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An Empirical Assessment

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Abstract

Can readership of sales flyers and free newspapers be estimated by revealing fingerprints? In this paper we report the results of an empirical analysis based on 4604 flyer-pages conducted to assess the feasibility of the method. Results are encouraging, and indicate that the method presently may serve as a conservative estimate of readership. Advertising management may thus use the fingerprints-approach as an alternative audience measure and thereby assess the convergent validity of the traditional interview method and the fingerprint approach. While the fingerprint method appears valid for sales catalogues its validity of measuring audience of small flyers is questionable.

1. Introduction

Historically, the survey approach has been the prevailing technique for measuring print media audiences, in contrast to TV audience measurement, where unobtrusive measurements, such as TV meters have been applied for many years. Measuring the audience to a print media involves measuring circulation and readership. Circulation relates to the number of copies circulated to the public, while readership refers to the number of readers of a specific issue or to the number of readers over a certain period. The ability to measure readership depends to a high degree on whether readers pay for the media.

Regarding *paid for* print media such as newspapers and magazines net circulation can be estimated fairly precise, and will in most developed countries be estimated or at least controlled by an independent audit bureau of circulation. Measurement of readership, on the other hand is much

more inaccurate, and in addition, it is the yardstick by which an advertiser measures the value of a print media. Generally, measurements are based on the survey approach, where samples of potential readers are asked to recall having read or just looked into or flicked through a particular newspaper- or magazine issue. Depending on the degrees of telescoping, most probably more for weeklies than for dailies, and more for monthlies than for weeklies, the demands on respondents' memory are heavy, and the possibility for errors are considerable. Also, sampling errors could be an issue, in particular for newspapers and magazines with small circulations, requiring large and hence costly samples to obtain a needed precision. . For a discussion of the flaws of the survey method in measuring readership see Brown (1999), Joyce (1986) and Walstra (1986).

For *free* print media such as sales or advertising flyers, sales catalogues and free daily newspapers measurement of readership is even more inaccurate. Readership measurement is generally based on the survey method as is the case for paid for print media and therefore it is subject to the same inaccuracies. In addition, flyers, catalogues and free newspapers are typically distributed (as described below) to households' mailboxes as unsolicited printed matters, and many receivers will not be interested at all and others only marginally interested, finding it difficult to distinguish between various flyers and difficult to remember having noticed or read a particular flyer in a particular week. This is unlike the situation for paid for printed media, where one would expect the buyer/subscriber to be reasonably involved in reading the medium and hence better able to remember the medium and the parts studied.

This paper focuses on sales and advertising flyers used mainly by retail chains and how to measure readership of flyers. The setting is the Danish retail market, where this type of flyers occupy an important position in the marketing mix applied by, in particular, grocery chains but also other

retailers. Flyers of nearly magazine size are accordingly issued on a weekly basis and distributed to all or most Danish households by the major retailers, and in this way huge amounts of advertising money are spend on a print media for which readership is measured rather vaguely using the survey method. On this background alternative, less obtrusive, and more accurate measurement methods of readership for print media, in general, would be desirable. The fingerprint method is one such alternative method, and the objective of this paper is to evaluate the feasibility of this method for measuring readership of sales flyers.

The remainder of this paper is organized into five sections. The next section presents and discusses two earlier efforts to measure fingerprints on print media and readership of the media. This is followed by a description of the research setting, of the distribution and discarding of sales flyers in Denmark, and our research methodology is outlined. In the fourth and final section we discuss our findings, evaluate the feasibility of the fingerprint method and discuss future research in this area.

2. Prior efforts of using finger print analysis for measuring readership

The first published effort to assess the audience of a print medium by analyzing fingerprints can be traced back to 1934. It became known as the "200,000 Fingerprints" study and was conducted by Time Magazine (DuBois, 1963). The purpose of the study was to investigate new ways for measuring readership of Time Magazine. The setup of the study was inspired by an obviously rationale: "If the magazine does something to the people, the people must do something to the magazine. If there were smudges they came from fingerprints. Could we possibly find fingerprints on the pages that would prove to us and to the advertisers that someone had actually been there, going through the magazine?" (DuBois 1963, page 7).

The experimental design and research setup was developed by a consulting company, founded and operated by a former Deputy Commissioner from the New York Police Department. A sample of magazines was distributed amongst subscribers of *Time Magazine*. All issues consisted of paper that had been exposed to careful chemical manipulation prior to being distributed (a solution of silver-nitrate crystals).[1] The type of paper used was found to be very sensitive to fingerprints, and 532 copies were gathered some days later. Subsequent analysis showed that they contained a total of 216.000 fingerprints or an average of about 400 fingerprints per issue. More than 90% of the issues contained fingerprints. According to the investigators, the average number of readers per issue was reported to be 3.26; for comparison the average household size in the US during the nineteen thirties was 4.01 (DuBois 1963 does not provide any specifics on how the number of readers per issue was estimated. Did the researchers really try to unravel *individual* fingerprints?).

According to Webb et al. (1981, 12) the "1934 study ... estimated an advertisement's readership level by analyzing the number of different fingerprints on the page. The set of prints was a valid remnant, and the analysis revealed a resourceful researcher." According to DuBois (1963), the cost of the study was $1.25 per fingerprint or $270.000 for the study. This amount corresponds to somewhere between $15.000.000 and $20.000.000 today. Unfortunately, the only available source regarding the 1934 study is Dubois' (1963) two-page summary. It is therefore difficult to assess the specifics of the research setup.

From a pure measurement perspective the reported findings appear to be impressive, indeed. However, some technical comments seem appropriate. Firstly, why should a subscriber pay for

[1] Note, that the procedure of exposing respondents to a hazardous solution without informing them beforehand probably would be regarded illegal today, due to laws protecting citizens from environmental and work related risks. Moreover, in many Western countries laws often severely limit the use of toxic material.

receiving a magazine and then not even read it? Secondly, as far as we can assess, the study has no managerial implications and lacks generalizability: In most cases it is not relevant - either due to economical or practical reasons or both - to manipulate the empirical data beforehand, that is *prior to* being subject to a respondent's behavior. Moreover, such a research setting necessitates that the study be planned as an experimental design or even as a laboratory experiment (and then it most probably ceases to be an unobtrusive study).

In a 1976 study Greene and Maloney considered the problem of finding an alternative method to measure print media audiences, noting that,

> "Magazine audience research has been going on for 40 years without any proof that what readers *claim* they read is what they actually did read. Are there ways to compare actual reading behavior with what people say they read when interviewed a few weeks later?" (Greene and Maloney, 1976).

The objective of their study then was to find out whether the analysis of fingerprints appearing on magazines could be used as a proxy for readership of the appropriate magazine.
From a methodological perspective, the new study was characterized as a disappointment.

The disappointing outcome of the 1976 study seems, however, to be based on a misunderstanding of how the fingerprints-approach can and cannot be used for measuring readership. The study attempted to identify *individual* fingerprints, i.e. linking fingerprints to a specific person, and this turned to be impossible in the experiment described in the paper. However, fingerprints or remnants after fingerprints were identified on around 5% of the considered pages, furthermore, the presence of a *positively identifiable* fingerprint is not a necessity for proving that a given page has been touched by an individual and thus most probably has been seen by that person. One could, of course, argue that the appearance of a fingerprint on a page only proves that the page has been *touched*, while it does not prove that the page has been *read*. While this argument is valid

concerning the front ("1") and rear page[2] ("n"), we do not think that the argument holds as long as we are dealing with the other pages (from "2" to "n-1"). Of course, touching a page does not necessarily imply "being exposed to". However, before applying this restrictive criterion on the fingerprints-study, it may be worthwhile to remember how 'exposure to a specific advertisement' usually is defined in a traditional measurement setting, "If the respondent being interviewed *states* that s/he has read or normally reads the magazine or the newspaper (in which the page containing the advertisement appeared), then s/he *automatically* counts as one "Opportunity To See" unit."[3] For instance, no check is performed on whether the person has or has not opened the newspaper-section, in which the advertisement appeared. Therefore, if fingerprints on a page does not imply exposure to the page and the environing medium, then an uncontrollable claim by someone to have read a given medium most often using aided recall definitely does not guarantee, that the person has been exposed to an explicit advertisement appearing on a specific issue and page in that medium.

We think it is rather unlikely that a person looks in another direction, while turning the pages of a print medium.[4] It is quite possible that s/he is a light reader and only glances at the pages of the medium. Nevertheless, in a technical sense, s/he is exposed to it.

In the following we will assume that the appearance of a fingerprint on a flyer page, apart from the front and rear pages indicates that the flyer has been read. We will not, however, attempt to distinguish between fingerprints to see whether they belong to different persons. Thus the fingerprint method is a conservative measure of readership.

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[2] Front and rear pages may have been contaminated, either by the postman/paper boy, or by the person, who discarded the flyer, or by both - also in cases where the flyer never was opened and studied by anyone.

[3] In some Scandinavian countries a specific advertisement is even regarded as obtaining, say, a 33% OTS-score, assumed that the respondent - according to self-reported behavior - claims to "usually" read "2 out of 6 issues" of the given print medium!

[4] One cannot say anything about the *degree of intensity* or *the interest* that accompanies a person's exposure. This would require other sophisticated measurement devices like an Eyes Movement Camera, a Pupil Dilation Response, a Tachistoscope, or a Galvanic Skin Generator. Note, that these methods cannot be integrated in an otherwise unobtrusive research design, since they imply that the respondent knows that her/his behavior is being observed.

3. Research setting and methodology

Before discussing the methodology, we briefly describe how sales flyers are distributed to households and eventually discarded in Denmark; also we assess the possibilities for characterizing households receiving the flyers in terms of demographic, socioeconomic and life style descriptors.

3.1 The Setting

The Danish society consists of around 2.5 million households (Statistics Denmark, Yearbook 2007). and retailers, who want to distribute sales flyers to a broad audience, can choose between two major distributors and several minor ones. The two major distributors are the *Danish Postal Service* and a commercial service, *Forbrugerkontakt, (Consumer Contact).* These distributors are able to deliver sales flyers and other printed matters to both the majority of households and to geographically specified target markets. Due to cultural habits and legal considerations, the overwhelming majority of flyers distributed to Danish households are not addressed to a specific resident.

According to a poll conducted by the marketing research agency GfK Denmark in 1999 roughly 70 percent of all flyers are recycled ending up in containers reserved for paper. Approximately one out of every six flyers is put into a disposable bag and thus mixed with ordinary garbage. Finally, about 5 percent are burned by households, and the rest of flyers are unaccounted for. These general findings are quite stable across basic background criteria such as age, gender and geography.

Sales flyers that were analyzed for fingerprints were sampled from containers at a recycling center in the Southern Denmark region. Therefore no information is available about the particular households who left the fingerprints. However, it is possible at the aggregate level to piece together

relevant information about the households. Recycling centers are placed all over the country and the area and hence the primary users served by a given center can, of course, be identified. Given a geographical description of an area served by a specified recycling center information on an aggregate level about the residents in that area can be collected. Geo-demographic information can be obtained from commercial market research companies, thus in Denmark the company *NeoZone* has developed a program that combines data from the Danish public census and the National Survey and Cadastre to produce a detailed geographical-statistical latticework of Denmark. Each cell of the latticework covers an area of 100 by 100 meters containing from a few to about a hundred persons. Demographic and socio-economic descriptors can now on an average basis be computed for each cell. In addition, the program assigns each cell to that of eight MOSAIC^{TM} life style segments that best fits the persons living within the cell.

When comparing the MOSAIC segments residing within a 5 km diameter of the recycling center (covering a space of 20 square miles) with the MOSAIC segments based on the whole country, we found that that the two categorizations roughly match. Suburb residents and pensioners are somewhat overrepresented in the regional district while both city center and rural residents are slightly underrepresented (specifics not shown). However, differences do not appear to be dramatic.

To sum up we find it justified to assume that the sample of consumers whose fingerprints appear on the flyers – regarded as a group - does not markedly differ from the population of Danish consumers.

Now assuming that the sample of consumers whose fingerprints appear on the flyers selected randomly from the recycling center does not deviate markedly from the population in the area served by the recycling center, it should be possible to collect a sample of consumers' traces - taken

from various recycling centers - that does not deviate markedly from that of the Danish population on important demographic, socio-economic and life style variables.

3.2 Methodology

Analyzing fingerprints on paper is a rather complicated procedure. First, all pages of a flyer need to be separated. Second, every page has to be dipped into a liquid called Ninhydrin (previously used in the 1976-study). Third, the wet page must be dried in a so-called test-chamber, a device resembling a big microwave oven. Finally, each page has to be scrutinized for fingerprints appearing on the page.

Based on prior behavioral studies and experience, we looked for fingerprints at the far right, middle and bottom of the odd (right) pages, and at the far left, middle and bottom of even (left) page.
In most cases, fingerprints only appear a few times across a sales flyer. If the flyer consists of, say, 32 pages, then one normally will find only 2 to 4 fingerprints across all pages. Typically, more fingerprints will be found on the first pages as compared to the last ones. Nevertheless, it is reasonable to assume that the person, who has left, say, one or two fingerprints on the first few pages, indeed has been flipping through the whole flyer - although no physical traces are to be found on the remaining pages. It should be noted that several big supermarket-chains tend to place diary products like milk, and bread, meat, vegetables, diapers, and toilet tissue in the hindmost part of the flyer. While the week's top offers are displayed on the front (or rear) page, the consumer needs to go to the last pages for learning about diary products that are on sale in the coming/present week. The first part of the flyer then typically contains advertisements for clothes, shoes, hardware, toys, electronics and personal care products.

For methodological reasons, the front and rear page of each flyer need to be excluded from analysis since these pages may have been touched and thus contaminated by someone different from the reader. Finally we note that since we are only trying to establish whether a fingerprint is present or not the analytical process is far less laborious than in a criminal investigation, where it is crucial for the prosecution to establish a positive match between a fingerprint found at the scene of the crime and the suspected person.

Fingerprints appear because people sweat. Human sweat consists of 98% water and 2% of amino acid. Only the "pure" amino acid is traceable. Sweating is an individual characteristic. Typically, fat, young, temperamental, stressed, and nervous individuals sweat more than people not possessing these characteristics. Senior citizens tend to develop dryer and "leathered" hands, implying that their fingerprints are difficult to trace. Sweat is known to correlate with season: People are obviously sweating much more on a hot summer day as compared to a cold winter evening. To complicate matters, two individuals having comparable physical and psychological characteristics, and being exposed to the same conditions (temperatures) may differ considerably with regard to how much sweat is secreted by the body's lymph nodes, and hence their ability to leave fingerprints.

To get a feel for how the fingerprint method would work and for potential problems involved in using the method we first conducted two minor pilot studies. These studies indicated that paper quality and temperature are of importance when using the method, and that the ability to 'produce' fingerprints varied across people. Paper of newspaper quality appeared to be the most receptive for fingerprints. Next, a new larger sample of flyers was collected in order to assess the feasibility of the fingerprints method in measuring print media readership. Based on the experiences from the

pilot studies the data collection was conducted in the summertime and two major samples were collected, one consisting of flyers of newspaper quality and one consisting of glossy magazine paper quality flyers. The samples were drawn from the same recycling center in the Southern Denmark region as were the samples for the pilot studies.

Throughout the data-gathering process we sampled several hundred flyers from containers. Because of limited analytical resources, we ended up scrutinizing 117 flyers. With few exceptions, households had received the flyers between one week and one month prior to being sampled. The flyers emanated from seven different advertisers (see Table 1). Usually, but not always, households receive flyers, originating from the same advertiser, on the same day, same issue/referring to the same future period of time concerning offers. The 117 items were distributed on eleven different days in the period May through September.

From a technical point of view our sampling method could be characterized as *judgmental sampling*. Thus the selection criteria were biased toward flyers emanating from certain producers, where we had been relatively successful at finding fingerprints during the pilot studies. The relation between the two types of paper quality were significantly reversed compared to the pilot phase, thus only 12% of pages analyzed in the pilot phase were of newspaper quality, while the comparable figure in the new sample was 82%, see Table 1. Whilst there is no obvious reason to believe that readership varies across paper quality[5], a generic focus on flyers of newspaper quality - according to the pilot test – should improve our chances of finding fingerprints.

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Table 1 in about here

[5] Some of the big grocery chains like *Føtex* and *Kvickly* use flyers of magazine quality paper, while others like *Brugsen* use the newspaper type. According to Gallup, all three flyers obtain readership figures of 70-80%. Source: Gallup CAPIbus 2000.

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4. Findings

While the number of issues collected in the empirical phase (117) appears to be modest, the number of pages examined is 4370. Analyzing several thousand pages for fingerprints becomes a laborious and time-consuming task, since each single page needs to be separated from the environing issue and subsequently treated and scrutinized individually.[6]

On a general level, only one third of the issues (38/117) included at least one valid fingerprint. See Table 1. However, the relative number of fingerprints varied substantially across categories. *Idényt*, a voluminous flyer containing multiple ads for different marketers (it has 20-30% non-advertising content), produced fingerprints in 19 out of 25 issues analyzed. The flyer *Intersport* on the other side contained only a single fingerprint across 6 issues (24 pages). It is worth noting, but hardly surprising, that the flyer containing most fingerprints (absolutely as well as relatively) was also the one having the most pages. Fingerprints were traced on 9% of all pages scrutinized. This figure is almost twice that reported in the earlier pilot study by Greene and Maloney.[7] Our somewhat better result might be explained partially by our biased selection of paper of newspaper quality and partially by our effort to include the otherwise exogenous variable "heat" in our design and use heat for improving the quality of our data.[8]

Additional findings were that significantly more fingerprints were found on the first half of the pages of flyers, see Table 1, compare columns IX and X (p-value = 0,012). Also, significantly more

[6] One should remember that our study was designed as a basic research project. At the end of the paper we make recommendations with regard to how the research design can be simplified, formalized and speeded up considerably, such that it can be used in applied settings.

[7] "[The expert] found smudges on 5% of observed pages" (Greene and Maloney 1976, 49).

[8] The researchers of the 1934-study found fingerprints on almost all issues analyzed. But their study had a different approach and cannot be compared to our study.

fingerprints were detected on odd-pages (more than twice as many) than on even pages, (p-value < 0,001), refer to Table 1 columns XI and XII. A reason for these findings could be that, as the reader flips the pages, the fingers (i.e., wetted by a tiny clot of spittle) become dry (unless it is wetted once more). Therefore, more fingerprints will be found in the first than in the second half of the flyer. Furthermore, it appears that the prevailing way of flipping through a print media is to use the thumb and/or forefinger of the right or left hand[9] and touch the right side (odd page number) prior to flipping the page (beginning with the front page). Although people's technique regarding the flipping process may vary considerably from person to person, it seems that most people touch both pages (the odd as well as the subsequent even page) when they do the flipping. The "load" on the odd page is probably highest, since it is the grip of the odd page that initiates the flipping. Moreover, one usually wets the finger with spit immediately before turning the odd page.

In column VIII of Table 1 we have estimated readership measures, solely based on the fingerprint approach. According to a recent commercial study by Danish Gallup (November 2006) 56% of respondents report to read flyers for *supermarkets and discount stores* "every time or almost every time", 23% report to read them "now and then", while 21% state that they "never or almost never" read them.

Data from a major supermarket chain *Super Brugsen* and from a major grocery discount chain, *Netto* are included in Table 1. *Super Brugsen* is a supermarket chain with a national retail market share of 10%, while *Netto* is a discount chain with a share of 12.5%. Comparing Gallup's findings (based on 1041 CAPI-interviews) with ours - See Table 1 - we note that our figures are much lower

[9] According to self-reports, about 90% of Danes claim to be right-handed. However, it seems that many right- handed people use the left hand for turning the page of a flyer. Some even use a combination, either by using both hands or by changing the hand now and then.

(31% and 11% respectively) than the corresponding figures provided by Gallup.[10] We should keep in mind though, that the two measurement approaches differ considerably. Note also, that our measure is a conservative one: There may be more than one fingerprint/reader per page.
Our figures on the two flyers are certainly underestimating the true but unknown readership. Obviously, the fingerprint-based estimates are downwards biased, implying that readership may have occurred without leaving any observable trace on the surface of the pages. A likely explanation to the absence of fingerprints is that both flyers contain relatively few pages (24 and 16 respectively including front and rear page).

Assuming that a flyer has less than, say, 50 pages, it may sometimes be impossible to find any fingerprints on it although it has been read. Our analysis contains data providing limited support to this assumption: By inspecting table 1 we note that 19 out of 25 issues of the voluminous flyer *Idényt* carried fingerprints. However, in 4 of the 19 cases, the first fingerprint was found on page-numbers higher than 24. Consequently, if our analysis had been limited to 24 pages, we would not have identified them as readers. In one case the first fingerprint appeared on page 94. In another case, the first fingerprint appeared on page 25 and still we were able to detect no less than 32 fingerprints across pages 25-119.

[10] So far, using the conventional approach, the survey method, to measuring the readership of flyers makes it difficult to provide valid readership figures that are chain-specific. Up to now Danish Gallup - in its "official" and published annual study - is asking respondents about their readership of flyers across generic categories, like "supermarkets", "photo-shops", "beauty shops" etc. While one could easy *ask* specifically for branded chains or even for stores, Gallup usually prevents doing so because they worry about question-ambiguity. Due to the fact that flyers are distributed without charge, it naturally follows that they are widely regarded a low involvement media. Therefore, many people will not be able to tell which specific flyer she/he has read but can at best remember the category. The ambiguity phenomenon does not at all affect the fingerprint-approach since it is per se carried out on the flyer/chain-specific level. From a different source we know that 72% of Danish households receive *Super Brugsen* while 88% receive *Netto* (Source: GfK Denmark, October 2000 based on 1023 responses from a mail panel). While these data are chain specific, receiving a flyer does not tell us anything about whether it is being read.

Our empirical sample consists of 117 issues covering 4604 pages (4370 valid pages). Two-thirds (67%) of the pages being analyzed refer to (19 issues of) one producer's advertising publication, *Idényt* (New Ideas). While this medium has more pages than several paid-for magazines, its paper quality shares more characteristics of the newspaper type than of the usual glossy magazine-type. Table 2 provides a fingerprint analysis of the 19 issues of *Idenyt* that contains at least one fingerprint. Each digit, "1", indicates whether or not at least one valid fingerprint has been identified on the appropriate page. The 2242 pages (19*120 minus 19 times* [front+rear page]) contain 324 pages with fingerprints (14.45%). The issues contain between 1 and 68 fingerprints (average = 17.1, standard deviation = 16.2). The first half of the flyer (the first sixty pages) contained slightly more fingerprints (172) than the second half (152) the difference is not statistically significant, while the odd page numbers contained significantly more fingerprints (219) than the even page numbers (105) – a difference significant at the 0,001 level.

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Table 2 in about here

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Clearly, the probability of finding a fingerprint on page *i* is greater, assuming that there is a fingerprint on either page *i-1* or *i+1*.[11] Almost half or 150 of the pages with fingerprints were either preceded or succeeded by another page with a fingerprint. Only in 99 cases was a page with a fingerprint separated by *at least two pages* without a fingerprint. In the remaining number of cases, a page with a fingerprint was separated by one page without a fingerprint. Thus, in 69% of cases [(324-99)/324] fingerprints were identified very close to other fingerprints. Had the fingerprints been distributed randomly across the flyers, a page with a fingerprint would on average be separated by 6 pages without a fingerprint (2242/324 = about 7). Thus, obviously fingerprints show a

[11] Thus, if one has identified a fingerprint on a given page, it is recommended that the one ore two preceding pages are scrutinized once more and that the subsequent one or two pages are examined with extraordinary carefulness.

tendency to cluster. This finding seems to fit with a common supposition concerning how a person flips through the pages of a flyer. She/he flips the pages until the fingers become dry then the fingertips are wetted by using spit, whereupon she/he proceeds to flip the succeeding pages. The first pages touched after the fingers have been wetted will contain more liquid and therefore it will be easier to detect fingerprints on these particular pages.

We were more than twice as successful at finding fingerprints on the odd-pages as compared to the even pages (219:105). This leads us to the conclusion that the odd-pages are crucial with regard to estimating readership by finding fingerprints. Assume for a moment that we had *only* been inspecting the odd pages for fingerprints. If we take a closer look at table 2 we find that *none* of the 19 issues would have been regarded unread, because all of them had at least one fingerprint on an odd page. When focusing our analysis on the odd-pages we find that 19.5% (219/1121) of them carried a fingerprint (Table 2 contains 1121 odd page numbers, if we exclude the 19 front pages). Note that some pages had several fingerprints on the same page.

The disappointing results of their 1976-pilot study led Greene and Maloney to the conclusion that the fingerprint-approach does not work properly. One of their arguments ran like this, "...suppose, a fingerprinting method could be devised that gave a 25-per-cent chance of identifying a reader's print on a *single* page [out of 38 (subsequent?) pages of a magazine, that they were inspecting]. Applying the binomial theorem, the reader would have to open as many as 16 pages to raise to 99 per cent the chance of our identifying his prints on at least one page and thus correctly calling him a 'reader'. The lack of the necessary positive identifications led us to scrap our detailed test of fingerprinting." (Greene and Maloney 1976).

We tend to agree with Greene and Maloney on the inappropriateness of using the fingerprints for measuring the readership of independent advertising pages that are picked up (or not picked up) by respondents according to some random procedure.

It is rather easy to explain why: Assume that we have developed a measurement device which is capable of finding fingerprints on 20% of all odd pages of a flyer, given that a person has flipped all pages of the flyer. If a magazine has 120 pages, our analysis would concentrate on the 59 odd pages (front page excluded). The fourth column of table 2 shows the total number of fingerprints found on the odd pages of each issue. In the far-right column we display the probabilities according to the binomial distribution in the way proposed by Greene and Maloney. What do these probabilities exactly tell us? An example: Issue 12 contained 10 fingerprints on odd pages. In a binomial setting this becomes: Number of trials = 59, probability of success on each trial = .20, and observed number of successful trials: 10 [or fewer]. The corresponding probability is 0.35.

Given 59 trials and a .20 probability of success, the expected average number of successes is (at least) 12 with a standard deviation of 3. Accordingly, we would need to find at least 19 fingerprints on the odd pages, before our results met the theoretical criterion (.99) suggested by Greene and Maloney. Of course a single fingerprint is sufficient in any empirical setting, but if we find less than 19, we perform worse than expected by the conservative and abstract benchmark measure offered by Greene and Maloney. Only 3 of the 19 issues analyzed in table 2 would fully satisfy their criterion (perhaps as much as 6 or 7, if we relax the benchmark somewhat).

While the statistical reasoning by Greene and Maloney is formally correct, one may question the very rationale of their argument. When using the binomial model in the way they do, it is inferred that the pages to be analyzed are, firstly mutually independent and secondly that a person reads the

magazine by randomly selecting one page of the magazine, then randomly selects a second one etc. without replacement.

We think that both assumptions lack situational relevance. A flyer's pages correspond to *a multiple of advertising pages that are bundled.* Therefore, page *i-1* is not independent of *i* in the context of a fingerprint analysis. In addition, a typical reader proceeds in a chronological way, beginning with the front page, then moving to page 2, 3, etc. and finishing her/his reading with the rear page.[12] Therefore, according to our view, it is inappropriate to use the binomial distribution in the way it is done by Greene and Maloney. We do not find it very probable that a person can touch 120 pages of a given flyer without leaving any trace whatsoever.

5. Managerial Implications, and Suggestions for Future Research

We conclude that, given the present state of technology, the fingerprint-approach is a valid method for voluminous magazine-like flyers and catalogues having 50+ pages. We find it rather unlikely for the publication to have been read without any single trace left of a fingerprint on some of the pages. For flyers containing a few pages the picture is less clear, since our results indicate that a flyer of this size apparently could be flipped through without leaving a fingerprint.

According to a commercial study conducted for *Idényt* the flyer is read by 60.6 % of adult Danes (unpublished Gallup study, 2001). This is to be compared to our estimate of 76% (Table 1, column VIII). Presumed that our readership estimate (76%) is correct, the interview-based figure (60.6%)

[12] Of course there are other ways to read a print medium. Some readers start with the rear page and flip backwards, others start from the beginning, then run sour or become distracted by an external cause like a phone call; or their interest is caught by something appearing in the medium, implying that they skip reading it to the end. Still others read the medium repeatedly or in discrete flows. However, we argue that the prevailing way of reading a medium is from front page to rear page.

used by the publishing companies' management is downwards biased.[13] In many cases, there is a close correspondence between the size of the audience and the price that a publisher charges for advertising space. In the present case this implies that the management is undercharging its advertising space by 20-25%.

While the present study is founded on a limited database, we believe that our fingerprint approach can be used by the advertising management of a company for assessing the validity of its conventional audience-measurement technique. If both methods, used simultaneously, roughly agree concerning audience measure, the *convergent validity* will be good, and vice versa.

Could our research process have been organized in a less laborious way, without the risk of loosing proof of positive readership? Retrospectively, that is based on the findings presented in Table 2 - it appears that the scrutinizing process could have been simplified considerably by applying two principles.

First, skip analyzing the even-page numbers, only scrutinize the odd ones. Recall, that none of the 19 issues listed in Table 2 has fingerprints that *only* appears on the even pages. Thus, by concentrating our analysis on odd pages, we would not have misclassified any of the 19 issues as unread. In our empirical analysis we have been investigating 25 issues of a flyer (*Idényt)*, each one consisting of 120 pages, totaling 3000; since front and rear pages were excluded, we had to analyze 2950 pages. If we were told to look at the odd pages only, it would have been sufficient for us to scrutinize 1475 pages.

[13] According to Gallup's unpublished study, 28% of *Idényt* readers are older than 60 years, while 10% are younger than 30. While 72% of the +60's report readership, the corresponding figure for -30's is 39%. Since sweat is believed to correlate negatively with age, these data ought to bias the fingerprints-data - ! - downwards (not Gallup's data), because the flyer has many old readers. They do not sweat much and their 'dried leathered' fingers make it difficult for the expert identifying their fingerprints.

Second, presume that we define an issue as read - and stop further analyzing the issue for fingerprints *as soon as the first print is identified*. According to Table 2, issue 4 has its first fingerprint on page 007. When combining these two rules, we only need to analyze 3 pages (003, 005, and 007), since page 007 contains the first fingerprint. Consequently, the issue is categorized as read, and we start analyzing the next issue, etc. Concerning the 6 issues without any fingerprint we would still - fruitlessly - be analyzing all 59 odd pages (=354). However, with regard to the 19 issues appearing in table 2, 161 pages would be sufficient. Thus, the 25 issues could have been analyzed without loss of positive identification by scrutinizing 515 pages, or only 17.5% of the entire data material, corresponding to - on the average - 20.6 pages per issue.

According to the fingerprint expert, the scrutiny process, that is separating pages, dipping in liquid, drying in the oven and looking for fingerprints, and making notes on a paper regarding one 120-page issue consumes about 45 minutes for a - trained - person, provided that every page is analyzed. That is 22.5 seconds per page (with very little learning-effect involved, though). Assumed that it is sufficient to analyze an average of 20.6 pages per issue, it would take approximately 13 work-hours to analyze 100 issues, each having 120 pages. This does not include sampling and performing a rudimentary data analysis. When choosing an appropriate research design, the process of collecting (finding) the 100 issues in containers will probably take somewhere between 5 and 10 hours (a guess based on our experience). The statistical analysis is quite easy and should take a best a few hours, if refined, standardized and carried out by routine. While there is very little learning involved in data gathering and statistical analysis, the latter is only marginally affected by sample size.

We think that a layperson can be taught to manage the process of scrutiny during a 2-3 day course. The manual process involves working with chemical liquids and therefore, the task necessitates a room with good ventilation facilities. A laboratory room is thus recommended. Moreover, some chemical liquids and a specialized bath-tube must be present. By far the most expensive equipment of the setup is the oven for drying the paper. The one used in the present research costs $20.000. However, useable devices can be purchased for approximately half that price. But they will have less capacity. Our computations above are based on a devise with a capacity of 300 liters.[14]

Alternatively to building one's own setup, the analyst could get the work done by outsourcing it to a specialized industrial agency that already possesses most of the necessary facilities. Our estimates should suffice to give the advertising management a rough idea about the fixed and variable costs that are required for performing the analysis.

The pilot study was conducted primarily, because we wanted to know if the fingerprint-approach was worth performing on a larger sample, and secondarily because we wanted to investigate the relationship between paper quality (glossy-magazine versus newspaper type) and fingerprints. One of the authors (the fingerprint-expert) assumed that it would be more difficult to find fingerprints on paper of glossy quality due to a lesser tendency of blank pages to assimilate liquid. The pilot study provided some support to this hypothesis: On pages of newspaper quality we found fingerprints on 12% of pages but only on 5.6% of pages of glossy-magazine quality. This tendency was confirmed and even reinforced when analyzing the 117 issues (Table 1): newspaper quality paper contained fingerprints on 10% of pages (376/3792) as compared to only 2,3% (19/812) with regard to

[14] Technically, the oven or test chamber is called *humility oven*. The authors were using an oven produced by German based *Weiss Umwelt Technik*. The wetted paper has to dry for 8-10 minutes. When using 8½ * 11 inch paper the oven's capacity is 40-60 pages.

magazine quality paper – a ratio of four to one.

An advantage of the approach presented here is that it allows for estimating readership across "brands" of flyers. For instance, it is a widely held belief within the industry that flyers distributed by some retailers enjoy higher popularity than those distributed by others. But so far it has not been possible to provide valid estimates of readership concerning flyers *belonging to an individual retailer/producer*.[15] Due to methodological problems linked to the self-reported approach, data can only be gathered on a "generic" level. Danish households receive an average of 23 free flyers each week - whether they want them or not - and thus they are regarded low involvement media.[16] (The standard questionnaire by Gallup in Denmark uses generic categories like "flyers from Supermarkets", "- from Toy Stores", -"from TV/Radio Stores," etc.).

Presently, several forensic laboratories are reporting some progress using a new liquid called Indanedione (a variant of Ninhydrin). Though preliminary tests seem encouraging, findings on the liquid's relevance for analyzing fingerprints on paper so far are contradictory (references to forensic journals to appear in next draft). One recent source reports the liquid to perform better on paper than ordinary Ninhydrin: "Investigators used the chemical on a newspaper found in the hotel room reportedly occupied by the killers of the Israeli Tourism Minister . . . Conventional methods probably wouldn't have worked, say Israeli print experts, but the new chemical helped track down two accomplices of the crime." (*Time*, January 21 2002). Other experiments have shown that the liquid, though promising with regard to several paper-surfaces, is *not* especially suited for newspapers.

[15] Earlier, we noted that the management of the flyer-magazine *Idényt* (a brand) reported a readership figure of 60,6%. While this figure is based on Gallup-data, it has not been published and can only be used as an approximation. Moreover, the specifics of Gallup's method are not known.

[16] An unpublished poll by the GfK Denmark's representative panel (n = 1089) shows that 73% of Danes agree upon a statement running "We receive by far too many flyers nowadays" (conducted January 1999).

The research approach used in this paper - to the best of our knowledge - has not been seriously investigated by marketing scholars up to this point of time. Our approach in some regards resembles the analysis of consumer garbage (see Ritenbaugh and Harrison, 1984, Cote, McCulloch, and Reilley, 1985) and may be seen as a continuance of this research tradition.

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Table 1: Fingerprint analysis of a Sample of Flyers

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Producer/ Distributor	No. of issues	+ FPs	- FPs	Valid pages of issue	Tot. no. pages (I x IV)	Total no. with valid FPs	Fraction of pages with FPs (VI/V)	"Reader-ship" (II/I)	FPs 1. half	FPs 2. half	FPs odd pages	FPs even pages
Idényt	25	19	6	118	2950	324	0.11	76%	175	149	219	105
Super Brugsen	16	5	11	22	352	34	0.09	31%	16	18	25	9
Real	13	4	9	22	286	11	0.04	30%	7	4	9	2
Netto	44	5	39	14	616	12	0.02	11%	8	4	6	6
El-Køb	9	3	6	6	54	6	0.08	33%	3	3	6	0
Intersport	6	1	5	4	24	1	0.03	17%	1	0	1	0
Kold. Storcenter	4	1	3	22	88	7	0.07	25%	6	1	6	1
Totals	117	38	79	-	4370	395	.09	-	216	179	272	123

Note that the number of fingerprints found in the first half of the flyers (valid pages varying from 4 to 118) is significantly higher as compared to the second half ($p = .0012$). Note also that the number of fingerprints found on odd pages is significantly higher than those found on even pages ***
($p < .001$). Front and rear pages of all issues have been excluded from computations.

Super Brugsen, and *Kolding Storcenter* possess newspaper quality. *Intersport*, *El-køb* and *Netto* are produced on blanc paper, while *Idényt* and *Real* can best be described as hybrids regarding paper quality.

Table 2: A Fingerprint Analysis of 2280 pages (19 Issues of Danish Flyer magazine *Idényt*)

Issue No.	“1” indicates at least one fingerprint on the individual page, while “0” indicates no fingerprint on the specific page	No. FPs	Odd FPs	Prob.
01	000000000000000000000000000000000000000100000000000000000000000000000000000000000000000000000000000000000000000000000000	01	01	<.01
02	000000000010000010000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000	02	02	<.01
03	000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000010000000000000010000000110	04	01	<.01
04	000000100000000000000000001010000000000000000000010000000000000000000000000000000000000000000000000000000100000000000000000	05	04	.01
05	000000000000000000000010000000000000101000000100000000000000000000000000000000000000000000000000000000000000000000001100	06	05	.02
06	000000100000001010000000000000000010000100000100010110100000000000000000000000000000000000000000000000000000000000000000	10	07	.08
07	000000000000000001000000000100000000000001000001000000000000000000010000010000000000000100000010000000100000000000000000100	10	09	.23
08	000000100000001000000000000000000000000000000000000000001000100000000110000110000000000000000000001000001000000000000000000	10	06	.04
09	000000100011000000001001000000000000000000000000000000000000000001000110000000000000000000000000000000000000000011000100	11	06	.04
10	000000000000000000000000001000000000000000100000000000000110000000001010000000100000000010000000100000001100000000110000000	13	07	.08
11	000100000000000000000000000000100011011010000000000001010000000000000000000000000100000000000000000000001000000010100000000	13	10	.35
12	000000000000100000000010000000000000000000100010001010000000000000000010000000010100000011000000000000010000000000000001000	13	10	.35
13	000000000000100010000000001010000010001000000000001000000100000000001000100000000000111000000000100000100000000000000000	15	13	.72
14	001000000000000000000000000001000000001000100010000010000000100000000010000000000101000000100000100101000000001000001010	17	16	.93
15	000100000100000000011000000010001000101100000000000010011010000000101000010000000000000001000000001101100010000000000000	22	15	.88
16	001110101010001010001001000000101100111001000010001011000010001100000000000010010010001100000000000100100000010000000000	32	22	>.99
17	000000000000000000000001010010010100000000000000001100000000000011001100000000110000110000111100000101000111111111010010	32	16	.93
18	001000101000111110101000111011000010111000101000000000010100110100000000010001110100010000010101000000000010100001010010	40	31	>.99
19	001011111111111100111110011000001111111011111001001011101100000001001000101001101100111100001000110111011110111100001110	68	38	>.99
Σ	004141713152425250315232225043403263448053612051107183325321202125026121513114424200646200216322320264421241334244024550	**324**	219	
Page No.	000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000111111111111111111111 000000000111111111122222222223333333333444444444455555555556666666666777777777788888888889999999999000000000011111111112 123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890			

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Fingerprints as a Proxy for Readership of Sales Flyers: An Empirical Assessment

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