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An Overview of How Eye Tracking Is Used in Communication Research

Nadine Bol[1(✉)], Sophie C. Boerman[1], Jennifer C. Romano Bergstrom[2], and Sanne Kruikemeier[1]

[1] Amsterdam School of Communication Research/ASCoR, University of Amsterdam, Amsterdam, The Netherlands
{n.bol, s.c.boerman, s.kruikemeier}@uva.nl
[2] Facebook, Menlo Park, USA
jennifer@romanocog.com

Abstract. Eye tracking gives communication scholars the opportunity to move beyond self-reported measures by examining more precisely how much visual attention is paid to information. However, we lack insight into how eye-tracking data is used in communication research. This literature review provides an overview of how eye tracking is used in communication research by examining published articles from the top-25 ranked communication journals between 2005 and 2015. Our results showed that most eye-tracking research was employed in the field of advertising. Furthermore, most studies used eye tracking to measure (visual) attention and used this as the study's dependent variable. A wide variety of eye-tracking measures were reported, including fixation time, fixation count, and visual shifts, and a wide variety of eye-tracking devices were used. Our results highlight opportunities for using eye tracking as well as identify other ways of using eye tracking to maximize its potential in communication research.

Keywords: Eye tracking · Communication research · (Visual) attention · Research methods

1 Introduction

Eye-movement data gives communication scholars the opportunity to examine more precisely how much visual attention has been paid to information [1–3]. Moreover, eye tracking moves beyond self-reported data by offering a rather objective measure that shows how visual and textual information is processed [4]. Tracking individuals' eye movements allows researchers to see what individuals find interesting and, possibly, gain insight into how information is perceived [5].

Although eye-tracking technology has been available for more than a century [4], the use of eye-movement data within the field of communication is remarkably limited. This is incredibly surprising as such data is of crucial importance for communication scholars. Mediated communication always involves some kind of material, both visual and textual. Yet, communication researchers have less knowledge about the actual attention people give to this information, as it is often assumed that self-reported measures are an indication of attention. Using eye-movement data, communication

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scholars may have a better understanding about which information receives attention. For example, eye-movement data can help gain insight into how online health information is processed (e.g., textual or visual information or both [6]). Moreover, eye tracking can be used to make ads more effective or give insight into how people select and read news about public affairs.

This study aims to contribute to this interesting – but understudied – area of research by exploring how eye tracking is currently used within communication research. This study takes the form of a literature review and examines thoroughly and systematically which measures and eye-tracking systems are deployed, and in which context and country the data were collected. We also describe the materials and samples used. As a result of this close examination of previous work, this study offers directions for future communication research in various fields that wish to use eye-movement data.

2 Method

2.1 Search Procedure

To find eligible studies that used eye tracking in communication research, we focused on articles published in the top-25 ranked communication journals from January 1, 2005 to December 8, 2015 (see Appendix for a list of the top-25 ranked communication journals). This top-25 list was based on the 5-year impact factor as indicated by the ISI Web of Knowledge [7] on November 25, 2015. Our focus on the top journals enabled us to provide an overview of the usage of eye tracking in the most important outlets in the field of communication. We used the Communication & Mass Media Complete database to search for eligible studies in the specific journals. Search terms included "eye track*" (All text field) and the name of the journal (Source field): this procedure was repeated for each of the 25 journals.

2.2 Data Extraction

For each article, the following characteristics were extracted: eye-tracking measures, type of eye-tracking measure (i.e., dependent variable, independent variable, mediator, moderator), intended communication measure, study sample (i.e., sample size, type of participants), material format, eye tracker specifications, field, and country (see Table 1).

3 Results

3.1 Study Selection

The search procedure yielded 90 articles. After screening the full-text content of these articles, 70 references were excluded, because they did not report on eye-tracking data (e.g., only mentioned eye tracking as recommended future methodological research approach, reported on previous eye-tracking studies). The remaining 20 articles were screened for data extraction of which the results are reported below.

Table 1. Main characteristics of included studies

Author (year)	Journal	Eye-tracking measure	Variable type	Communication measure	Field	Material format	Sample	Eye tracker	Country
Bassett-Guntera et al. (2014)	JoHC	Dwell time	DV/IV	Attention	Health	Text on screen	Undergraduate students (N = 77)	The Eyelink II	Canada
Beattie et al. (2010)	JLSP	Fixation time; % fixation; fixation count (40 ms)	DV	Attention	Language	Video	Students (N = 10)	ASL Model 504	UK
Bente et al. (2008)	HCR	Unclear	DV	Visual Attention	CMC	Text, audio, video	Convenience sample (N = 150)	Mediascore, 25 Hz	Germany
Boerman et al. (2015)	JoA	Fixation time (80 ms)	MED	Visual attention	Advertising (TV)	TV program	Undergraduate students (N = 149)	SMI RED, 120 Hz	The Netherlands
Dix et al. (2010)	JAR	% (fixation) time	DV/IV	Banner eye gaze	Advertising (TV)	Video ads	Adult TV viewers (N = 248)	FaceLAB	Australia
Galesic et al. (2008)	POQ	Fixation time; fixation count (100 ms)	DV	Attention	Public opinion	Survey questions	Convenience sample (N = 108)	Tobii 1750, 50 Hz	US
Hartmann et al. (2013)	IJAR	Fixation time; fixation count; visit count	DV	Attention	Advertising (print)	Print ad	Undergraduate students (N = 75)	Tobii T60	Unknown
Heath (2009)	JAR	Number of fixations-per-second	DV	Attention/processing	Advertising (print & TV)	Print & video ads	Convenience sample (N = 17)	Unknown	UK
Heath et al. (2009)	JAR	Number of fixations-persecond	DV	Attention	Advertising (TV)	Video ads	University staff and students (N = 28)	Unknown	UK
Janssens et al. (2012)	IJAR	Number of jumps between page and ad (200 ms)	MC/MOD	Divided attention	Advertising (online)	Online ads (webpages)	Undergraduate students (N = 58; N = 66; N = 71)	SMI RED, 50/60 Hz	Belgium
Mackert et al. (2013)	JoHC	Fixation time; fixation count	DV	Attention	Health	Nutrition label information	University staff and literacy program partici-pants (N = 49)	Tobii T60	US
Neale et al. (2013)	JAR	Eyes-on-screen in seconds	DV	Exposure time	Advertising (TV & online)	Still & video ads	Representative US & Australian sample (N = 35)	Mirametrix system	US & Australia

(*Continued*)

Table 1. (*Continued*)

Author (year)	Journal	Eye-tracking measure	Variable type	Communication measure	Field	Material format	Sample	Eye tracker	Country
Pan et al. (2007)	JCMC	Fixation time; fixation count; pupil dilation; scanpaths (50 ms)	DV	Trust and implicit awareness	CMC	Webpages	Undergraduate students (N = 16)	ASL Model 504, 60 Hz	US
Perego et al. (2010)	MP	Fixation time; fixation count; path length; visual shifts (100 ms)	DV	Cognitive processing	Language	Video	Under/postgraduate students (N = 16)	Tobii 1750, 50 Hz	Hungary
Sanders-Jackson et al. (2011)	HCR	Fixation time	DV	Visual Attention	Public health	Video ads	Convenience sample of smokers (N = 71)	ASL Model 504, 19”	US
Siefert et al. (2008)	IJAR	Ratio time in/off center screen; ratio time on/off screen; eye movements and fixations inside screen but not in center	DV	Central ten-dency; screen time; visual processing activity	Advertising (TV)	Video ads	Convenience sample (N = 100)	Unknown	US
Smit et al. (2015)	JAR	% fixations during first 5 s; % fixations on text, brand, visual (100 ms)	DV	Visual attention	Advertising (print)	Magazine ads	Representative samples (N = 105)	Tobii	The Netherlands
Steele et al. (2013)	JAR	Fixation time	DV	Visual attention	Advertising (TV & online)	Video & online ads	Representative samples (N = 129; N = 122)	Tobii, 17”	US
Treutler et al. (2010)	JAR	% fixation time	DV	Visual attention	Advertising (print, radio, TV, online)	Display & video ads	Representative sample (N = 114)	Unknown	Canada
Turner et al. (2014)	JoHC	Gaze duration (100 ms)	DV	Visual attention	Health	Products on screen	Undergraduate students (N = 89)	MyTobii D10, 17”	US

Abbreviations: JoHC = Journal of Health Communication; JLSP = Journal of Language and Social Psychology; HCR = Human Communication Research; JoA = Journal of Advertising; JAR = Journal of Advertising Research; POQ = Public Opinion Quarterly; IJAR = International Journal of Advertising Research; JCMC = Journal of Computer-Mediated Communication; MP = Media Psychology; DV = dependent variable, IV = independent variable, MED = mediator, MOD = moderator, MC = manipulation check; CMC = Computer-mediated communication.

3.2 Study Characteristics

The included studies mostly reported on eye-tracking data in the field of advertising [8–16], but some eye-tracking studies were also conducted in (public) health [1, 17–19], language studies [20, 21], and computer-mediated communication [22, 23]. Nine studies reported on fixation time [1, 8, 10, 15, 18, 20, 21, 23, 24] or relative fixation time (% fixation time) as eye-tracking measure [9, 14, 16, 20]. Six articles reported on fixation count [10, 18, 20, 21, 23, 24], two on number of fixations-per-second [11, 12], and two on scan paths [23, 24] and visual shifts [24]. Furthermore, one study reported on (re)visit counts [10], one on gaze duration [19], one on dwell time [17], and one on number of jumps between page and ad [13].

The majority of studies used these eye-tracking measures to capture (visual) attention (n = 15) and used these measures as the study's dependent variable (n = 18). Most material formats included ads, either in the form of print [10, 11, 14], video [1, 9, 11, 12, 15, 16, 20, 24–26], or online [13, 15, 16, 25]. Other non-advertisement material formats included video clips [20], survey questions [21], nutrition labels [18], webpages [23], and products [19]. Although nine articles employed eye tracking on more than 100 participants [8, 9, 13–16, 21, 22, 26], more articles reported on samples below 100 participants (n = 11). The 20 articles showed a wide variety of eye-tracking apparatus used. Seven studies assessed the eye-tracking measures using a Tobii eye tracker [10, 14, 15, 18, 19, 21, 24], three used the ASL Model 504 [1, 20, 23], and two used an SMI [8, 13]. All studies were conducted in Western countries (e.g., the US, Western Europe).

In addition, we noted that different eye trackers measure data with different Hz, which indicates the number of times data is acquired within one second, and different studies use different thresholds with regard to the minimum milliseconds required for a fixation to be registered. Our results showed that some studies use eye trackers with a gaze sample rate of only 25 Hz [22], whereas others collect their data at 120 Hz [8]. Fixations were mostly registered after 100 ms [14, 19, 21, 24], and range from 40 ms [20] to 200 ms [13]. However, most studies did not provide specifications on Hz and ms.

4 Discussion

This literature review explored how eye tracking is used in communication research. The results show that, although a significant number of articles mention the method, only few actually report on eye-tracking data. Eye tracking appears to be mostly used in the field of advertising, and typically quantitatively. In general, it is used to measure (visual) attention to specific content, assessed by a variety of eye-tracking measures, such as fixation time, fixation count, and visual shifts. Furthermore, eye tracking in communication research is employed on various material formats, such as print, video, and webpages.

Our findings suggest that other possible uses of eye tracking, such as usability research or even qualitative usage, seems to be neglected in communication research. Based the low numbers of studies that have employed eye tracking, and because the method could be used for many different goals, we believe that eye tracking has much

more potential in communication research. Such potential may include using eye-tracking measures to indicate different communication measures, such as interest [27], applying eye-tracking methodology to other fields of communication research, such as political communication, and extending eye-tracking practices to mobile devices, such as smartphones and tablets [28].

The reported eye-tracking studies often involve rather large samples of more than 100 participants. This is in contrast to non-academic, practical usability research that includes eye tracking, that often uses smaller samples. Although there is no magic number for proper sample size, there is much debate about what sample size is sufficient for eye-tracking research [29]. A meta-analysis may be a potential next step that could reveal interesting insights about effect sizes and power in these studies. Nevertheless, eye tracking can provide various valuable measures, which can give clear insights into the effectiveness of communication materials. However, most of the studies only report one or two measures.

Given the wide variety of eye-tracking devices used in the different studies, it is uncertain whether the eye-tracking data is comparable. Different eye trackers measure data with different Hz, which means that the data acquired from these different devices vary in accuracy. Related to this issue is the difference between studies in the minimum milliseconds required for a fixation to be registered. Whereas some studies use a threshold of 80 ms [8], others register fixations after 100 ms [14] or 200 ms [13]. Moreover, several studies do not specify the minimum milliseconds for a fixation to be registered. It is thus debatable whether we can compare often-used measures such as fixation time and fixation count. We believe that communication research could benefit from more consistency in usage of eye trackers and thresholds and that future studies should make it a priority to include these specifications in their publications.

Another remarkable observation was that all studies were conducted in Western countries (e.g., the US, Australia, The Netherlands, Belgium, and the UK). Future research should be administered in non-Westerns countries, and may even consider comparing attention to communication in Western to non-Western countries. This is especially important because people from different cultures, with different languages and writing systems, may process written messages and even videos differently.

Altogether, this review provides insight into the usage of eye tracking in communication research. Based on our findings, we have formed several directions for further research. Despite these benefits, it is important to note an important limitation – communication research may not be always only published in top-25 ranked communication journals. Thus our review is not a complete overview of *all* eye-tracking studies. However, it provides insights about eye-tracking usage in the most important outlets in the field of communication.

Appendix: Top-25 Ranked Communication Journals (Alphabetical Order)

Communication Monographs
Communication Research
Communication Theory

Health Communication
Human Communication Research
Information Communication & Society
International Journal of Advertising
International Journal of Press-Politics
Journal of Advertising
Journal of Advertising Research
Journal of Communication
Journal of Computer-Mediated Communication
Journal of Health Communication
Journal of Language and Social Psychology
Journal of Social and Personal Relationships
Management Communication Quarterly
Media Psychology
New Media & Society
Personal Relationships
Political Communication
Public Opinion Quarterly
Public Understanding of Science
Research on Language and Social Interaction
Science Communication
Telecommunications Policy

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7. ISI Web of Knowledge: Journal citation reports: journals from subject categories communication (2015). http://admin-apps.webofknowledge.com/JCR/JCR
8. Boerman, S.C., Van Reijmersdal, E.A., Neijens, P.C.: Using eye tracking to understand the effects of brand placement disclosure types in television programs. J. Advert. **44**, 196–207 (2015). 10.1080/00913367.2014.967423

9. Dix, S., Bellman, S., Haddad, H., Varan, D.: Using interactive program-loyalty banners to reduce TV ad avoidance. J. Advert. Res. **50**, 154–160 (2010). doi:10.2501/S0021849910091312
10. Hartmann, P., Apaolaza, V., Alija, P.: Nature imagery in advertising: attention restoration and memory effects. Int. J. Advert. **32**, 183–210 (2013). doi:10.2501/IJA-32-2-183-210
11. Heath, R.G.: Emotional engagement: how television builds big brands at low attention. J. Advert. Res. **49**, 62–73 (2009). doi:10.2501/S0021849909090060
12. Heath, R.G., Nairn, A.C., Bottomley, P.A.: How effective is creativity? emotive content in TV advertising does not increase attention. J. Advert. Res. **49**, 450–463 (2009). doi:10.2501/S0021849909091077
13. Janssens, W., De Pelsmacker, P., Geuens, M.: Online advertising and congruency effects: it depends on how you look at it. Int. J. Advert. **31**, 579–604 (2012). doi:10.2501/IJA-31-3-579-604
14. Smit, E., Boerman, S., Van Meurs, L.: The power of direct context as revealed by eye tracking: a model tracks relative attention to competing editorial and promotional content. J. Advert. Res. **55**, 216–227 (2015). doi:10.2501/JAR-55-2-216-227
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