following three main categories of reading styles. Based on reviewing the transcripts of the comments each participant was then categorized into one or more of the reading style categories, collaboratively by the researcher and the administrator of the experiments.

Twelve participants were placed in two categories, as they commented on different styles of news reading in different contexts. None of the participants was classified into all three categories. Six of the participants could not be placed in any of the three reading style categories based on their comments, but neither did their comments suggest an additional reading style category.

Table 4: Percentage of participants that associated the given attribute with the given publication version when they explained their preferences

Attribute	Publication version					All versions
	A	B	C	D	E	
Familiar	35	5	5	5	22	73
Traditional feel	3	0	14	0	0	16
Intuitive, easy to use	32	22	14	8	14	89
Difficult, unintuitive to use	0	3	11	35	3	51
Abundance, richness of content	0	0	0	0	8	8
Scarcity of content	0	5	0	8	0	14
Too much information at once	0	0	0	0	14	14
Comfortable amount of information visible at once	3	3	0	0	0	5
Unecological	8	0	0	0	0	8
Ecological	0	0	3	0	0	3
Creates trash at home	8	0	0	0	0	8
Does not create trash at home	0	3	3	0	0	5
No disturbing glare	8	0	0	0	0	8
Disturbing glare	0	3	0	0	0	3
Not tiresome for my eyes	5	0	0	0	0	5
No need for device, electricity, or network connection	8	0	0	0	0	8
Newspaper sections can be divided between family members at home	5	0	0	0	0	5
Navigation is easy, intuitive	0	11	5	22	5	43
Navigation is difficult, unintuitive	0	5	5	11	3	24
Moving around in the publication is effortless	5	11	22	5	0	43
Moving around in the publication is cumbersome	8	0	11	5	5	30
Attractive layout and visual appearance, beautiful	3	5	5	0	0	14
Unattractive layout and visual appearance, boring, ugly	0	3	0	11	3	16
Easy to perceive all the content that the publication has to offer	11	14	16	5	5	51
Difficult to perceive all the content that the publication has to offer	3	5	3	3	3	16
Feeling lost, not knowing how to get back to frontpage or previously visited locations	0	5	0	11	8	24
Easy to know my location in the publication	11	8	0	5	0	24
Difficult to find what I am looking for	3	8	0	5	5	22
Easy to find what I am looking for	8	14	8	3	5	38
Easy to find interesting articles	3	14	0	5	16	38
Easy to find important news	3	3	0	0	3	8
Intuitive, easy-to-grasp structure	3	38	5	14	8	68
Complex, unintuitive structure	0	3	3	0	14	19
For enjoyable, sensuos, relaxing reading experiences	8	0	0	0	0	8
Feels good in my hands	11	0	0	0	0	11
Comments, discussions, sharing, searching, and other extra functionalities	0	0	0	0	14	14
No comments, discussions, or sharing options	0	0	3	0	0	3
Possibility to zoom in	0	0	3	0	0	3
Comfortable to read articles	5	3	0	8	0	16
Unpleasant to read articles	0	3	8	5	3	19
Latest, updated news	0	0	0	0	27	27
Not perceived as a daily publication	0	0	0	0	24	24
Easy to carry with me	5	3	0	0	3	11
Advertisements or other elements are distracting, difficult to concentrate	0	0	11	3	5	19
Advertisements are a pleasant part of the publication, not distracting	3	0	8	0	3	14
Pleasant size	11	0	0	0	0	11
Easy to access anywhere on any device	0	0	0	0	3	3
Chance to come across interesting articles and topics unexpectedly, serendipitiously	3	0	0	0	3	5

Participants categories: (1) Keeping up with what is going on in the world generally (38 %). Readers with this motivation typically want to browse through the whole publication, seeing all that it has to offer and stopping to focus more on articles that they consider to be important. (2) Keeping informed of what is going on in areas that are personally interesting (48 %). Readers with this motivation value quick access to sections that are of interest to them, without having to pay attention to anything else. (3) Finding latest, interesting, or entertaining news to read, quickly and easily (28 %). The motivation is not to read news of any specific category or to find specific information, but rather to catch up with the latest news or to read news content as an enjoyable pastime, typically on a short break between other activities.

3.6 Interpretation of experiences evoked by different publication based on questionnaire results and qualitative summaries of the reading sessions

Using the summaries written upon reviewing of the eye tracking videos with retrospective comments, and building on the previously presented results the following overall interpretations were made of the user experiences of the five publication versions.

3.6.1 Version A: Printed newspaper

The printed tabloid format newspaper, which many participants considered easier to handle in many reading situations than the previous broadsheet version, was generally well regarded. The larger size of a newspaper spread, and the well-used possibilities it offered for laying out the content, was appreciated by many participants. Enjoyable reading experience overall, as well as familiarity, supported the choice of this version for many participants. However, a considerable number of participants, while acknowledging the enjoyable reading experience of a printed newspaper, preferred to read their daily news articles from a digital medium – reading daily news from a printed newspaper had no place in their current daily routines. Considering the gaze paths, and the allocation of attention to different elements of the publication, many participants found the way the advertisements were incorporated in the layout of the printed newspaper to be natural and pleasant for them: they could easily pay closer attention to advertisements if they spotted something interesting (or decide not to do so) but they did not feel that this took away from the flow of reading the publication, as opposed to advertising in digital publications, which many participants commented to be distracting to their reading experience.

3.6.2 Version B: iPad app

The iPad app was generally considered to be visually rather impressive, and the navigation between sections via the bar available from the bottom corner to be intuitive to use. This native app also felt more responsive to most participants than the versions D and E, which were used in a web browser. Due to the relatively intuitive navigation, freedom from severe usability problems, and the pleasing visual appearance, the iPad app was generally rather well liked (77.5 % of the participants ranked it in their top 3 when choosing the preferred version).

3.6.3 Version C: Digital edition (print replica)

Some participants thought that pleasant layout of the print version transferred rather nicely to the digital device in this digital edition that replicated the pages of the printed newspaper. Other advantages mentioned included the immediate familiarity to those used to reading the printed newspaper. Also, the navigation through the multi-page view of the miniaturized pages was considered intuitive in its simplicity by some participants, and provided a clear overall view of all content available within the publication (something that was often perceived to be lacking from the other digital versions). Some participants used this miniaturized view extensively to browse the publication, only tapping to go to individual pages if they spotted something that appeared interesting. On the other hand, some participants did not see the point of reading a replica of the printed pages on a digital device (especially on a relatively small screen of a tablet). Reading the text was particularly problematic on this version for those participants that were not able to comfortably read the text at the default size at which the pages were presented: they had to constantly combine two-fingered zooming (in order to read paragraphs) and dragging (to scroll the page), which was cumbersome.

3.6.4 Version D: Browser newspaper

Preferred by some for the ability to use it across different digital platforms, the browser newspaper (used on the Safari browser in the iPad) did not generally provide a very good user experience. The navigation was considered to be confusing. While some positive comments were given for the ability scroll the article headers separately on the right side of the front page, most participants found the fact that the dragging on the front page only affected a part of the page to be confusing. The fact that links to all sections were not initially visible in the navigation bar was considered a disadvantage by many participants. Many participants reported feeling lost when moving from article to another within the publication; for example, it was not intuitively obvious how to get back to an article or a part of the publication where they had previously been in. The user experience also suffered from occasional delays in responses to user actions (problems in network connections may have caused some of the delays).

3.6.5 Version E: News web page (HS.fi)

Unlike the other versions, which were daily publications, version E was a continuously updated news web site, and in this aspect essentially different from the other versions. It also divided the opinions the most among the participants. It is likely that the different styles of news reading were most strongly reflected in the opinions regarding this version. Many participants felt that the layout was too full of everything (with many screens worth of material to scroll through on the home page, and additional links on the right side) and preferred what they considered to be a cleaner structure of conventional news publications. However, for the participants used to reading their daily news on the web, this version offered what they wanted in a familiar format, a serving of news for quick reading, with possibilities to quickly jump to the latest or most popular articles. Other flavours of the web, like seeing comments from other readers, also contributed to making this the preferred version for some readers.

4. Discussion

Factor analysis and experience map visualizations based on multivariate analysis of the user experience questionnaire responses provided information on relevant experience dimensions and appropriate items for measuring them, and allowed us to describe the perceived and experienced differences between the publication versions. Particularly, dimensions such as perceived usability, classical aesthetics, expressive aesthetics, and focused attention were consistently separated to different factors, and meaningful differences were found between the publication versions in these dimensions.

Based on the results it also appears to be possible to meaningfully measure and compare aspects such perceived trustworthiness, playfulness, and entertainingness or interestingness of different publication designs, as well as the emotional impact of different designs and the relationships between the experienced emotions and other dimensions. For example, in this data set low usability correlated with feelings of frustrated and anxious feelings, and expressive aesthetics correlated with perceived playfulness of the publication. Further, the data suggested that it could be possible to meaningfully measure the design concepts of visual hierarchy and abundance of information shown, as perceived by the reader. However, in the case of these and previously mentioned dimensions, it should be noted that the experiment and analysis carried out in this study does not constitute a full validation of the questionnaire dimensions and items. Rather, these results should be understood as a preliminary exploration into feasibility of meaningfully measuring these rather complex dimensions, with more work needed to build validated questionnaires for reliably measuring them. Still, it is interesting to note that it appears to be possible to meaningfully measure and also relate to one another various aspects of user experience, from aesthetics and usability to emotional responses and perceptions such as trustworthiness or entertainingness of the publication, all of which were found to vary with the layout of the content, despite the content intent itself remaining essentially the same. The attributes associated by the participants with different publication versions can be compared with the items and experience dimensions used in the questionnaire, and used to inform the further development and application of measures of news reading experiences.

The reliability and validity of different parts of the questionnaire can be judged to a degree based on factor structure of Table 1. The fact that items supposed to measure a single construct are loaded strongly on the same factor suggest their reliability as a measure of that construct, as is the case for items 72–77, constituting a measure of perceived usefulness, for example. Divergent validity of this measure is suggested by the fact that it is loaded onto different factor than the items meant to measure distinct constructs such as Focused Attention (items loaded mostly on factor 4) and Aesthetics (items loaded mostly on factor 2). It should be noted that not all dimensions are assumed to be consistent psychological constructs. Items 22–30, for example, are related to different aspects of usability, which is used as an aggregate indicator of these different aspects, rather than a single psychological construct. The fact that different constructs or indicators are loaded onto same factor should not be taken to mean that they fundamentally measure the same aspect of user experience; rather, it shows that they are correlated within this data set. For example, expressive aesthetics were associated with playfulness and joyful and enthusiastic emotional responses, all of them mostly loaded onto factor 4, while being presented with too much information at one glance (item 4, loaded onto factor 5) seems to be a possible cause of anxious and tense feelings (items 54 and 55, also loaded significantly on factor 5). Table 3 further shows the user experience dimensions on which significant differences were found between the examined publication versions, suggesting the relevance of these measures in differentiating between the experiences evoked by different designs.

The three general news reading style categories derived from the comments of participants cover the principal motivations among all the participants of the experi-

ment, with many additional personal idiosyncrasies in the reading styles, as was to be expected. The printed newspaper lends itself well to most of these different styles of reading, assuming it is at hand in the given context. The accumulated learnings from the design of printed newspapers are not directly applicable to the world of digital publications, and digital newspapers are still finding their form. It is not clear what kind of design choices are most suitable in digital news publications, or if any single type of layout would satisfy different reading styles generally. A given digital version may be suitable for a certain style of reading but not for another one, depending on its layout and how its navigation is implemented. The results from the experiment indicated that this was indeed the case here. The vast majority of participants liked the reading experience of a printed newspaper, even if they reported that printed newspapers did not anymore have a place in their daily routines. However, there was considerable variation among the participants in which of the digital versions was preferred for the reading experience it provided, not explained by the person's attitude to printed newspaper.

The results indicated that none of the digital versions included in the experiment, while satisfying some readers, would do very well in catering to all styles of reading. Specific aspects in which all digital versions struggled to various degrees in comparison to the printed newspaper was in giving the reader an intuitive feel for all the content that is available in the publication and allowing the reader to perceive her current position in the publication. Printed newspaper naturally enjoys all the benefits of a tangible physical object in this regard, while in the case of digital versions the layout choices, including the implementation of the navigation system, had a strong influence on how this is perceived. For some readers it was very important to have a good understanding of where a newspaper starts and where it ends, and to have a good idea of how to go back to a specific place in the publication that they had previously visited. Others were fine with and preferred a web style continuous stream of news over an easier-to-perceive set of news that they could digest; navigationally, for them it was sufficient if they could quickly return to the front page of the publication. Indeed, these were the two main preference-based clusters among the participants. In both groups the reading experience that the printed newspaper provided was valued rather highly, the difference being in their attitudes and preferences regarding the digital newspaper versions. One group preferred to have their digital news presented in a publication that followed the tradition of printed newspapers, while the other group saw no need to carry this kind of layout over into the digital domain, preferring a news web site style of dynamic and continuous news stream.

Further findings were related to the flow of attention in different versions. A pleasant flow of attention is known to be a central aspect of a good reading experience. Again the printed newspaper excelled in this regard, with more variability among the digital versions. A common example that came up in the experiments was the placement of advertisements and how it affected the flow of reading. Many participants commented on how a newspaper spread allowed one to smoothly direct one's attention to interesting parts, quickly noticing different elements such as advertisements but not paying much attention unless they appeared interesting. In some digital versions participants were in many cases clearly distracted and irritated by advertisements when they suddenly interrupted their flow of attention: the publications did not include pop-up advertisements as such, but the effect was as distracting if the person suddenly found himself looking at an advertisement, partly forced on him by the layout, and had to make an effort to continue past the advertisement. Again, while the results did not provide clear-cut general design rules for directing attention in digital news publications, it did show how different designs had considerable effects on the flow of attention and consequently on the overall experience provided by the publication.

Beyond the observations on the reading experiences and styles, the experiments served as a test of combining and integrating different approaches to evaluating the user experience of media products and services. We found user testing with eye-tracking, followed by a retrospective commenting session to be a very useful approach for extracting valuable information for interpreting the other results. During the retrospective commenting we showed the participant a video recording of their reading session, augmented by the gaze path from the eye tracking glasses, and asked them to explain their own experience: what they were doing, what they thought and felt. Seeing the video recording with the visualization of their own gaze path appeared to be a good motivator for most persons to retrospectively and introspectively consider and discuss their own reading experience, and also to relate it to their reading style more generally.

The gaze path data revealed the focal points and transition paths of attention, the retrospective commenting provided qualitative data, the both of which served to explain results of the multivariate analysis of the media experience questionnaire data. The final preference judgements between different publication versions and the comments to justify those judgments indicated what aspects of the experience the participants found valuable, and together with other data, helped to paint a more complete picture of the user experiences of the tested publication versions.

5. Conclusions

A multipart laboratory experiment was carried out in order to compare and investigate different aspects of the user experiences evoked by five different versions of a newspaper. These versions, a printed tabloid size newspaper and four digital versions with different types of layouts and design choices, essentially provided five different ways of presenting the same content to the reader. As the news reading habits and preferences are changing with the ongoing digital transformation, it is essential to understand how different kinds of design choices relate to different dimensions of user experience and what kinds of designs best serve different styles of reading.

While the properties of the publication versions included in the experiment necessarily bounded the user experiences that could be expected to arise in this study, the experimental setup was designed with the goal of increasing the understanding of news reading experiences, habits, and preferences also more generally, beyond the usability details related to idiosyncrasies of these specific publication versions. Multiple research methods were combined in the experiment for twofold purposes: to support the interpretation of results through integration and comparison of results obtained by different methods, and to test and develop the user experience measurement and analysis methods themselves. A central aspect of useful user experience measurement is finding out what to measure. Thus, through this experiment, we also set out to increase the understanding of the relevant and measurable dimensions of news reading experiences.

A mobile eye tracker was used to record a scene video and to capture the eye movements of each participant as she or he browsed the newspaper. After reading the given newspaper version, the participant was shown the video recording of his or her reading sessions, captured with the eye tracker and augmented with a cursor showing the participant's gaze path. The participant was asked to retrospectively comment on his or her reading experience while watching the eye tracking video, to comment on their own actions, goals, thoughts, and feelings throughout the reading sessions. Based on the videos and commentaries, summaries of each reading session were later written, describing the actions and the flow of attention of the participants during the session, with further interpretations and other points added based on the retrospective commentary. After each reading session each participant also filled a 92-item questionnaire, with items from a media experience framework that were postulated to be appropriate for measuring certain relevant dimensions of news reading experiences, as well as items adapted from two validated questionnaires for user engagement and perceived visual aesthetics of web sites. Finally, having spent approximately five minutes reading each of the publications versions, each participant was asked to rank order the versions according to his or her own preference, first choosing the version that he or she would choose if she had to use only one of the versions in his or her daily life. The participant was also asked to justify her choice, to explain why she liked the particular version and why she thought it best suited her news reading style.

The analysis of the questionnaire responses showed that the questionnaire did in fact indicate meaningful differences between the tested publication versions on the different dimensions of media experience that it was designed to measure, and that the measures were consistent with the data acquired from other approaches. The questionnaire has so far not been extensively tested, and the work done in this study does not yet constitute a proper validation of the questionnaire, but these results do suggest that the questionnaire can be a useful tool in measuring media experience. The results, along with other similar studies published in the recent years, provide useful information for future considerations and validation efforts for media experience measures, as well as for practical application of such measures in different phases of iterative design processes.

The qualitative data from the retrospectively commented eye tracking videos was in line with the results obtained with the questionnaire, and further supported the interpretation of results, helping to see what kinds of design and experience aspects lead to the differences seen in the multivariate analysis and visualizations of the questionnaire data and to further explain the preferences among the participants. 42.5 % of participants ranked the printed newspaper first in their order of preference. While the printed newspaper was by far the most frequent preferred choice of individual publication versions and the reading experience that it provided was well liked across all participants, it should be noted that the majority of participants (57.5 %) still preferred one of the digital versions if they had to choose only one publication version for their daily news reading. Many of them commented that while they still enjoyed the experience of reading a printed newspaper, they did not anymore have room for it in their daily routines, thus preferring one of the digital versions.

However, the results suggest that, unlike the printed newspaper, none of the digital versions succeeded particularly well to catering to reading styles and preferences of different readers. This result was strongly emphasize by two distinct clusters of participants found based on the preference judgments. While the

printed newspaper was highly ranked in both groups, the most significant difference between the two groups seems to be the attitude towards reading news articles in the form of continuous streams as often found on different web sites. One group preferred the printed newspaper and digital versions that can be understood to stem from the tradition of the printed newspaper. The other group preferred the web style of news presentation and saw no need for digital versions mimicking the printed paper.

Acknowledgements

The study reported in this paper was carried out in the Next Media research program, funded by Tekes, the Finnish funding agency for innovation. Additional analysis of the results was carried out in a project funded by VTS, the media research foundation in Finland. The authors are also grateful to the participants of the study for their time and effort. The authors would also like to thank the anonymous reviewers of the original manuscript for their comments, which were helpful in preparing the final version of the paper – the responsibility for any remaining deficiencies lies solely with the authors.

References

Albert, W., Gribbons, W. and Almadas, J., 2009. Pre-conscious assessment of trust: a case study of financial and health care web sites. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 53(6). San Antonio, Texas, 19–23 October 2009. Thousand Oaks: Sage Publications, Inc., pp. 449–453.

Aldenderfer, M.S. and Blashfield, R.K., 1984. *Cluster Analysis: Quantitative Applications in the Social Sciences*. Beverly Hills, California: Sage Publications, Inc.

Aranyi, G., 2012. *Developing a Psychological Model of End-user's Experience with News Web Sites*. Ph.D. Thesis. Teesside University. [pdf] Available at: <http://hdl.handle.net/10149/236331> [Accessed 12 April 2016]

Aranyi, G. and van Schaik, P., 2015. Modeling user experience with news websites. *Journal of the Association for Information Science and Technology*, 66(12), pp. 2471–2493.

Aranyi, G. and van Schaik, P., 2016. Testing a model of user-experience with news websites. *Journal of the Association for Information Science and Technology*, 67(7), pp. 1555–1575.

Aranyi, G., van Schaik, P. and Barker, P., 2012. Using think-aloud and psychometrics to explore users' experience with a news web site. *Interacting with Computers*, 24(2), pp. 69–77.

Bangor, A., Kortum, P.T. and Miller, J.T., 2008. An empirical evaluation of the system usability scale. *International Journal of Human-Computer Interaction*, 24(6), pp. 574–594.

Bangor, A., Kortum, P. and Miller, J., 2009. Determining what individual SUS scores mean: adding an adjective rating scale. *Journal of usability studies*, 4(3), pp. 114–123.

Barnett, L., 2007. The nature of playfulness in young adults. *Personality and Individual Differences*, 43(4), pp. 949–958.

Bradley, M.M. and Lang, P.J., 1994. Measuring emotion: the self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, 25(1), pp. 49–59.

Brakus, J.J., Schmitt, B.H. and Zarantonello, L., 2009. Brand experience: What is it? How is it measured? Does it affect loyalty? *Journal of Marketing*, 73(3), pp. 52–68.

Brooke, J., 1996. SUS-A quick and dirty usability scale. *Usability evaluation in industry*, 189(194), pp. 4–7.

Chorianopoulos, K. and Spinellis, D., 2004. Affective usability evaluation for an interactive music television channel. *ACM Computers in Entertainment*, 2(3), pp. 1–11.

Csikszentmihalyi, M., 1990. *Flow: the Psychology of Optimal Experience*. New York: Harper & Row.

d'Haenens, L., Jankowski, N., and Heuvelman, A., 2004. News in online and print newspapers: differences in reader consumption and recall. *New Media & Society*, 6(3), pp. 363–382.

Davis Jr, F.D., 1986. *A Technology Acceptance Model for Empirically Testing New End-user Information Systems: Theory and Results*. Ph.D. Thesis. Massachusetts Institute of Technology.

Davis, F.D., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*. 13(3), pp. 319–340.

Friedrich, P., Mensonen, A., Aikala, M. and Grenman, K., 2014. "Digital newspaper makes my home tidier" – evaluating user experience with user-defined attributes. In: *Proceedings of the 27th Bled eConference, eEcosystems*. Bled, Slovenia, 1–5 June 2014. Kranj, Slovenia: Faculty of Organizational Sciences, University of Maribor, pp. 17–24.

Gefen, D., 2002. Reflections on the dimensions of trust and trustworthiness among online consumers. *ACM SIGIS Database*, 33(3), pp. 38–53.

Graham, L., 2008. Gestalt theory in interactive media design. *Journal of Humanities & Social Sciences*, 2(1).

Hartson, R. and Pyla, P.S., 2012. *The UX Book: Process and Guidelines for Ensuring a Quality User Experience*, Amsterdam, etc.: Morgan Kaufmann, Elsevier.

Hassenzahl, M., 2003. The thing and I: understanding the relationship between user and product. In: M.A. Blythe, K. Overbeeke, A.F. Monk and P.C. Wright, eds. 2003. *Funology: From Usability to Enjoyment*. Dordrecht, Boston, London: Kluwer Academic Publishers, pp. 31–42.

Hassenzahl, M., 2010. Experience design: technology for all the right reasons. In: J. Carroll, ed. 2010. *Synthesis Lectures on Human-Centered Informatics*, 3(1), pp. 1–95.

Hassenzahl, M., Burmester, M. and Koller, F., 2003. AttrakDiff: ein Fragebogen zur Messung wahr-genommener hedonischer und pragmatischer Qualität (AttrakDif: a questionnaire for the measurement of perceived hedonic and pragmatic quality). In: J. Ziegler and G. Szwillus, eds. 2003. *Mensch & Computer 2003. Interaktion in Bewegung*. Stuttgart, Leipzig: B.G. Teubner. pp. 187–196.

Hassenzahl, M., Schöbel, M. and Trautmann, T., 2008. How motivational orientation influences the evaluation and choice of hedonic and pragmatic interactive products: the role of regulatory focus. *Interacting with Computers*, 20(4–5), pp. 473–479.

Hassenzahl, M. and Tractinsky, N., 2006. User experience – a research agenda. *Behaviour & Information Technology*, 25(2), pp. 91–97.

Helle, M., Ravaja, N., Heikkilä, H., Kallenbach, J., Kankainen, A., Kätsyri, J., Laine, J. and Marghescu, D., 2011. *A Theoretical Model of Media Experience and Research Methods for Studying It*. [pdf] TEKES: Next Media research program. Available at: <http://www.mediaconceptsrg.net/wp-content/uploads/2013/02/D0.4.1_0.4.2_MEDIAEXPERIENCE_A-Theoretical-Model-of-Media-Experience-Harri-Heikkilä-Merha-Helle.pdf> [Accessed 13 June 2016].

Howard Chen, Y.H. and Corkindale, D., 2008. Towards an understanding of the behavioral intention to use online news services: an exploratory study. *Internet Research*, 18(3), pp. 286–312.

Hyrskykari, A., Ovaska, S., Majaranta, P., Räihä, K.-J. and Lehtinen, M., 2008. Gaze path stimulation in retrospective think-aloud. *Journal of Eye Movement Research*, 2(4), pp. 1–18.

Ihlström, C. and Lundberg, J., 2002. The audience of Swedish local online newspapers: a longitudinal study. In: J.A. Carvalho, ed. *Technology Interactions: Proceedings of the 6th International ICCC IFIP Conference on Electronic Publishing*. Karlovy Vary, Czech Republic, 6–8 November 2002, Berlin: VWF, pp. 92–102.

International Organization for Standardization, 1998. *ISO 9241-11:1998 Ergonomic requirements for office work with visual display terminals (VDTs) – Part 11: Guidance on usability*. Geneva: ISO.

Jackson, J.E., 2003. *A User's Guide to Principal Components*. New York, etc.: John Wiley & Sons.

Kirakowski, J. and Corbett, M., 1993. SUMI: the software usability measurement inventory. *British Journal of Educational Technology*, 24(3), pp. 210–212.

Kirakowski, J. and Cierlik, B., 1998. Measuring the usability of web sites. In: *Proceedings of the Human Factors and Ergonomics Society Annual Meeting 42nd Annual Meeting*. Santa Monica CA: HFES, 42(2), Sage Publications, pp. 424–428.

Lallemand, C., Gronier, G. and Koenig, V., 2015. User experience: a concept without consensus? Exploring practitioners' perspectives through an international survey. *Computers in Human Behavior*, 43, pp. 35–48.

Lavie, T. and Tractinsky, N., 2004. Assessing dimensions of perceived visual aesthetics of web sites. *International Journal of Human-Computer Studies*, 60(3), pp. 269–298.

Lessiter, J., Freeman, J., Keogh, E. and Davidoff, J., 2001. A cross-media presence questionnaire: the ITC-sense of presence inventory. *Presence: Teleoperators and Virtual Environments*, 10(3), pp. 282–297.

Lewis, J.R., 1991. Psychometric evaluation of an after-scenario questionnaire for computer usability studies: the ASQ. *ACM SIGCHI Bulletin*, 23(1), pp. 78–81.

Lewis, J.R., 1995. IBM computer usability satisfaction questionnaires: psychometric evaluation and instructions for use. *International Journal of Human-Computer Interaction*, 7(1), pp. 57–78.

Lewis, J.R. and Sauro, J., 2009. The factor structure of the system usability scale. In: M. Kurosu, ed. 2009. *HCD 2009 Proceedings of the 1st International Conference on Human Centered Design, Held as Part of HCI International 2009*, San Diego, California, USA, 19–24 July 2009. Berlin: Springer, pp. 94–103.

Lidwell, W., Holden, K., Butler, J. and Elam, K., 2010. *Universal Principles of Design: 125 ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions, and Teach through Design*. Beverly, Massachusetts: Rockport Publishers.

Lindgaard, G., Fernandes, G., Dudek, C. and Brown, J., 2006. Attention web designers: you have 50 milliseconds to make a good first impression! *Behaviour & information technology*, 25(2), pp. 115–126.

Lu, Y., Wang, X. and Ma, Y., 2013. Comparing user experience in a news website across three devices: iPhone, iPad, and desktop. *Proceedings of the American Society for Information Science and Technology*, 50(1), pp. 1–4.

Lund, A., 2001. Measuring usability with the USE questionnaire. *Usability Interface*, 8(2), pp. 3–6.

Mensonen, A., Aikala, M., Laine, J. and Seisto, A., 2012. Consumer perception of printed point-of-purchase displays. *Journal of Print and Media Technology Research*, 1(4), pp. 205–213.

Mérigot, B., Durbec, J.P. and Gaertner, J.C., 2010. On goodness-of-fit measure for dendrogram-based analyses. *Ecology*, 91(6), pp. 1850–1859.

Novak, T.P. and Hoffman, D.L., 1997. *Measuring the Flow Experience Among Web Users*. [pdf] Vanderbilt University: Project 2000. Available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.89.1411&rep=rep1&type=pdf> [Accessed 13 June 2016].

Novak, T.P., Hoffman, D.L. and Duhachek, A., 2003. The influence of goal-directed and experiential activities on online flow experiences. *Journal of consumer psychology*, 13(1&2), pp. 3–16.

Nunnally, J.C. and Bernstein, I.H., 1994. *Psychometric Theory*. Third edition. New York: McGraw-Hill, Inc.

O'Brien, H.L., 2010. The influence of hedonic and utilitarian motivations on user engagement: the case of online shopping experiences. *Interacting with Computers: Special Issue on User Experience*, 22(5), pp. 344–352.

Pesonen, E., 2015. *The User Experience of Digital News: Reading and Authentication on Browser Optimized Versions and Digital Replicas*. M.Sc. Thesis. Tampere University of Technology.

Pesonen, E., Jumisko-Pyykkö, S. and Väätäjä, H., 2015. User experience of digital news: two semi-long term field studies. In: MUM'15 *Proceedings of the 14th International Conference on Mobile and Ubiquitous Multimedia*. Linz, Austria, 30 November–2 December 2015. New York: ACM, pp. 51–63.

Poels, K., de Kort, Y.A.W. and Ijsselsteijn, W.A., 2006. *FUGA The Fun of Gaming: Measuring the Human Experience of Media Enjoyment*. [pdf] Helsinki School of Economics: FUGA STREP / NEST-PATH, Deliverable D3.3. Available at:<https://pure.tue.nl/ws/files/21666952/Fuga_d3.3.pdf> [Accessed 13 June 2016].

Schrepp, M., Held, T. and Laugwitz, B., 2006. The influence of hedonic quality on the attractiveness of user interfaces of business management software. *Interacting with Computers*, 18(5), pp. 1055–1069.

Tewksbury, D. and Althaus, S.L., 2000. Differences in knowledge acquisition among readers of the paper and online versions of a national newspaper. *Journalism & Mass Communication Quarterly*, 77(3), pp. 457–479.

Thüring, M. and Mahlke, S., 2007. Usability, aesthetics and emotions in human–technology interaction. *International Journal of Psychology*, 42(4), pp. 253–264.

Tullis, T. and Albert, B., 2013. *Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics*. Second Edition. Amsterdam, etc.: Morgan Kauffman Publishers, Elsevier.

Vaughan, M.W. and Dillon, A., 2006. Why structure and genre matter for users of digital information: a longitudinal experiment with readers of a web-based newspaper. *International Journal of Human-Computer Studies*, 64(6), pp. 502–526.

Vorderer, P, Wirth, W., Gouveia, F.R., Biocca, F., Saari, T., Jäncke, F., Böcking, S., Schramm, H., Gysbers, A., Hartmann, T., Klimmt, C., Laarni, J., Ravaja, N., Sacau, A., Baumgartner, T. and Jäncke, P., 2004. *Development of the MEC spatial presence questionnaire (MEC SPQ), Report to the European Community*. Project Presence: Measurement, Effect, Conditions (MEC), IST-2001-37661.

WAMMI, 2016. [online] Available at: <http://www.wammi.com> [Accessed 13 June 2016].

Watson, D., Clark, L.A. and Tellegen, A., 1988. Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, 54(6), pp. 1063–1070.