PASSIVE MEASUREMENT OF PRINT REVISITED: THE CASE OF DIGITAL MAGAZINES

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In the early part of this century, print appeared to be in danger of being left behind as the only medium whose measurement relied exclusively on self-reports. The newest medium – the Internet – could be measured passively through software installed on panelists' browsers or the addition of tracking code to publishers' content and ads. At the same time, two old media, radio and outdoor, moved in the direction of passive measurement through devices carried by panelists that recorded the sounds to which they were exposed or their locations, respectively. Even television, the only medium that could be measured passively for most of its history, was moving even further in the direction of passive measurement in the United States through the replacement of diaries with people meters for local station measurement in larger markets.

As other media marched down the passive measurement path, print was vulnerable to the perception that its measurement might be perceived as less accurate because it was self-reported or less granular because it was based on readership of average issues. That is why Roberta McConochie of Arbitron and Jane Bailey of Time Inc. raised the possibility of using radio frequency identification (RFID) technology to measure print audiences at an ARF/ESOMAR conference in 2004. That is why, as reported in Mattlin, McLaren, and Galin's 2007 Symposium paper in Vienna, GfK MRI embarked on an effort to develop RFID sensors to detect the openings and closings of printed magazines and the turning of pages within them. Perhaps printed pages could be given an electronic trail.

Much has changed since then. Interest in passively measuring *paper* copies has waned. At the same time, the ability to passively measure the use of print *content* has increased due to the advent of digital editions of newspapers and magazines. These digital editions, produced through mobile apps, do leave an electronic trail. Indeed, as electronic distribution of print content grows, passive measurement of print will also presumably grow, allowing print to join the march to passive measurement on which all other media have embarked.

Though it is apparent that there would be benefits in transitioning toward more passive measurement, it is important to understand the full implications of such a transition for the way that this medium is evaluated as an advertising platform. This paper begins to explore those implications. It represents an update to Jay Mattlin's paper with Scott McDonald at the Prague Symposium in 2005 on the promise and potential pitfalls of a wholesale shift from self-reported to passive measurement of printed magazines.

There are two major approaches for passively measuring audiences of digital magazines:

- Publishers of most digital magazine apps embed an electronic code within the app that records and transmits usage data on those apps to the publisher. These data include not only downloading and opening of the app, but also opening of individual pages, use of interactive features, and time stamps for each action taken within the app. Since the electronic code is embedded in the architecture of every user's copy of the app, the data are transmitted for every user of the app. These data are proprietary to the app's publisher. This type of measurement will be referred to hereafter as **app-centric measurement**.

- In order to obtain data on usage of apps from multiple app publishers, some research companies have developed measurement apps which, when installed on tablets or mobile phones, record and transmit data on usage of all of the apps on those devices to the research company. This solution requires the recruitment of a panel to download and install the measurement app. This type of measurement will therefore be referred to as **panel-centric measurement**.

These two measurement methods parallel the two main methods of measuring the Web – site-centric and panel-centric data collection. As the digital editions' share of total audience grows, these two types of measurement are likely to become increasingly important for evaluating magazines and newspapers as advertising vehicles. It is therefore important to understand the metrics each of them produce, their potential benefits to the publishing industry, and the potential consequences to the print industry in relying on each of them.

In order to analyze their potential impact, we will be employing the same framework used in the 2005 paper on the potential impact of measuring print audiences with RFID-tagged magazines and RFID tag readers. This framework consists of exploring the impact of a methodology change in four general areas: cost to publishers; privacy concerns; research issues, including metrics produced by these methods; and technical issues.

IMPACT OF APP-CENTRIC MEASUREMENT: COST AND PRIVACY

The cost and privacy issues entailed by app-centric measurement will be discussed briefly, followed by a discussion of the research and technical issues.

In order to implement app-centric measurement, publishers need to either use digital publishing software that includes tracking software or deploy a Software Development Kit (SDK) into their digital magazine apps that installs the tracking code. Publishers also need to devote staffing resources to installing the SDKs, placing the tracking tags, and organizing the flow of continuously-updated output from in-app measurement systems. Publishers do therefore incur some incremental costs in software purchases and staff time to adopt an app-centric measurement approach. However, the software costs might be bundled into the costs of the publishing software, and the incremental staff time may not require the hiring of dedicated additional staff. The incremental cost of passively measuring digital editions through in-app tracking is therefore far lower than the incremental cost of inserting RFID tags into every copy of a magazine.

Privacy does not appear, thus far, to have been much of an obstacle to the implementation of measurement software within apps. While there has been a good deal of concern raised about Internet privacy and social media privacy, we are unaware of any organized opposition specifically to tracking within apps on privacy grounds. Perhaps there has been so little public attention to data from in-app tracking because it has been overshadowed by Web tracking, phone call monitoring, and geolocation tracking. In the future, then, consumers might become more resistant to in-app measurement on privacy grounds as they become more aware of the wealth of detailed information that publishers can obtain from in-app measurement software.

IMPACT OF APP-CENTRIC MEASUREMENT: RESEARCH AND TECHNICAL ISSUES

Most of the research issues surrounding the use of app-centric data for evaluating digital magazine audiences center on the metrics produced by these systems. In exploring the research issues raised by app-centric measurement, it is helpful to examine the differences between in-app measurement and audience surveys in the kinds of metrics they produce.

METRICS USED TO EVALUATE PRINT

The purpose of audience metrics for any medium is to answer a set of common questions about a media vehicle's audience that a potential advertiser might have in evaluating that vehicle as an advertising platform or that a producer of the vehicle might have about the vehicle's consumers. At a basic level, the most common questions are:

- **How many?** How many people were exposed to the content of the vehicle or the advertising within it or had an opportunity to see the advertising? This broad category encompasses the most common question answered by our readership surveys – what is the size of the audience for an average issue? Other metrics that address this question in the print industry are paid circulation; the reach of a schedule of titles; the size of the audience for newspaper sections or individual magazine issues; and the number of people who notice individual ads.

- **How much?** How much of the vehicle did consumers read or watch or listen to? In print metrics, this question would be answered through data on the percentage of pages read or average page exposure.

- **How long?** How much time did people spend reading, watching or listening to the vehicle? This is particularly important in measurement of television viewing but is also asked in many print currency surveys.

- **How often?** How often did the consumer read/see/listen to the vehicle? In the case of print, this question can be applied to titles as a whole (i.e., frequency of reading) or to individual issues (number of pick-ups).

- **How consumed?** This general question has to do with the context of consumption that might affect a consumer's receptivity to advertising messages. For printed publications, this context is measured by questions on source of copy, place of reading, attitudes towards the publication, and intensity or thoroughness of reading.

- **Who?** What are the characteristics of the people exposed to the vehicle – their demographics, lifestyles, usage of other media, attitudes, and product consumption? These questions make up a major component of many print audience surveys.

- **So what?** What was the impact of exposure on the advertiser's objectives – brand awareness, brand disposition, sales? While these questions may not be covered in many print readership currency studies, they lie at the heart of ad effectiveness studies, such as Starch.

In order to understand app-centric measurement's potential contributions to fulfilling the audience information needs of print buyers and sellers, it is important to look closely at this method's ability to answer these questions.

ABILITY OF IN-APP MEASUREMENT SOFTWARE TO DELIVER THOSE METRICS

App-centric measurement systems are able to answer all of these questions about digital editions of magazines and newspapers. However, the answers they provide are quite different, in general, from the answers obtained through readership surveys. The differences between the metrics produced by app-centric measurement and traditional readership surveys are shown in the table below:

QUESTION	Metrics provided by app-centric measurement software	Metrics from traditional readership surveys
How many?	Magazine app installs; digital edition downloads, visits, sessions, page views, ad views, video views for individual titles or in some systems, multiple titles tracked by the same in-app analytics system	Average and specific issue audience, reach of multiple issues of the same magazine, reach of a schedule of multiple magazines, ad noting scores
How much?	Views of individual articles and sections[1]	Percent of pages read, average page exposure
How long?	Time spent per issue, article, page, ad	Time spent with average issue
How often?	Number of openings/sessions, number of issues read[2]	Number of reading occasions for an individual issue, frequency of reading the magazine
How consumed?	Time of day and day of week of reading, geolocaton of reading, how purchased (sub vs.single copy sale vs. authenticator), device used, order in which the issue was read	Source of copy (sub, newsstand, pass-along), place of reading, intensity of reading
Who?	Geography, operating system	Demographics, psychographics, activities, lifestyles, other media consumed, products purchased and used
So what?	Use of interactive features within ads, click-throughs to advertisers' Web sites	Brand disposition and actions taken post-exposure

In-app electronic tracking of digital editions, when applied accurately and consistently, can provide many of the benefits that had been sought with RFID tagging (as outlined in the 2005 Symposium paper):

- Data on "How many" without reliance on respondents' memories;

- Data on "How many" unencumbered by the "response error" problems that have occupied Symposia in years past, such as title confusion and social desirability;

- Data on "How many" that are not subject to the potential biases in recent reading due to parallel and replicated reading;

- Data on "How Many" read individual issues;

- Data on "How Many" read individual ads;

- The ability to track "How Many" are exposed to individual digital issues over time, obviating the need to model audience accumulation.

- Data on "How Much" of the digital magazine or newspaper was read – by article or section;

- Data on "How Long" readers spent with individual issues;

- Data on "How Long" readers spent with individual articles, pages, and ads;

- Data on "How Often" individual issues of the digital magazine were opened, again without reliance on self-reports;

- Data on "How Often" individual titles were read without asking respondents to answer the question about how many out of 4 or 6 or 12 issues they read;

- Data on dayparts of heaviest and lightest reading ("How Consumed?");

- Data on reading among subscribers and single-copy buyers without relying on respondents to report their source of copy accurately. ("How Consumed?);

- More frequent and more timely reporting of all of the above data.

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[1] Compiling data across pages may require additional analysis beyond that available in a standard report from such systems.

[2] Available in some systems but may not be available in all of them.

In addition, electronic tagging provides one key benefit that even RFID tagging did not – that the answers to the "How Many,""How Much,""How Long,""How Often," and "How Consumed" questions are based on a census of all devices on which the application is available, thereby eliminating sampling error.Perhaps more important, census-level measurement also holds the potential for measuring usage of every digital magazine, regardless of the size of its audience. Traditional audience measurement surveys cannot produce reliable estimates for smaller-audience magazines due to sample size constraints.

However, it is also clear from the comparison above that there are some metrics that census-level electronic tagging alone cannot provide:

- **How Many?**:App-centric data on "How Many" represents counts of the numbers of buyers or machines, not the numbers of *readers*. Pass-along readers, such as other readers within a household or office who share the same tablet, are not counted within the tally of the number of downloads or issue openings. "How Many" metrics from an in-app electronic tracking system are more closely akin to circulation metrics than audience metrics. At the same time, some digital publishing platforms count the numbers of devices rather than the number of buyers. For these platforms, those who read a digital magazine on two different devices are counted twice.

- **How Many?**: In some census-level app-centric measurement systems, the codes set up for tallying openings of a particular digital magazine are not set up to recognize codes from other digital magazines. Therefore it is impossible for these measurement systems to determine the net reach of a magazine schedule consisting of insertions in multiple titles. Other measurement systems, such as those for some newsstand apps, track individual buyers' identifying codes and so can determine the number of buyers who have opened two or more different titles that use the same in-app measurement system (e.g., all titles delivered within the same newsstand app). However, no in-app measurement system can determine the number of openings of a set of digital magazines that employ different in-app measurement systems.

- **How Consumed?**: Only surveys can provide certain key "quality of reading" metrics, such as where the title was read, interest in advertising within it, and the reader's overall opinion of the magazine. Electronic tracking cannot provide these metrics.

- **Who**?: App-centric electronic tracking systems are like coin-activated turnstiles – they simply count without regard to the identities of those being counted. Without further intervention and data collection, they cannot be linked to any other data source. Therefore, census-level electronic tracking cannot provide audience profile data, including data on the products consumed by a digital magazine's readers.

- **So wha**t?: While electronic tracking software can detect readers' actions within an ad, such as activating interactive features, it cannot measure the impact of the ad exposure on subsequent reader actions.

App-centric measurement offers a level of granularity and objective accuracythat traditional surveys cannot, but there are important metrics used by both publishers and advertisers to evaluate print vehicles that app-centric measurement alone cannot provide. Pass-along reading, reach of multi-title schedules, quality of reading, demographics, psychographics, and advertising impact are beyond the scope of census-level app-centric measurement of digital magazines.

TECHNICAL LIMITATIONS OF ELECTRONIC IN-APP TRACKING

Of course, in spite of its advantages in granularity and accuracy, app-centric measurement can only serve as a currency for digital magazines if it meets the publishing and advertising community's standards for comprehensiveness, consistency, and availability. So far, those standards have not yet been achieved, at least in the United States.

The most salient reason that app-centric data are not used as a currency is simply that doing so would require cooperation from the publishers of all of the major ad-supported magazines in a market. All publishers and digital newsstands that do not already use in-app tracking systems would need to install such a system in their digital magazine apps. These tracking systems would have to consistently track magazines with the same standards and event definitions across all publishers. Moreover, all publishers would need to be willing to share the data for these metrics with the ad agency and advertising communities. In the United States, the MPA (formerly the Magazine Publishers Association and now the Association of Magazine Media) has recommended that publishers release five "How Many,""How Often," and "How Long" metrics to ad agencies and advertisers, all of which can be captured through app-centric measurement. Thus far, adoption of these recommendationsamong publishers has been far from universal.

Other potential technical barriers to the creation of a currency for digital magazines based on app-centric data are:

- **Comprehensiveness**: Some tracking tools do not record usage of individual pages or durations. In addition, there is some risk of under-counting off-line app usage. Typically, the app usage data from the tags are transmitted back to the measurement company's server when the app is open and the reader's device is wirelessly connected to the Web. If the reader's device is offline when he or she is looking at the digital edition and is not in range of a wireless Internet access point, the data are not transmitted until the magazine app is open and the device is back online. Therefore, if a digital issue is read offline, those readership data will not be transmitted until the next time

the reader opens the magazine app. So, usage data for any one issue may not be really complete until the next issue has been released and subscribers open their magazine apps again. In addition, it is possible that the data for single copy buyers may be under-represented if their last reading session for a particular issue occurs offline and they never download another issue. In fact, single copy buyers who look at one particular issue entirely offlinemight never be recorded by app-centric measurement systems at all.

- **Consistency across digital platforms**: There are a number of different digital publishing platforms with built-in app-centric tracking and a number of companies that provide app-centric measurement. Not all of them define an"opening" of an app or the duration of anexposure in the same way.

- **Consistency across devices**: Magazine apps are created for different mobile operating systems (i.e., Android, iOS). The ways in which the measurement SDK's work may vary between operating systems.

- **Consistency across versions of the apps**: Even publishers using the same digital publishing software or the same SDKs may be using different versions of the software or SDKs. In addition, when publishers update their magazine apps, subscribers who are still using the old versions of the apps might be measured differently than those with the updated apps.

- **Consistency across publishers**: Different publishers choose to tag their content in different ways.

While app-centric measurement is helping magazines and newspapers to join the electronic media measurement club, this kind of measurement is currently not able to address all of the measurement questions that buyers and sellers of this medium ask in a consistent, comprehensive fashion. Even if all magazines and newspapersceased print production tomorrow, app-centric measurement would have to be supplemented with other data sources.

ABILITY OF PANEL-CENTRIC MEASUREMENT TO ADDRESS THOSE LIMITATIONS

One way of addressing the questions that app-centric measurement cannot answer completely is the adoption of the second passive measurement approach – panel-centric measurement. A number of companies have developed software meter apps that can be installed on mobile and tablet devices to collect data on usage of apps and, in many cases, mobile Web sites. Several studies that employed such meters were reported at the previous PDRF in San Francisco.

This solution parallels the RFID-based solution explored in the Mattlin-McDonald paper at the 2005 Symposium. It provides passively-collected electronic data on a medium's usage rather than data from self-reports, it involves the tracking of a sample, and it is person-based rather than device-based. This solution therefore gives rise to the same question addressed by that 2005 paper: How would print audience measurement be affected by replacing an audience measurement survey with a metered panel to generate data on the metrics that app-centric data alone cannot produce?

Measurement software installed on individuals' devices holds the promise of providing data on many of the same metrics as app-centric measurement, plus . . .

- Counts of "How Many" people were exposed to any magazine schedule consisting of multiple titles;

- Unduplicated counts of "How Many" people read a particular magazine across all of the users' devices, provided that panelists install the meter on all of theirtablet and mobile devices;

- Enhancements to "How Consumed" data due to the ability to track use of *all* apps, including non-magazine apps and, in most cases, mobile Web browsing behavior as well;

- The inclusion of "Who" data through a survey prior to or at the time of recruitment into the panel;

- The inclusion of "So what" data through the meter's ability to track Web usage on the device on which the meter has been installed;

- The inclusion of "So what" data through some meters' ability to send surveys to panelists' devices and link their survey responses to the individual panelists' passively-collected data.

It might appear that panel-centric measurement of digital magazines with app measurement software could represent the future of magazine audience research, allowing print to join the other media on the path to passive measurement. Before embracing this vision, however, it behooves us to ask what consequences would be of replacing print audience surveys with a panel in which participants are asked to download such app-measurement software on each of their mobile and tablet devices.

ISSUES TO CONSIDER IN PANEL-CENTRIC MEASUREMENT OF DIGITAL MAGAZINES

Following are the cost, privacy, and research issues that should be considered in relying solely on panel-centric measurement apps to produce a currency for digital magazines:

- **Cost**: Publishers bear no increase in direct costs for panel-centric measurement. Publishers would not have to do anything to generate panel-centric data on digital magazine usage. Unlike passive measurement of printed copies, which would have required publishers to insert RFID tags in all printed copies, no special hardware or software needs to be installed by publishers for panel-centric measurement of digital magazines. The only cost issue of concern to publishers would be the indirect cost of higher research prices (see below).

- **Privacy**: Since panel-centric data areobtained only among those who provide consent to the research company to have their data collected, panel-centric measurement with app tracking meters does not trigger any privacy issues for the general public. Unlike RFID tagging, which would have required that every magazine be tagged, digital magazine copies do not need to be universally tagged in order for app measurement meters to detect their use on panelists' tablets. However, privacy concerns do play a role as a research issue, as noted below.

- **Research issues**: While cost and privacy concerns would be negligible, replacing an audience measurement survey with a passively-measured device panel for tracking digital magazines and newspapers would raise a host of research issues:

  1. **Sample size**: Because the data are based on samples, rather than a census, panel-based measurement does not allow for the measurement of digital publications with small numbers of readers. Currently, that category includes all but a handful of digital magazines. The audiences of digital magazines are not as large as the audiences of paper copies and are not likely to reach that milestone for the foreseeable future. In the United States, digital circulation accounts for 3.3% of total circulation of audited magazines.[3] GfK MRI estimates, based on the most recent wave of its National Study, that 5.2% of adults read digital editions of any of the titles it measures, compared to nearly 80% of their printed editions. At these levels, if the publishing and advertising community wishes to maintain the same level of sampling error relative to magazine audience size, the sample size required for measuring the average issue readership of digital magazines with a device-metered panel would be considerably larger than the current print currency sample sizes. It is truethat panel-centric measurement, all else being equal, increases the effective size of the sample for measuring average issue audience due to the gain in reliability from measuring audiences of multiple individual issues. However, this gain in effective sample size due to repeated observations of readership over the course of six months or a year would be more than offset by the increase in sample size needed to estimate the size of a much smaller audience with anything close to the same level of precision that surveys of print audiences currently enjoy.

  2. **Pass-along reading:** As is the case with in-app tracking, app meters cannot distinguish between different people who may be using the same device. Therefore, app meters alone cannot determine "How Many" people read a digital magazine; the meters can only count devices, not individual users of the devices.

  3. **Respondent cooperation**: The history of panel measurement of other media suggests that it is likely to be more difficult to convince respondents to download software that would reveal all of the apps they use than to convince them to answer a set of questions. Deere and Carroll reported in their 2011 paper that just 5% of the subscribers to The Economist app agreed to participate in a one-month test of an on-device meter. One of the main barriers to participation, they reported, was concerns about privacy. Even some of those who might be initially willing to participate might have difficulty in installing the software or might delete the measurement app at the first sign of trouble with their device. Panel-centric measurement would thereby run the risk of depressing the response rates that are already challenging to maintain.

  4. **Field administration**: Administering a panel is more labor-intensive and complex than administering a cross-sectional survey with a sample of comparable size. Additional infrastructure would need to be put in place to keep track of panelists. Additional staff would need to be hired to help out panelists with problems, administer incentives, and ensure as much as possible that panelists do not delete the measurement app.

  5. **Research costs:** A panel-centric print audience study is likely to be more expensive than a print audience survey. The additional staff and additional infrastructure would add to the study's costs. Research companies would need to pay additional incentives to panelists after the initial incentive in order to maintain panelists' cooperation for six months or longer. And the volume of data continuously transmitting from the app measurement software would probably exceed the volume of data from one or two questionnaires. These cost increases could be partially offset by reduced interviewing costs due to a shorter initial questionnaire.

  6. **Missing data:** If several days have passed between transmissions of data for a particular respondent, there is no way to determine whether the respondent hasn't been using any apps on her device or whether she simply

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[3] http://www.auditedmedia.com/news/blog/2013/august/the-top-25-us-consumer-magazines-for-june-2013.aspx

deleted the measurement app from her device. Eventually, after a week or more of no data transmissions the research company might conclude that the respondent was "out-of-tab" and contact the respondent to ask her to restore the measurement app to her device. But during the period that the respondent was out-of-tab, her usage data wouldn't be counted, and the digital magazines she read would not be counted in those magazines' audiences. "Out-of-tab" respondents would be a more serious problem for print audience research than for TV audience research, because people spend less time reading magazines than watching TV. Measurement app deletion could be particularly damaging to magazines with smaller audiences.

7. **App categorization:** In order to monitor the use of digital magazine or newspaper apps on all operating systems, plus ancillary branded apps produced by publishing companies, the apps of advertisers, and the apps produced by other media companies, it is necessary to create a library of available apps on all operating systems. This represents an incremental effort beyond the requirements of carrying out a magazine and newspaper audience survey.

8. **Qualitative data**:Passively-collected data from measurement apps cannot provide all of the qualitative data available from a survey, such as interest in the edit, interest in the advertising, and opinions about the magazine. However, there are other qualitative measures that measurement apps do offer. For example, duration of exposure and frequency of opening a digital magazine can be monitored by measurement apps without having to tax respondents' memories. Measurement apps are also able to record openings of other apps and time spent with them, providing context to respondents' digital magazine-reading experiences. Some measurement apps have added the capability of tracking the device's geolocation, enabling the researcher to obtain an indication of place of reading. And of course, on-device measurement apps that can be programmed to send questionnaires to the devices on which they are installed are able to solicit panelists' opinions about magazines.

TECHNICAL ISSUES TO CONSIDER WITH APP MEASUREMENT METERS

Finally, it is important to understand the potential impact of measurement apps on magazine audience research from a technical standpoint.

GfK MRI has tested a number of app measurement meters over the last two years. In these tests, we compared passively-collected data from device meters with logs kept by employees on whose devices the meter was installed. Though we cannot reveal the meters we have tested, let alone the results of individual tests, we have encountered the following issues with one or more of them. Some meters encountered fewer of these issues than others. Nevertheless, in selecting a meter for magazine audience research, these are the potential problems to watch out for:

1. **Different operating systems:** There are two major mobile operating systems – Android and iOS. It has been our experience that app measurement tools have to be tailored for each operating system. A measurement app that works on one operating system will generally not work on the other. Apple' iOS is a less welcoming environment for measurement apps. Apple strictly controls the measurement apps that are allowed within its iTunes store. Obtaining Apple's approval to include measurement apps in its iTunes store remains one of the obstacles in tracking digital magazines on iPads with on-device meters. In addition, even though Android and Apple devices command up to 80% of the mobile market, digital magazines can be read on other operating systems as well.[4] A meter seeking to measure digital magazines on all of these devices would need to be adapted to these smaller mobile operating systems as well.

2. **Proliferation of devices and versions of operating systems:** App meters designed to run on the Android operating system may not work on all Andriod devices. For example, the Kindle Fire and Barnes & Noble Nook both run on forked versions of Android. Meters need to be optimized to run on each of these devices. Metering apps must also be approved by Barnes & Noble before they can be downloaded on Nook devices. In addition, meters which are built to run on the most recent version of an operating system may need to be adjusted to run on prior versions of the operating systems for respondents with older devices.[5] As newer versions of each operating system and new versions of each device are released, the meter may need to be continually updated.

3. **Difficulty in meter installation:** Meters to monitor television are usually installed by a professional installer. Meters to monitor radio generally consist of a device that is carried or worn by a respondent. Unless the device panel is recruited face-to-face, respondents would have to install the app measurement meter on their own. While most of the meters we tested were not difficult for tech-savvy employees of research companies to install, the same may not be true of randomly-selected panelists.

4. **Meter shut-offs**:We found in our testing that we sometimes lost data for hours, even days, when the meter crashed unexpectedly or when the operating system software shut off the meter. The sudden shut-downs were particularly problematic for iOS devices, as the operating system tried to conserve power by shutting off apps that didn't appear

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[4]http://www.business2community.com/tech-gadgets/2013-roundup-of-mobility-smartphone-and-tablet-forecasts-market-estimates-0380572; http://www.netmarketshare.com/operating-system-market-share.aspx?qprid=8&qpcustomd=1.

[5] This issue was noted in both Deere and Carroll's and Kilger, Ring, and Romer's 2011 PRDF papers.

to be active. When embarking on a research project with app metering software, it is critically important to test it to ensure that such shut-downs and crashes do not occur.

5. **Degradation of device performance:** Some of the meters we tested required a lot of power and so drained the device's battery quickly. They also slowed down the loading of some Web sites and rendered the device incapable of loading certain apps or certain video content. Panelists who suffer a degradation in the performance of their device may, at a minimum, alter their device usage patterns or, at worst, drop out of the panel.

6. **Determining how long an app is open:** It is sometimes difficult for meters to identify when an app that has been opened is no longer being used.[6]This is particularly the case when the device has fallen asleep. The meter cannot always judge whether the device is still awake and the app is still being used. If a magazine app has been opened and then the device is set aside for the night, without being turned off, it may appear that the magazine app has been open for 12 hours. In order to correct for such over-counting, some metering systems attempt to clean their "time spent" data by capping the time spent with a particular app at a certain amount of time if the device hasn't been turned off or another app hasn't been activated. While this kind of cleaning might help to eliminate undue inflation in estimates of the time spent with certain apps we found that the cleaning algorithms can adversely affect estimates of time spent with digital magazines, which tend to be used for longer periods of time than other kinds of apps.

7. **Difficulty in identifying magazine titles**: Meters are unable to identify titles of digital magazines that are read on newsstand-style apps, such as Zinio or Next Issue Media, or the newsstands for the Kindle or Nook. On Apple devices, many magazines have their own stand-alone apps, and meters are generally able to identify these magazines when users read them. However, if a publisher uses the same app to distribute multiple digital titles on Apple devices, meters would not necessarily be able to differentiate between those publisher's digital magazines. Fewer magazines in the US have stand-alone apps on Android than on iOS devices. Many magazines without stand-alone Android apps are read on the "Google Play Magazines" app, and device meters cannot distinguish between magazines that are read on this Android app.

8. **Difficulty in identifying magazine issues:** None of the meters we tested were able to determine the issue dates of the digital magazines whose usage they captured. Even when the device meter is able to identify the digital magazines read on a tablet device, it cannot, without additional data, be used to estimate the readership of individual digital issues.

9. **Inability to measure within-app activity:** As of this writing, hardly any of the major device-based meters claim to be capable of measuring within-app activity, such as usage of and time spent on individual pages or ads. These meters collect app-level data rather than data on individual pieces of content within a digital magazine app. Many measurement apps do capture HTTP-related data, though, and so might be used to infer click-throughs to advertisers' Web sites or to publishers' video content. If HTTP-related events rarely occur due to an opening of an ad, on-device meters may not be able to capture all of the exposure to that ad.

10. **Inability to measure app installations:** Most of the meters we tested were not able to detect the installations of particular apps on Apple devices. This is not an issue for Android devices.

11. **Inability to measure app deletions:** Similarly, most of the meters we tested did not flag the occasions on which apps were deleted from Apple devices, and none of them captured the names of the apps being deleted from Apple devices.[7] Some of them were capable of capturing app deletions on Android devices, and some were not.

12. **App and category naming conventions:** It is difficult for some of the metering systems to correctly identify the apps and to place them in the correct categories.

We believe that on-device meters will continue to evolve and to overcome most of these technical challenges. Indeed, the latest versions of some meters may well have already done so. However, it is important to be aware of these issues and to test for them when embarking on a project with such meters.

All in all, device meters for measuring digital editions of magazines actually raise fewer concerns than RFID tagging. The cost and privacy issues surrounding device meters are less severe than those that confronted RFID tagging. Daunting as the lists of research and technical issues above might have seemed, they are generally not as daunting as those that confronted RFID measurement of printed publications. Nonetheless, the issues outlined above would need to be addressed -- through vigorous testing, supplementary data sources, and some modeling -- before the adoption of a metered device panel as a currency for digital magazines.

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[6] This was referred to as the "'pocketful of measurement' problem" in Kilger, Ring and Romer's 2011 PDRF Paper.
[7] One of the meters did identify instances in which an app was deleted but couldn't identify which one was deleted.

In fact, most of the technical issues with panel-centric measurement outlined above do not apply to and can be resolved by in-app measurement. App-centric tags are not known to crash, do not wear down the device battery, require no installation by the user, and can identify individual titles, issues, and ads. Moreover, app-centric measurement would overcome many of the limitations of a panel in measuring "How Many" for digital magazines with relatively small numbers of buyers. A combination of app-centric measurement with a panel equipped with a measurement tool that monitors all of their app activities might therefore offer a potent solution for digital magazine editions. This sort of combination parallels the "hybrid" model that prevails in Web measurement– census-level data through tags on Web sites combined with a panel whose browsers are continually measured to provide data on cross-Web site usage and demographic profiles.

Of course, in order for a hybrid solution to work, publishers would all have to agree to release their within-app data, and digital magazine audiences would have to grow large enough for their demographic profiles to be projectable with a reasonably-sized sample. Models would need to be built to account for gaps in app-centric data due to off-line reading from single-copy buyers and for instances when panelists are out of tab due to meter deletion or unanticipated software shut-downs. In-app measurement systems and on-device meters would need to be continually adapted to new devices, new versions of publishing software, and updates in mobile operating systems. Libraries of app names would need to be developed and coded into appropriate categories in order to take maximum advantage of the data offered by device meters. Research costs may rise, while response rates (for the panel) may well fall below audience measurement survey response rates.

Even if all of these steps were taken, though, the powerful combination of app-centric and panel-centric measurement would still fall short in several respects without additional data collection:

- With respect to "How Many," neither method can capture pass-along readers.
- With respect to "How Consumed," neither method would obtain the quality of reading data on opinions about the magazine and interest in the ads in it.
- With respect to "Who," neither method would paint full profiles of the readers of a particular magazine, including other media consumed, products purchased, and psychographics.
- With respect to "So what," neither method can capture noticing of ads or subsequent actions taken as a result of seeing the ads.

Most of these gaps could be filled by surveys – either at the panel recruitment stage or delivered on panelists' devices through the on-device meter. In the future, it may be possible for meters to trigger the release of a survey to the panelist's device after the reading of a digital magazine, enabling researchers to obtain panelists' qualitative attitudes towards the digital magazines they read shortly after the reading experience.

FINAL THOUGHTS

One of the points of the 2005 PDRF paper bears repeating here. Print publishers have claimed, particularly in the last couple of decades, that reading magazines is an inherently more engaging, immersive, and lean-forward experience than using other media. The nature of that experience, as well as consumers' unique attachment to their print publications, has served as a rationale for print's generally higher CPMs. The term used in print audience surveys throughout the world for measuring exposure to print– "read or looked into" – implies the immersiveness of that experience, that being counted as part of the audience for a print publication extends beyond seeing a magazine or newspaper page open in front of you. If the qualitative measures that are included in most print audience questionnaires were to be discarded, would we be signaling that reading a magazine or newspaper is qualitatively no different than exposure to other media? If digital magazines are measured in the same way as othermedia -- by following their electronic trail -- do magazines run the risk of being valued and priced in the same way as other media? To put it another way, would purely passive measurement of print imply that print is as passive a medium as radio or television?

There is an inherent tendency among marketers and market researchers to trust electronic data more than self-reported data, to regard "Big Data" from digital counters as superior to data from the memories of human beings. Print and digital researchers should not be lulled into a false sense of security about machine-based data; researchers need to be aware that electronic data do not answer all of the questions that print audience measurement is expected to answer and do not answer the remaining questions as consistently, comprehensively, or accurately as they should be answered. In measuring audience sizes of and interactions with digital editions of magazines and newspapers and the ads within those publications, passive measurement will be essential as those digital editions grow in popularity. However, surveys will also continue to be important in filling in the gaps left by electronic measurement. We will still need to continue asking questions.

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