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Exposure Research Going Mobile: A Smartphone-Based Measurement of Media Exposure to Political Information in a Convergent Media Environment

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ABSTRACT

In today's convergent media environment, media exposure becomes increasingly channel-independent and social media-bound, and media content is more frequently accessed on mobile devices. This calls for new approaches to measuring media exposure. This study applies an innovative approach to survey (n = 2378) exposure to political information in the form of a mobile diary measurement, accessible via a specifically developed app. Respondents exhibited broad acceptance and uptake of the mobile measurement, resulting in an almost representative sample and equally satisfactory application of different platform modes. The study furthermore confirms limitations of mere usage time measurements of social media platforms in effects research and explores a range of actual content types that citizens encounter in social networks. It recommends more frequent use of mobile exposure measurements and argues for a content-related assessment of social media use in effects research.

Introduction

The increasing popularity of mobile media devices poses new challenges for media exposure measurement research and offers new solutions to such challenges. Smartphones, tablets or hybrids play a key role in citizens' media habits and testify to a diversification of content, a fragmentation of audiences (Bennett & Iyengar, 2008), and a convergence of formerly distinct media channels. The digitalization of media content, its distribution via social media platforms, and the 24/7 availability of communication on citizens' most private mobile media devices make it increasingly difficult to map the information citizens are exposed to throughout the day.

Contemporary media exposure measurements have to deal with three aspects that are caused by these changes in todays' media environment: (1) the increasing amount of media content citizens can potentially receive, (2) a blurring of formerly distinct media channels (e.g. TV and print), which now offer most of their content online, and (3) a personalization of citizens' media diet. This personalization is primarily visible in algorithm-driven information exposure on social media platforms (e.g. Facebook, Twitter) or customized news apps (e.g. *Pulse, Zite* and upcoming *Apple News*; Westlund, 2015).

To address these challenges our study uses two steps that build on one another. Firstly, it develops a comprehensive way of assessing citizens' political media diet. This new measure is straightforward and can be answered in a short time so that, secondly, it can be applied in a diary survey on mobile devices.

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The comprehensive observation of media exposure is achieved by including offline and online sources in the same measure. A structured assessment of a range of social media content in our measure is furthermore an attempt to get access to the most personalized part of citizens' media diet.

To make it easy for respondents to answer the questionnaire, the survey is set up in a straightforward manner (Engels & Best, 2012). Otherwise, it would not be possible to apply the new measure to a short mobile survey. A repeated send-out over the course of several days is expedient in a "high choice media environment" (Prior, 2009), in which the increasing amount of information and a growing share of short-term exposure (e.g., on social media) put a heavy toll on respondents' memory.

With the innovation of measure and method, our study presents a new way to measure citizens' media exposure in a convergent media environment, both in terms of including a broader range of sources and asking exposure questions more frequently.

From digital to convergent media

Digitalization is a core shift in the media environment in the last two decades. It creates a new online-only sphere of information and allows distribution of content from former offline-media in the rapidly growing number of digital networks (Schulz, 2014). The result is a convergent media environment where information is *diversified* (Prior, 2007), *personalized* (Sunstein, 2007), and received by a *fragmented audience* (Bennett & Iyengar, 2008). Electronically available media content makes it possible to combine formerly distinct media channels (Chadwick, 2013), which converge into one *stream of information*. Content is disconnected from one exclusive channel; for example, a news article can be published online *and* in print.

Social media platforms are both a driver and a result of these changes. On these platforms, information from different channels converge and hard as well as soft news, interpersonal communication and advertising can now be found on one single platform. These developments have radically changed citizens' media exposure in a convergent media environment and consequently challenge common exposure measurements. This is a challenge new methods and measures need to address.

Exposure measurement in a convergent media environment

Media exposure measurement research has always had to adapt to changes in media environment and technological advances (see, e.g., Chaffee & Schleuder, 1986; Price, 1993; Shoemaker & Reese, 1990). More recently, the tracking of media use (LaCour & Vavreck, 2014), the use of log-data (Boase, 2013), and improvements to self-reported measures (e.g., Dilliplane, Goldman, & Mutz, 2013; Prior, 2013) reflect the challenges exposure measurement has to deal with.

However, most currently used measurements rely on a separation of channels, i.e., they still structure self-reported measurements according to TV, radio, print, or online media use (see Lee, Hornick & Hennessey, 2008; Stenport, Markstedt, & Crain, 2014). In a convergent media environment, exposure measurements increasingly need to (1) account for a growing share of audiences not relying on channel distinctions and (2) allow for a more comprehensive measurement of media exposure by integrating on- and offline sources (e.g., news webpages or social media platforms).

Development of the instrument

Including all channels of citizens' political media diet (e.g. all existing blogs, pages, profiles and video platforms) in one measurement remains a great challenge for exposure measurement research. The blurring of media channels can furthermore make it difficult to match exposure to one specific source. Inaccurate reporting of exposure to this plethora of online contents therefore becomes a potential problem. Engel and Best (2012) addressed this increasing diversification in media content and the difficulty in distinguishing between channels. Rather than relying on categories like TV, print, or online, which may be less applicable today, they suggest basing media exposure

measurement on sensual perception. They develop the two media-relevant senses "listening" and "seeing" further into exposure categories: listening, reading, and watching. The subsequent modes of reception are *Audio, Page*, and *Stream*.[1]

This approach is the starting point for our measurement. It offers the seamless incorporation of online media into a comprehensible survey set-up and is a first attempt at a structured assessment of social media exposure, since specific content types that respondents encounter on these platforms can be included. Our study focuses on exposure to political information, but this approach can also be used to measure exposure to other topics (e.g., entertainment, health, etc.).

We argue that structuring a measurement independently of channels (i.e., not asking about exposure to, for example, TV) makes it easier for respondents to connect the content they have been exposed to, with the original source channel (i.e., an option to state having watched a news clip on YouTube and not on television). Furthermore, this approach allows for a more complete exposure assessment, since it fits very different sources of information, e.g., blogs, social media, and independent online outlets. Finally, it potentially reduces respondents' recall efforts (Prior, 2009) by offering specific lists of potential sources for each mode (i.e., *Audio, Page*, and *Stream*), which respondents can rely on when checking for the exposure to political content.

The exposure measures in our study consist of a simple three-step measurement. The first step, *Audio*, is simply assessed with one question about *where* respondents have heard about politics today ((1) *offline radio*, (2) *online radio*, (3) *friends, family or colleagues*, (4) *others* and (5) *not at all*)). The assessments of *page* and *stream* exposure are more comprehensive. Respondents are asked in the second step, *Page*, where they have read about politics ((1) *printed newspaper*, (2) *newspaper website*, (3) other *news media websites* (e.g., of TV channels), (4) *other websites* (e.g., blogs), (5) *social media platforms* (e.g., Facebook or Twitter), (6) *others*, and (7) *nowhere*)). Social media platforms drive high volumes of traffic to other websites (Hermida, 2012), and respondents indicating exposure to items 2–4 are asked how many of these online sources they accessed via links from social media (*most of them, some of them*, and *none of them*). Respondents who indicate exposure to political information on social media platforms are then asked what they actually read (status updates, comments, tweets, or links from (1) *parties, politicians, political organizations, or political actors*, (2) *news media*, (3) *other pages or blogs on social media*, (4) *friends or followers*, as well as (5) *paid ads from parties, politicians, political organizations or political actors*, and (6) *others*). Respondents who have read information about politics from friends or followers are asked about their personal relationship to these contacts to estimate their network composition (*people you know personally and have a close relationship with* (e.g., good friends, family); *people you know personally but do not have a close relationship with* (e.g., mutual friends); or *people you do not know personally*). The same structure and filters are used to assess respondents' audiovisual *Stream* exposure in the third step (see Appendix A for full questionnaire).

The described *Audio-Page-Stream* measurement is a straightforward approach, intended for very short response times. This makes it a good fit for the frequent times of measurements, such as in a diary study.

A mobile exposure diary

To reach a high number of measurement points, we apply the suggested measure to a survey conducted on mobile devices. Smartphones and tablets are increasingly used in survey research (Link et al., 2014). Given the high distribution of mobile media devices in many countries, such as Denmark where this study is conducted,[2] the active usage of these devices,[3] and the instant media exposure via the mobile

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[1]*Audio* refers to listening to the radio online and offline as well as using other audio sources on and outside the Internet, e.g., listening to music, audio books and sources. *Page* refers to print media like newspapers or magazines, books and all written media content found online. *Stream* corresponds to offline TV usage and other audiovisual exposure outside the Internet as well as every use of moving images online.

[2]In Denmark, 90% of all citizens between age 16 and 65 own a mobile media device (Emarketer, 2014).

[3]According to Meeker and Wu (2013) smartphone owners check their phone 100–150 times a day.

devices, it seems timely to tap the population's media consumption via smartphone-based technology. The ubiquity and accessibility of mobile devices are considerable advantages for mobile surveys. The fact that "dead times" (e.g. public transportation, waiting rooms, etc.; see Oulasvirta, Rattenbury, Ma, & Raita, 2012) can now not only be used to expose to media but also to respond to surveys, is another important reason to pursue a mobile media exposure measurement.

Few studies have used mobile devices to measure media exposure, and very rarely have different survey modes been applied. Prior research has used, for instance, log-data to assess media use on a smartphone (e.g., Boase & Ling, 2013), tracking of media use (Mitchell, Rosenstiel, Santhanam, & Christian, 2012), and so-called 'in-the-moment'-measurement (Link et al., 2014), more often referred to as Experienced Sampling Method (ESM) (e.g. Sonck, Fernee, & Ross, 2013). Another, sparsely applied, possibility is to use mobile devices for self-reported measurements. In addition to an optimization for different platforms, Link et al. (2014) claim that pure mobile surveys first and foremost need to be "short and simple" (p. 782), so they adapt to users' routines. A short response-time of a mobile survey allows respondents to take it in various situations, independently of time and place. When mobile media exposure surveys achieve this brevity, they can be used more frequently, as in a diary structure of exposure assessment.

We argue that an exposure diary accounts best for high choice, short-termed media exposure. The increasing availability of media content, due to online and mobile access, potentially shortens average durations of exposure. In turn, short-term exposure increases the recall effort respondents have to make when asked to report their media use. Memory bias due to long recall periods (e.g., *in the last week*) is a frequent criticism for self-reported measurements and can, among other things, lead to over-reported exposure (Prior, 2009).

A diary approach is therefore valuable because it asks users to report their media exposure to political content on a daily basis. Diaries are typically considered a "gold standard" for media exposure measurements (Fikkers, Piotrowski, & Valkenburg, 2015), because the likelihood of good recall is higher when respondents assess their media consumption on the day of exposure (Schwarz & Oyserman, 2001). Diaries are particularly valuable when they ask about specific media content (e.g., political information) rather than general media exposure because it involves an "extra cognitive step" (Fikkers et al., 2015, p. 4). A large number of measurement time points is believed to lower respondents' recall efforts; this reduction is particularly valuable when we want to measure short-time exposures in a convergent media environment (e.g., on social media).

Methodological research objectives

Our study is conducted by using the mobile devices of respondents as a survey platform. Using new technologies in survey research always implies several uncertainties, which might explain why only few studies have relied on smartphone-based surveys. Our study thus enters new ground and allows us to shed light on the methodological feasibility of smartphone-based measurements in terms of response rate, response time, the skewness of a sample that solely uses mobile devices, and sample differences in the survey mode.

According to Slater (2004), there are drawbacks to media diaries concerning respondents' motivation, accuracy of recordings, and duration. Sonck et al. (2013) reported low response rates in a diary survey via smartphone because the questions were asked multiple times. This problem may also occur in our study, which runs over 15 consecutive days. It is therefore important to know how many respondents participate in such a mobile device exposure measurement. This takes us to the first question.

> RQ1a: *What is the response rate of our mobile exposure measurement diary in general and how does it differ between age groups?*

Our measure is intended to produce a short response time. No studies suggest a specific response time for a made-for-mobile survey, but according to Link et al. (2014), the perfect response time,

after respondents have received the invitation, matches that of other smartphone activities, such as checking the news, reading an email, or looking up information. We therefore ask the following.

RQ1b: What is the response time of our mobile exposure measurement?

To our knowledge, our study is the first to give respondents the choice of participating in the media exposure survey via a dedicated app (iOS and Android) or via their smartphone's browser. Multi-mode studies offer the advantage of higher accessibility for respondents but come with the disadvantage of possible differences in response characteristics (Yun & Trumbo, 2000). Although we attempt to make the platforms as similar as possible, respondents may differ according to the platform they use. We therefore ask the following.

RQ2: Does taking the survey in an app or in a mobile browser affect the reported media exposure of the respondents?

Assessing political information exposure on social media

Our study assesses political information exposure from offline as well as online sources. For online sources, we introduce a new measure of exposure to political information obtained via social media and therefore test for its potential improvements, compared to other measures previously applied in this field of research. The political use of, for example, Twitter and Facebook is frequently used to explain citizens' participatory behavior (Boulainne, 2015). Thus, social media are of special interest because of their expected mobilizing effects (Rojas & Puig-I-Abril, 2009) or their fostering participation due to the partly unintentional exposure to political topics and news (deSilver, 2014). However, the actual content citizens are exposed to on social media is hard to capture, as is the actual role of social media in the citizens' political information diet. Especially citizens' personalized and thereby closed information environment on social media poses challenges to exposure measurements. This may explain why prior studies have used proxy rather than actual exposure measurements in their attempts to tap exposure to political information on social media. Gil de Zúñiga, Jung, and Valenzuela (2012) asked respondents how often they use social networks to stay informed about certain topics; Xenos, Vromen, and Loader (2014) simply used the indication of usage frequency of different social media platforms; and Tang and Lee (2013) asked respondents to estimate how often their friends share political information. These approaches were valuable in their specific context; however, we argue that a more thorough investigation of social media effects requires more precise measures. Some social media effect studies clearly assume that the use of social media is related to exposure to political content. However, it is still not clear to what extent that is the case. By comparing the mere use of a social media platform with the political content to which respondents are actually exposed on this platform, the study attempts to answer the following question.

RQ3: How is respondents' mere use of a social media platform related to their exposure to political information on this platform?

It is difficult to assess exposure to *content* on social media platforms given the manifold origins of information, the algorithm-driven, individualized information environment, and restrictiveness of exposure data for researchers. However, for traditional media, recent exposure measures differentiate between content types, for example different TV programs, rather than relying on simple frequency measures (Dilliplane, Goldmann, & Mutz, 2013; Prior, 2009). This makes it possible to distinguish between effects that for example exposure to entertainment or news programs can have on political participation (e.g., Boukes, 2015).

In research on effects of political information exposure on social media, such a distinction between different types of content is rare, mostly due to the inaccessibility of data. Studies that include social media as a source of information can be more precise about the effects of exposure if they acknowledge that citizens can receive very different types of political content and include those in their exposure measures. To demonstrate this approach and to provide a starting point for future effect studies of the importance of these different types of content, the study asks the following.

> RQ4: How often do different types of political content received on social media occur in citizens' political media diet?

Summing up, the study intends to develop a comprehensive exposure measure that fits a convergent media environment and to apply it to a mobile survey setting. We therefore investigate the methodological feasibility of a mobile survey with respect to two aspects that are especially important for an exposure measurement, namely response rate (RQ1a) and platform effects (RQ2). The surveying of response time (RQ1b) is a test of how well the newly developed and straightforward measure corresponds to a mobile survey setting.

Our comprehensive exposure measurement approach is further examined by assessing the respondents' exposure to political information on social media against their more general social media use (RQ3) and by assessing their exposure to different types of political content (RQ4).

Method

Our mobile study used a two-step sampling procedure. First, respondents were invited to take an online survey. Second, the ones who took the online survey were asked to participate in our mobile study. In Denmark, 93% of the households have access to the Internet (Danmarks Statistik, 2014). Respondents were randomly selected from a pollster's database[4] to become a panel member; 30% agreed. Panel members (N = 10,315) were stratified towards age and gender to represent the Danish population and invited to take an online survey; 45% took the survey (N = 4641). Our study was conducted within the framework of a larger project that focuses especially on young and elderly citizens. These two groups are therefore oversampled: 60% of the elderly agreed to take the survey (N = 1831). In the youth sample, 12,000 people in the 17–21 age group were randomly sampled, using state register address data; 20% took part in the study (N = 2335). Altogether, 9125 respondents participated in the online survey of the main study.

All respondents were asked to provide their mobile phone number and be available for 'a few, short mobile surveys'. Of the 4,460 respondents who provided their telephone number, 53% (n = 2378[5]) participated in the study, which ran over 15 consecutive days in February/March 2015.

Pretest

Studies of the feasibility of a measurement like ours are rare, so we conducted a pretest. We asked respondents from the pretest of the general study to take part in the pretest of the mobile measurement (n = 182) and answer the survey via the downloaded app or in their mobile browser via a text message invitation. The respondents were randomly assigned to two survey time conditions: One at 9:45 PM asking about today's media exposure, and one at 8:00 AM the next day asking about yesterday's exposure. Results indicated a good feasibility in general, a higher response rate for respondents using the app, and a substantially higher response rate among respondents of condition

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[4]The pollster recruits panelists on several hundred Danish webpages (Baker et al., 2010; Pfeiffer & Garrett, 2014). Panelists represent the Danish population on the basis of age, gender, education, occupation, and region, compared to census data.

[5]Chi-square goodness-of-fit tests were used to test for sample differences between main (N = 9125) and mobile sample (n = 2378) regarding gender (n.s.), income (n.s.), age (60–79 age group underrepresented by 6.1%, $p < .000$), mobile internet use (heavy users underrepresented by 2.5%; $p < .024$) and political interest (low interested underrepresented by 3.6%; $p < .000$).

one, i.e., the late evening invitation (see Ohme, de Vreese, & Albæk, 2015). We therefore decided to send out survey invitations at 9:45 PM. Responses indicated some confusion about the *Audio-Page-Stream* measurement, so we used icons to clarify the distinctiveness. Based on the pretest results, no other major changes were necessary.

Procedure

All respondents were informed via email and text message about the upcoming survey and the option of downloading the app or conducting the survey in their mobile browser. To be able to capture short-term exposure and lower recall efforts, we chose to ask respondents to report their media use once a day. A higher frequency was considered problematic due to the comparatively higher pressure on respondents. A gift card worth $150 was drawn each day among all participating respondents. The survey invitation was sent out on 15 consecutive days at 9:45 PM, using the above-described measurement.

To account for the diary structure of the data with varying participation days among respondents, a relative exposure measurement was calculated on an individual data level. The frequency of exposure was divided by the days each respondent had participated in the survey. The relative measure ranged from 0–1, with 1 indicating exposure to a certain item of content on all days the respondent had participated.

Results

The main goal of our study is to propose this new, smartphone-based diary approach, to test for its feasibility and demonstrate its contributions to a measurement of media exposure in a convergent media environment. Testing for the appropriateness of a newly proposed measurement is crucial for the evaluation of the results, however.

The test-retest reliability of the measurement was assessed, using the true-score approach as suggested by Heise (1969) and recently applied by Dilliplane, Goldmann and Mutz (2013). The measurement of 15 consecutive days was split into three periods of measurement, each consisting of five consecutive days. Appendix B reports the true-score reliabilities and stability measures for three modes of offline exposure to political information and to political information read on social media, since this is one special focus of the study. Results indicate a stable measurement over time across all exposure modes. The true-score reliability of the measurement shows a high (television, $R = .82$) up to very high (radio, $R = .94$; newspaper, $R = .90$) test-retest reliability. For the measurement of political information read on social media, a moderate ($R = .67$) reliability was found.

To answer RQ1, we give an overview of response rate and time. Due to the diary study design with 15 consecutive days of measurement, the overall response rate (RQ 1a) differed from day to day, ranging from 37 to 21% in a slow, but steady decline. Over the course of the 15 days, the average response rate was 25%, differing slightly between the three age groups: 22% (17–29), 30% (30–59), and 29% (60–79).

The average response time (RQ 1b) over the course of the 15 days was 106 sec (*Min* = 68 sec; *Max* = 222 sec), and it dropped steadily over the course of the study. Due to the high stability of the measurement displayed in Appendix B, this decrease can be seen as an indication that respondents became used to the way questions were asked.

RQ 2 asked whether the difference in platform (app or mobile browser) affects the media exposure measured for the respondents. Three t-tests were conducted, testing for differences between respondents using the two platforms.

The first independent group t-test revealed that respondents taking the survey in their mobile browser ($M = .42$, $SD = .29$) were slightly but significantly exposed to more offline political information than respondents using the app ($M = .38$, $SD = .28$); t (1648) = 3.8, $p < .000$. The second t-test revealed no significant difference in political online media exposure (t (2376) = −1.8, $p > .05$) between respondents using the app ($M = .15$, $SD = .15$) and respondents using the mobile browser ($M = .14$, $SD = .16$). Likewise, the third t-test showed no significant difference in exposure

to political information on social media (t(2376) = 1.5, p > .05) between respondents using the app (*M* = .20, *SD* = .25) and respondents participating via a mobile browser (*M* = .22, *SD* = .30). Thus, we only observed a small skew for one of three media exposure types, indicating considerable congruency between platform modes.

To assess how well the mere time spent on a social media platform predicts exposure to political information on social media, RQ3 asked how the two measures are related. Facebook is the most widely used social media platform in Denmark and we therefore compared its usage with political information exposure on social media.

In the main study, we asked the respondents two questions about how much time they spend on Facebook. (1) We asked about their general Facebook usage (*less than once a month* up to *several times a day*). (2) We asked respondents who use Facebook daily a time-spent question (*less than half an hour* up to *four hours or more*).

The descriptives of general Facebook usage indicate that the more respondents use Facebook, the higher their exposure to political information on social media platforms (see Table 1).

However, nearly one quarter of the respondents using Facebook daily (24.6%) report no exposure to political information on social media. The correlation between Facebook usage and exposure to political information on social media is thus significant but low (r = .288, p = .000). For the measure assessing time spent on Facebook, a linear relationship is visible (see Table 2).

When we test for the correlation between time spent on Facebook and exposure to political information on social media, we find a modest correlation (r = .229, p = .000). Usage of a social media platform and exposure to political information in such a network are thus only loosely connected, since a considerable part of the respondents who use Facebook regularly are not exposed to political information at all. Furthermore, a clear distinction between high and low exposure to political information becomes visible.

One advantage of our new measure is that it allows us to distinguish between different content types to which citizens may be exposed on social media platforms. RQ4 asked how frequently different types of political information on social media appear in citizens' media diet. The results displayed in Table 3 indicate high exposure to posts and videos from news media and personal contacts on social media. With a relative measurement dependent on the number of days respondents participated, a mean of 0.5 indicates that respondents were exposed to a certain content type on 50% of the days they participated in the survey.

Table 1. Facebook usage and exposure to political information by day.

| | Exposure to Political Information on Social Media | | | | | |
| | No | | Low | | High | |
Use of Facebook	N	%	N	%	N	%
Less than once a month	20	76.9	5	19.2	1	3.8
Less than once a week	71	83.5	11	12.9	3	3.5
Less than once a day	155	58.5	72	27.2	38	14.3
Daily	408	24.6	600	36.1	653	39.3

Note: N = 2037; high/low distinction by median split.

Table 2. Daily Facebook usage and exposure to political information.

| | Exposure to Political Information on Social Media | | | | | |
| | No | | Low | | High | |
Daily use of Facebook	N	%	N	%	N	%
Up to one hour	289	31.6	350	38.3	275	30.1
Up to two hours	86	17.4	173	34.9	236	47.7
Up to three hours	25	15.4	49	30.2	88	54.3
Up to four hours	5	10.2	15	30.6	29	59.2
More than four hours	3	7.3	13	31.7	25	61.0

Note: N = 1661; high/low distinction by median split.

Table 3. Type of political content exposed on social media

Content type	n	M	SD
Posts or tweets from news media pages	936	.69	.38
Posts, comments or tweets from friends or followers	936	.55	.42
Videos from friends or followers	619	.42	.43
Videos from news media pages	619	.41	.43
Posts or tweets from political actors or institutions	936	.41	.41
Videos posted by other pages or profiles (e.g., blogs)	619	.31	.39
Political video ads (e.g., suggestions, commercials)	619	.19	.35
Videos posted by political actors or institutions	619	.17	.32
Posts or tweets from other pages or blogs	936	.17	.29
Paid ads from political actors or institutions	936	.03	.15

Note: Min = 0, Max = 1. Includes only respondents participated at least 4 of 15 survey days.

Discussion

In times of ubiquitous access to all kinds of media and a convergence of content coming from formerly distinct media channels, it is important that exposure research tracks these developments. This study developed a new *Audio-Page-Stream* measure (Engel & Best, 2012) to ask about media exposure to political information and applied it to a mobile diary exposure measurement. The contribution of our study is threefold. First, it developed and conducted a large-scale mobile exposure measurement, proving that such a measurement is feasible and should be considered in future research. Second, it presents a structured way to assess exposure to political content offline, on social media and other online sources, thereby adapting to a convergent media environment. Third, it indicates the need for a more thorough and detailed assessment of exposure to political information on social media, since the mere usage of a platform was shown to be almost unrelated to the exposure to political information.

Our study has shown that it is realistic and feasible to use mobile surveys in countries with a high smartphone distribution as an alternative to more traditional forms of measurement and that it is technically possible to conduct such a study on a large scale with several thousand respondents. Offering a mobile measurement as an app and in the respondents' mobile browser furthermore allows for high accessibility without serious platform bias effects. Previous research recommends that mobile surveys are adapted to respondents' usage routines and are kept short and simple (Link et al., 2014). The new approach of the *Audio-Page-Stream* measurement has proven effective in achieving a short response time of less than 2 min. The study furthermore shows a satisfactory acceptance, uptake, and response rate of the smartphone-based study among respondents, especially considering that the survey ran for 15 consecutive days.

Our mobile exposure measurement can give a comprehensive picture of citizens' media exposure due to its alternative way of structuring exposure questions and because it can repeat these questions over the course of several days or weeks. Our study assessed the exposure to political information, but the structure of the measurement can also be adapted to other fields of content (e.g. economic news, health information, etc.). These findings might encourage future research to use a mobile exposure measurement of specific media content.

Political use of social media is becoming more common and citizens' usage of these platforms is often used to explain effects like mobilization, knowledge and participation (Boulianne, 2015). Therefore, actual exposure to political information on social media needs more research attention. This study confirms the weak association of the mere use of a platform like Facebook and actual exposure to political information. A considerable number of respondents who frequently use social media receive no political information at all, and there is a clear difference between low and high exposure to political information, which is almost unrelated to usage frequency.

The study finds a large spread in content types of political information on social media, which supports the recommendation to use more detailed measurements to test for effects of political social media use. Future studies might therefore include the proposed structured assessment of political information exposure on social media and supplement our findings by retesting the use of content types for different subgroups, potentially resulting in an even more fine-grained item structure.

Limitations

The study applied a new measure to an upcoming survey method and therefore has several limitations. First, a smartphone-based study is only possible in countries with a high smartphone distribution. A comparison of the nationwide sample representing the Danish population and the mobile sample only yields marginal skews, but a sample bias in such a study cannot be completely ruled out. This should not prevent further studies from conducting mobile exposure measurements, but should be taken into account when the data is analyzed and interpreted.

Second, the satisfactory true-score reliability of our measurement is only seen as a first indication of the appropriateness of the measurement. It has to be noted, that the test-retest reliability (Heise, 1969) was used differently in our approach compared to other studies. We do not rely on three distinct waves but three measurement points, each consisting of the means of five consecutive days. Heise (1969) mentions potential problems with shorter time intervals. Surveying specifically media exposure, however, Lee et al. (2008) see problems for too long time spans between the measurements. In a recent study, Fikkers et al. (2015) could not establish sufficient test-retest reliability for a diary measure of exposure to violence on TV. Possible reasons may be a less frequent exposure to violent content in their study (compared to political information) and the impacting social desirability of reporting correctly about exposure to violence, given that the sample consisted of 10–14 year old children. The mobile diary in our study, in contrast, was able to demonstrate a sufficient reliability. Furthermore, true-score reliability estimates have not been widely applied to online media exposure and are therefore difficult to compare. Given a more erratic and fluent exposure situation on social media, it is reasonable to expect reliability estimates to be lower compared to offline exposure modes. Our findings support this argumentation but still indicate a moderate reliability for social media exposure. Future research should therefore address how the reliability of diary measures, including various online sources, can be established.

Third, the validity of the questions asked has not yet been tested, and results should be interpreted against the background of a non-validated measurement. It furthermore remains an open question if asking respondents about their media exposure once a day is the best frequency option. One objective of our study was to addresses the short-term exposure that especially occurs with online media. However, applying the *Audio-Page-Stream* measurement more frequently, as for example in ESM studies (Sonck, Fernee, & Ross, 2013; Karnowski & Doedens, 2010), might yield more accurate results. Future research therefore has to find the middle ground in the tradeoff between highly frequent measurements that capture a bigger share of exposure and the pressure on respondents and potential negative effects.

Going along with the shortcoming regarding the validity of the measurement, the media exposure data in our study is still self-reported and therefore challengeable. Self-reported measurements are widely used in exposure research (Slater, 2004); however, the results of this study have to be read in light of potential imprecisions (e.g., an over-reporting as described by Prior, 2009). A potential solution to the shortcomings regarding the validity of our measurement is to compare results of the *Audio-Page-Stream* measurement with log-data (e.g., Boase, 2013 and Boase & Ling, 2013). The use of log-data is seen as especially valuable here, since real exposure data can be used for a validity test, rather than relying on auxiliary measures like predictive validity.

Fourth, 30% of the of initially selected respondents agreed to be a member of our study. The results of this study thus have to be interpreted against the background of challenged representativeness, due to the participation rate. However, stratification in the selection of respondents was used to improve representativity and this dovetails with an increasing use of stratification in online survey research (Baker et al., 2010; Pfeiffer & Garrett, 2014).

These limitations notwithstanding, this study shows that it is possible to use a measurement of media exposure that accounts for a convergent media environment and is short and simple enough to be implemented in a smartphone-based diary study. In situations where resources or circumstances do not allow for the use of log-data and unless social media platforms share their walled data with research institutions, a full observation of media exposure is hard to establish. Here, our study provides an additional approach that may be valuable in terms of assessing the full spectrum of exposure in a convergent media environment.

Other results of this study show a considerable amount of exposure to political information on social media; in the 17–29 age group, social media exposure even exceeds other online or offline exposure. It thus seems that the new path of exposure measurement suggested in this study is worth pursuing in the future. We need assessments that include all media types and do not rely on channel distinctions that no longer apply to large parts of society. New media will play an increasing role in generations' media use, but we know little about the effects of this exposure, be it in terms of political participation and civic engagement or other fields of research. This study might encourage future research to consider the content level of social media exposure more closely.

The study further illustrates that the benefits of using mobile devices in exposure research, namely high accessibility of respondents and the possibility of high-frequency measurements, yield satisfactory response rates, and acceptance among respondents. The difficulties that channel-independent, social media-bound and mobile accessed media use poses to audience research in general are maybe best beaten at their own game: by exposure research going mobile.

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Appendix A: Audio-page-stream measure

Audio

Where have you heard information about politics today?

On the radio offline
On the radio online
From friends, family or colleagues
Others (please specify)
I haven't heard anything about politics today

Page

Where have you read information about politics today?

In an printed newspaper
On an website of a newspaper
On other websites of media outlets (e.g. DR, TV2)
On other websites, (e.g. blogs)
On social media platforms like Facebook or Twitter
Others
I haven't read anything about politics today

How much of the information you've read online about politics today did you reach following links from social media?

Most of it
Some of it
None of it
I don't remember

What did you read on social media platforms about politics today?

Posts, comments, tweets or links...
 ...by parties, politicians, political organizations or political actors
 ...by news media
 ...by other pages or blogs
 ...by friends and followers
Paid ads from parties, politicians, political organizations or political actors
Others

Were the posts or tweets by friends or followers mostly from...

... people you know personally and have a close relationship with (e.g. good friends, family)?
... people you know personally without having a close relationship (e.g. mutual friends)?
... people you don't know personally?

Stream

Where have you watched information about politics today?

On TV offline
On broadcasters websites (on demand or streamed live)
On other websites (e.g. news pages or video platforms, e.g. YouTube)
On social media platforms like Facebook
Others (please specify)
I haven't watched information about politics today

How much of the information you've watched online about politics did you reach following links from social media?

Most of it
Some of it
None of it
I don't remember

What did you watch on a social media platform about politics today?

Political ads (e.g. suggestions, commercials)
Videos posted by parties, political organizations or candidates
Videos posted by TV- or radio stations or newspapers
Videos posted by other pages or profiles (e.g. news pages or blogs)
Videos posted or shared by friends and followers
Others

Were the videos posted or shared by friends or followers mostly from...

... people you know personally and have a close relationship with (e.g. good friends, family)?
... people you know personally without having a close relationship (e.g. mutual friends)?
... people you don't know personally?

Appendix B: Reliability and stability of the measurement

Descriptives, reliabilities, and stability coefficients for offline and social media exposure

Exposure measurement	N	M	SD	$R_{eliablity}$	S_{12}	S_{23}	S_{13}
Heard on radio (offline)				.94	.82	.90	.74
Time 1	559	.39	.38				
Time 2	452	.34	.38				
Time 3	313	.40	.39				
Read in a newspaper (offline)				.90	.96	.93	.90
Time 1	559	.32	.39				
Time 2	452	.35	.41				
Time 3	313	.37	.41				
Watched on TV (offline)				.82	.92	.97	.90
Time 1	559	.63	.35				
Time 2	452	.51	.39				
Time 3	313	.52	.38				
Read on social media				.67	.94	1.0	1.0
Time 1	559	.27	.33				
Time 2	452	.12	.24				
Time 3	313	.10	.23				

Note: Heise true-score reliabilities are presented, using the products of the raw correlations between time 1 and 2 and between time 2 and 3, and then dividing it by the raw correlation between time 1 and 3. S_{12} refers to the stability between times 1 and 2; S_{23} the stability between times 2 and 3; S_{13} the stability between times 1 and 3.