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The Behavioral Score Approach to Dependent Variables

Bobby J. Calder and Edward C. Malthouse
Department of Marketing
Northwestern University

Theoretical explanation is most often confined to the independent or predictor variables in most consumer research. Consumer behavior itself is either not measured or measured as a single manifest variable, usually of the form, How/will you buy/use product _____ in a period of time? Dependent variables should be considered from a more theoretical point of view. To this end we develop an approach to dependent variables using behavior scores that span the theoretical domain of a behavior. We apply this approach to develop a specific measure of newspaper readership using data from a national sample of 37,000 consumers.

The ultimate goal of many studies in consumer research is to relate explanatory variables to actual consumer behavior; that is, to the purchase and use of a product or service. Much attention in this work is given to the conceptualization and measurement of explanatory variables. In contrast, comparatively little attention is typically given to the dependent variable, consumer behavior itself. The conceptualization and measurement of behavior is taken as given by the research context on the basis of face validity. If one is interested in explaining consumer behavior with respect to *X*, then the dependent variable is simply whether or how much consumers purchase or use *X*.

Though the topic has been neglected, there are many issues that need attention related to using consumer behavior as a dependent variable. In our view the most critical issue is whether behavior should be conceptualized and measured as a simple manifest variable. We seek to show that the face validity approach, which we discuss later in its usual implementation as the "critical question approach," has severe limitations that can be addressed through what we call the "behavior score" approach to conceptualizing and measuring behavior as a dependent variable.

The context of our research is newspaper readership. Many variables have been proposed to explain variation among consumers in readership behavior. Indeed, this behavior has been of both theoretical (e.g., Burgoon, 1980; Loges & Ball-Rokeach, 1993) and practical concern (e.g., the Audit Bureau of Circulation [ABC] leads an ongoing, coordinated effort in this regard[1]). In all of this work, and consistent with the overall picture of consumer research sketched earlier, readership behavior is what we wish to predict and explain, the ultimate dependent variable. But, conceptually, what is it?

The answer to this question may seem obvious. Readership is simply reading the newspaper during some period of time. This obvious answer, however, begs the question of what reading the newspaper means. Consider two people. One read the newspaper the day before yesterday for 20 min, but did not read the paper yesterday. The other person read the newspaper yesterday and the day before for 10 min each day. Is one more of a newspaper reader than the other? Or is their readership the same?

The point of this example is that the conceptual meaning of readership is not so obvious. And how one answers the aforementioned questions is as crucial to explaining readership as the explanatory variables are themselves. Thus what is needed is a systematic way of conceptualizing behavior and then of measuring it. Before proposing a solution to this problem, we first examine previous approaches to readership in more detail.

THE CRITICAL QUESTION APPROACH

The most common approach has been to define readership in a certain way and then to formulate a single question that re-

Requests for reprints should be sent to Bobby J. Calder, Kellstadt Distinguished Professor of Marketing and Psychology, Northwestern University, Evanston 60201.

[1]See http://www.accessabc.com

flects this definition. We call this the "critical question" approach. Several different critical questions have been used to measure readership. *Frequency*, the number of days during the past week that one has read a newspaper, was used as the measure of readership in Burgoon and Burgoon (1980)and Burgoon, Burgoon, and Wilkinson (1981a, 1981b). *Time* spent reading the newspaper was used by Loges and Ball-Rokeach (1993) and Cobb (1986). Versions of *completion* (e.g., noticed headlines, read some, read most) was used by McCombs and Mauro (1977) and Weaver and Mauro (1978). Subscribing to a newspaper was used by Lain (1986). Read "at least once a week" was used by Schoenbach, Lauf, McLeod, and Scheufele (1999). "Read every day" is used by Straits (1991). Exposure and attention to newspaper hard news was used by McLeod, Scheufele, and Moy (1999). As of this writing the standard question approved by the ABC is "When was the last time before today that you read or looked into any part of a weekday copy of the _____ newspaper?" The answer format is: *Yesterday, Before yesterday, Not sure.* The ABC question and the associated definition are now widely accepted. Other versions of "read yesterday" were used by Sharon (1973) and Wang (1977).

Consider the critical question approach in general and the aforementioned readership question in particular. As long as one accepts the definition of behavior that underlies the critical question, there is nothing wrong with this approach. The problem is that the definition may be too limited. Any single definition at best leads to an overly narrow question. This can easily be seen by returning to the two people considered earlier. If the question is "read yesterday," the second person is a reader, but the first person is not, because that person did not read the paper yesterday, even though he or she did read it the day before. We could define readership differently (e.g., as something other than looking at the paper in some time period). We could define it as the average amount of time spent with the paper. If we ask a question based on time, the aforementioned two people are equivalent, because both read an average of 10 min a day. But are the two people really the same? One did read the paper twice as often as the other. We see that the measurement of readership is entirely dependent on our definition and that any single question is overly narrow and arbitrary. This issue of one question versus multiple questions reflects the classic concerns of increasing reliability and the limitations of any single question in spanning the entire conceptual domain of a behavior.

THE READER BEHAVIOR SCORE (RBS) APPROACH

In measuring readership we want to quantify a person's overall pattern of usage of the newspaper with a single score. We call this their RBS. This score can then be compared to the score of any other person, so that we are comparing their total pattern of usage. Another way of saying this is that we want to order people on a unidimensional scale of readership where each person's score reflects their total usage of the newspaper.

A person's RBS is manifested in a number of different aspects of their usage behavior. Accordingly we must use multiple questions to capture different aspects of usage and employ these to determine the underlying RBS. These questions should cover as many different aspects of readership as possible and the analysis will determine whether a particular question does or does not reflect RBS.

We use classical factor analysis model with a single factor. In this analysis readership itself is a latent variable, which cannot be measured directly. We can only draw inference about readership though its manifestations, which are assumed to be simple linear functions of readership and an additive measurement error term. The manifestations of readership that emerge from this research, and their variable names, are as follows.

Q1: Weekday Time. How much time do you spend on an average weekday (Monday–Friday) reading or looking into the _____ newspaper? Respondents are allowed to check one of the following six intervals: do not read newspaper, 1–15 min, 16–30 min, 31–45 min, 46–60 min, and 61 min or more.

Q2: Sunday Time. How much time, if any, do you spend reading or looking into any part of the _____ newspaper on an average weekend plus any time during the week? Respondents are allowed to check one of the following eight intervals: do not read newspaper, Less than 1/2 hr, 1/2 hr to less than 1 hr, 1 hr to less than 1 1/2 hr; 1 1/2 hr to less than 2 hr, 2 hr to less than 2 1/2 hr, 2 1/2 hr to less than 3 hr, and more than 3 hr.

Q3,4: Frequency. Since the first of the year, which days do you read or look into the _____ newspaper in an average 7-day week? (Check all that apply). Respondents are given eight check boxes, one for each day of the week and another for "Do not read newspaper" so that nonreaders have something to check too. Frequency is the fraction of possible days during a 7-day week that a person reads the newspaper. If a newspaper publishes 6 "weekday" papers, weekday frequency is the number of these issues divided by 6. Sunday frequency is either 0 (nonreader) or 1 (reader). Some newspapers publish a single weekend edition rather than separate Saturday and Sunday papers. For these newspapers weekday frequency is the number of days divided by 5.

Q5,6: Completion. How much of the _____ newspaper do you read or look into on an average weekday and an average weekend? (Please check one box for weekday and one box for weekend.) Respondents are given the following 5-point scale for both weekday and weekend: *none/almost none, 1/4, 1/2, 3/4,* and *almost all/all.*

Before describing the results of our analysis, it is necessary to make the following useful distinction. Sometimes it is of interest to measure a person's readership (RBS) for a particular newspaper. In other cases the person's readership of multiple newspapers may be of interest. We refer to the former as RBS and the latter as total reader behavior score (TRBS; their total readership across all newspapers read). RBS is of interest when studying readership from the standpoint of individual newspapers. We would, for example, employ RBS to compare the level of readership of different types of newspapers. TRBS is of interest in comparing different types of readers, as with the readership of younger versus older people.

Next we describe our research samples of people and newspapers, and then the results of our analysis of RBS and TRBS. Following this we describe findings that relate to the reliability and validity of these measures of readership.

THE SAMPLE

We use data from a multistage probability sample of the general U.S. population. The data were collected as part of the IMPACT study conducted by the Readership Institute at Northwestern University. The sample was designed to be both representative of the population and of newspapers. Technical details of the sampling procedures are given next.

The first step of the sampling process was to select a representative sample of daily newspapers in the United States. We compiled a sampling frame using lists of newspapers from the Newspaper Association of America, the ABC, and *Editor and Publisher*. We dropped newspapers with the following characteristics: (a) average daily circulation under 10,000, (b) non-English language, (c) specialty newspapers such as *Investor's Business Daily*, and (d) national newspapers (i.e., *New York Times*, *Wall Street Journal*, or *USA Today*). In total, the sampling frame consisted of 846 newspapers.

We stratified the sampling frame into six strata by applying κ means clustering to circulation data from ABC, household counts from the U.S. Postal Service, and demographic data from Claritas and the U.S. Census. In defining the strata we needed to identify the "market" for each newspaper. We defined home counties as those counties that make up 80% of total circulation. The strata were defined using the average daily circulation, number of households in the home counties, number of zip codes in the home counties, number of home counties, Claritas' measure of urbanicity averaged over the home counties, number of competitive daily newspapers in the DMA, and a measure of market penetration in the home counties. Characteristics of six strata are summarized in Table 1.

We drew simple random samples without replacement from each stratum so that we would have approximately the same number of newspapers from each stratum. In total, 101 out of 104 newspapers agreed to participate in the study, giving a response rate of 97%. The final list of participating newspapers included 18 from small town, 20 from small town/city+, 14 from small city local, 17 from city local, 15 from city regional, and 17 from big city.

The second step of the sampling procedure was to draw a random sample of consumers from each of the 101 newspaper markets. We drew names randomly from the zip codes accounting for 80% of circulation within each newspaper's home market. The sampling frame was a list of names compiled by a direct marketing list provider. We mailed 115,890 surveys between June 1, 2000 and July 15, 2000. The number of surveys mailed to each market was selected to produce approximately the same number of respondents. Surveys were allocated to zip codes within a market in proportion to the number of people living in the zip code. The individual in the household 18 years or older with the most recent birthday was asked to complete the survey. An incentive of $3 was attached to each survey, and responders were entered into drawings for 15 cash prizes. In total, 37,036 responded, giving a response rate of 37%. The distribution of the number of responses in each market was normal shaped with a mean of 337, standard deviation of 46, minimum of 271, and maximum of 472. Response rates in individual markets varied between 25% and 50% with a standard deviation of 6%.

The last step in the sampling procedure was to do a telephone survey of nonresponders. This was done to determine if nonresponders were systematically different from responders. Over the phone, we administered an abridged version of the mail survey to a random sample of 2,000

TABLE 1
Summary Statistics of Strata

Stratum	*N*	*Circulation**	*Households**	*Zips Codes**	*Counties**	*Urbanicity**[a]	*Penetration**[b]	*Competition**
Small town	278	15,464	36,529	11.9	1.3	2	1.3	6.2
Small town/city+	162	36,500	68,897	30.6	3.6	1.6	1.3	3.7
Small city local	184	29,763	131,281	21.8	1.3	2.9	0.8	12
City local	81	96,864	212,684	34.4	1.5	3	1.2	9.2
City regional	64	111,397	219,378	59.2	6.1	2	1.2	3.4
Big city	77	366,887	959,606	112.7	3.3	3.6	0.9	10.2

N = total number of newspapers in stratum; * = average number in home market.
[a]1 = rural; 2 = town; 3 = city; 4 = suburb; 5 = urban.
[b]larger values indicate higher penetration. An average of 1.3 is high; 0.9 is moderate.

nonresponders to the mail survey, approximately 20 from each market. We found that nonresponders were more likely to be nonreaders. The results of the phone survey were accordingly used to compute sampling weights to correct for this in the main survey. It turned out that 74% of nonresponders were "readers," meaning they look into a newspaper during a typical 7-day week, whereas 93% of responders were readers.

Respondents to the mail survey were also weighted based on age and sex to make the sample more representative. Weights were computed to reflect a random sample from the United States using data from phone surveys, Claritas, and the 1990 Census.

MEASURING RBS

Consistent with our focus on multiple manifestations of readership, we began our analysis by considering a number of potential manifestations. The goal was to analyze these to find the best set for determining RBS. Specifically, we hypothesized that there are three core manifestations of readership: *time*, *frequency*, and *completion*. Our rationale was as follows. As indicated earlier, there is ample precedent for using versions of time frequency and completion. We also consider another qualitative difference as potential manifestation to readership. This is the distinction between "weekday," which usually includes Saturday, and "Sunday" editions, which for some newspapers is a weekend edition. The Sunday edition of most papers is substantially larger and more costly than the weekday editions. Many markets have segments of people who read only the Sunday edition, and not the weekday editions, or visa versa. For these reasons we hypothesized that the Sunday edition should receive special consideration when measuring readership.

A simple way of including the distinction between weekday and Sunday in our analysis is to measure time, frequency, and completion for both weekday and Sunday editions (the factor analysis will determine if any of these variables should receive less weight in computing our measure of readership). Questions Q1-Q6 given earlier are a product of this reasoning.

We considered one other potential manifestation of readership, time with the Sunday advertisements. Most Sunday papers include a large amount of advertising and many readers spend a substantial amount of time reading these advertisements. Should this time be considered an indicator of newspaper readership? To determine this we included the following question:

Q7: Sunday Advertising Time. How much of the total time you spend with the _____ newspaper is spent looking at advertising inserts? Respondents are given the same check boxes as for Sunday Time.

It should be noted that we considered other potential manifestations but did not include them in this research.

Other researchers have considered subscriptions as an indicator of readership (Lain, 1986). We did not include subscriptions because we feel it a poor indicator of readership for several reasons. A household may subscribe to a newspaper, but not all adult members of the household may read it. People may read a newspaper without subscribing to it (e.g., vending machines, at work, passalong, etc.). Having a subscription is thus neither a necessary nor sufficient condition for readership. The part of readership that is captured by subscriptions is subsumed by our frequency measure.

We factor-analyzed the seven variables described earlier to determine which questions are manifestations of readership. We estimated a factor model using maximum likelihood. The results of the analysis are given in Table 2. The smaller factor loading on Sunday ad time leads us to question whether this variable should be included in the factor.

We explore this further by computing coefficient alpha, which measures the reliability of the RBS scale. The value of alpha for all seven variables is .91, indicating a highly reliable scale. When Sunday ad time is omitted, the six-item scale has a slightly improved alpha of .92. Based on these analyses we have decided to drop Sunday ad time from the RBS scale.

As our final estimate of readership, we use a simple average of the *transformed* individual items. We transformed each of the six scales to have a maximum value of 7 and a minimum value of 1, where the value 7 indicates maximum reading. For example, if the response to the completion questions is keyed with values 0 – 4, the transformed version of a response x is simply $1 + 6x / 4$; likewise for Sunday frequency, 1 indicates nonreader and 7 indicates reader. RBS is the simple average of these six indicators. For newspapers that do not publish a weekend or Sunday edition, RBS is the simple average of weekday time, frequency, and completeness.

The loadings from the factor analysis are all roughly equal, suggesting that a simple average will produce similar results to a score using the factor loadings. The correlation between RBS computed with a simple average and the factor

TABLE 2
Factor Loadings Estimated With Maximum Likelihood With and Without the Sunday Time Ads Variable

	RBS		
Variable	*With Ads*	*Without Ads*	*TRBS*
Weekday completion	0.88	0.9	—
Sunday completion	0.85	0.85	—
Weekday frequency	0.82	0.84	0.73
Weekday time	0.81	0.82	0.79
Sunday time	0.76	0.77	0.82
Sunday frequency	0.76	0.76	0.75
Sunday ad time	0.49	—	

Note. RBS = reader behavior score; TRBS = total reader behavior score.

analysis scores exceeded .998. Moreover, there are two other advantages to using the simple average of the variables with our transformation. First, it is conceptually simpler. Second, it does not depend on sampling idiosyncrasies. The most common alternative approach to normalizing units would be to use *Z* scores (i.e., transform variables to have mean 0 and variance 1); a simple average of *Z* scores would use this transformation, but so does factor analysis because it decomposes the correlation matrix. We do not use this approach here because the resulting scores would depend on idiosyncrasies of the sample. Computing *Z* scores involves dividing by the sample standard deviation, which depends on both sampling variation and market characteristics. Each of the six scales depends on market characteristics, but the dependence is most easily seen with the Sunday frequency variable, which is dichotomous. If p is the fraction who read the Sunday paper in a particular market, the standard deviation is $\sqrt{p(1-p)}$. Thus, Sunday frequency is implicitly given more weight in markets with very high Sunday Penetration than in those with lower penetration (e.g., 50%). One benefit of our transformation is that the value 1 indicates a complete nonreader, whereas any scale estimated through *Z* scores will not have a guaranteed minimum value. Another benefit is that our approach is more comparable across markets.

FINDINGS

Reliability

Both RBS and TRBS are highly reliable. As mentioned earlier, the value of coefficient alpha for RBS is .92. Coefficient alpha decreases when any single item is deleted from the scale. Coefficient alpha for TRBS is .82.

Examining Readership Using RBS and TRBS

The readership of U.S. newspapers, from the standpoint of individual newspapers (RBS) and allowing for readership of multiple newspapers (TRBS), is shown in Figure 1. The distributions of RBS and TRBS are computed using nonparametric density estimates. Additional summary statistics are provided in Table 3. Both distributions have bimodal shapes, with modes of nonreaders and heavy readers. The mode for TRBS of nonreaders is much smaller than the mode for RBS of nonreaders, indicating that many of those who do not read a specific newspaper do read some competitive daily newspaper. Both distributions have a substantial mass of "light" readers between the modes.

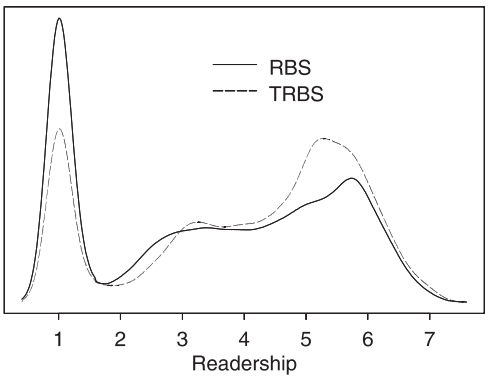

FIGURE 1 Nonparametric density estimates of the distributions of reader behavior score and total reader behavior score.

TABLE 3
Summary Statistics for RBS and TRBS

Statistic	*RBS*	*TRBS*
M	3.55	4.07
SD	1.93	1.78
First quartile	1.00	2.90
Median	3.73	4.55
Third quartile	5.32	5.48
90th percentile	6.93	6.01
95th percentile	6.30	6.30

Note. RBS = reader behavior scores; TRBS = total reader behavior scores.

Figure 2 shows the distributions of RBS and TRBS for the sampling strata. The distributions of TRBS (dotted lines) are amazingly similar across the six types of markets. Each has two modes with a sizeable group of light readers in between. The mode for heavy readers is slightly higher than the one for nonreaders. The centers of the heavy reader modes are all a bit less than 6. The dispersions of the heavy reader modes are greater than the dispersions of the nonreader modes.

The distributions of RBS (solid lines) are rather different. Of the variables that were used to define the strata, competition likely plays a leading role in explaining the differences between the RBS and TRBS distributions; the differences should be greatest for newspapers in highly competitive markets because consumers have more options. Small-city local newspa-

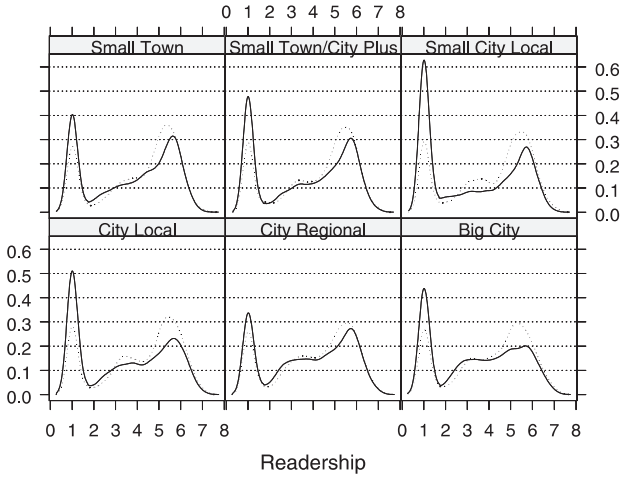

FIGURE 2 Nonparametric density estimates of the distributions of reader behavior score (solid line) and total reader behavior score (dotted line) for the sampling strata.

pers have the highest mode of nonreaders, which is intuitive given that these newspapers also have the most competition; likewise, city regional newspapers have the smallest mode of nonreaders and have the least competition (from Table 1).

Validity: Relation With Churn

Validity can be assessed by showing that a measure is related to other things that it should be related to. We can thus provide evidence for the validity of RBS and TRBS by showing that they are related to other variables in the survey as we would expect. We evaluate the criterion validity of RBS by correlating it with a measure of churn for a particular newspaper. One would expect "readership" of a particular paper to have a negative correlation with churn. If more people have a lower RBS they should find the newspaper less useful and be more likely to drop their subscriptions (churn). We measured churn with the following question:

> Regardless of whether you have the _____ newspaper delivered at home or work right now, how many times have you canceled the paper in the last 5 years? (response options include: Never canceled, 1–2 times, 3–4 times, 5–6 times, 7–8 times, 9 or more times, and Never had paper delivered)

Respondents who checked "Never had paper delivered" were omitted from this analysis. We found that churn as measured by this question was in fact linked to RBS, thereby providing evidence for the validity of RBS. The technical details of the analyses are given next.

We computed correlations using random coefficient models (e.g., Kreft & de Leeuw, 1998). For the purpose of this analysis, we standardized RBS and churn to have $M = 0$ and Variance = 1. Let (x_{ij}, y_{ij}) denote the standardized values of churn and RBS, respectively, for respondent i of newspaper j = 1, ..., 101. Both are standardized at the newspaper level (i.e., the mean and standard deviation of newspaper j was used rather than the overall mean and standard deviation). We assume

$$y_{ij} = x_{ij} b_j + e_{ij},$$

where e_{ij} are i.i.d. normal random variables with $M = 0$ and Variance = σ^2, and coefficient b_j is a random variable with $M = \beta$ and variance = σ_β^2. Recall that for simple linear regression, the slope of one standardized variable regressed on another equals the Pearson correlation between the two. Our estimates of b_j are a way of estimating the correlation between RBS and churn for newspaper j. Because we have a random sample of newspapers, β estimates the correlation between RBS and churn for all newspapers in the United States.

Figure 3 shows the distribution of correlations across newspapers. The average (β) is estimated as –.23 and σ_β^2 is estimated as .0081. Individual correlations range from –.36 to –.12. The P value testing H_0: $\beta = 0$ against a two-sided alternative is less than .0001. The strong and highly significant correlation supports the contention that RBS measures readership.

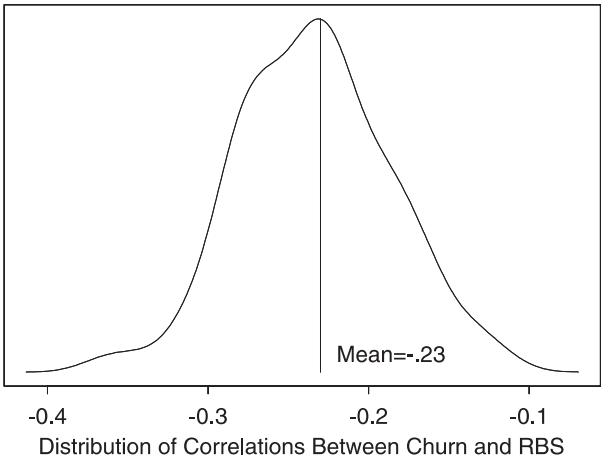

FIGURE 3 Nonparametric density estimates of the distribution of correlations between reader behavior score and churn.

When the dependent variable of a regression is measured with error, the mean squared error (MSE) can be larger and R^2 smaller than if the dependent variable were measured without error. The effects of an inflated MSE include (a) making it more difficult to reject the null hypotheses that all slopes equal 0 or that any particular slope equals 0 and (b) increasing the size of confidence intervals for a slope. The correlation between RBS and churn is .27, which is larger than the correlations of any of the six components of RBS with churn. The correlation between churn and Sunday time is .13, weekday time is .18, Sunday frequency is .15, weekday frequency is .26, Sunday completeness is .17, and weekday completeness is .20. It is plausible that the reason RBS has a higher correlation than any of its individual components is that RBS is a more reliable measure of readership in that it is measured with less error.

Validity: Comparing Readership Across Generations

Figure 4 shows conditional distributions of RBS and TRBS for three generations. We define Generations X and Y as those born after December 31, 1964 and baby boomers as those born between January 1, 1946 and December 31, 1964. For those born before 1946, there is a substantial mode around RBS = 6. For the baby boomers there is a smaller mode around RBS = 5.5 and substantially more light readers than for the pre-1946 generation (e.g., 2 < RBS < 5). Most Generation X and Y readers are light readers and few have RBS > 5.5. The modes of nonreaders are not as different across gen-

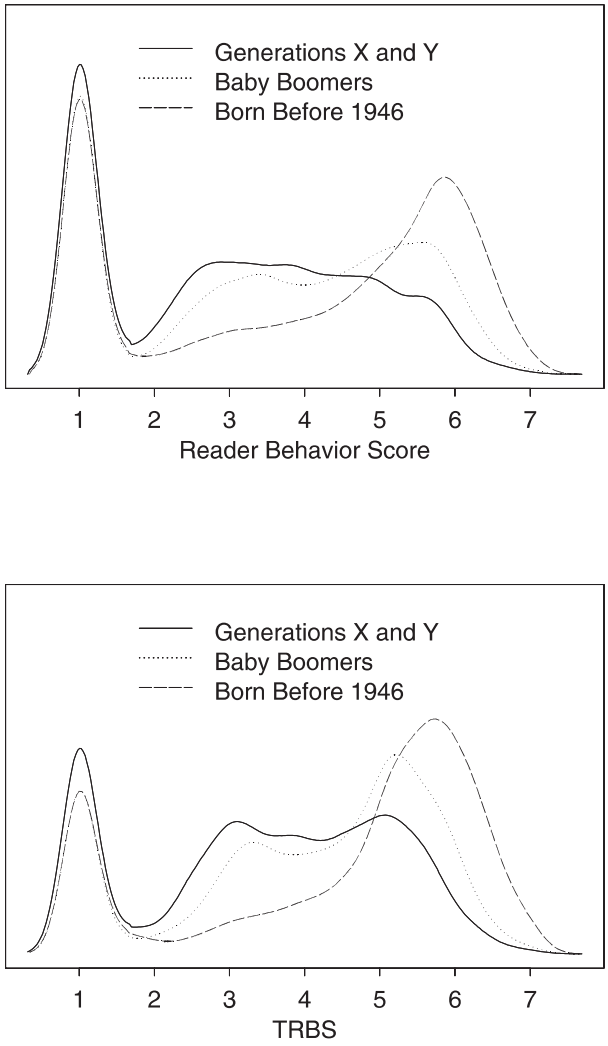

FIGURE 4 Nonparametric density estimates of the distributions of reader behavior score and total reader behavior score for three generations.

erations, suggesting that Generations *X* and *Y* are still reading newspapers, but not as much as earlier generations.

DISCUSSION

A consumer behavior can be a latent variable. Studying such a consumer behavior with a single "critical" question will not span the entire conceptual domain of the behavior. Often, the critical question approach will produce measurements with lower validity and reliability.

We illustrate this approach by proposing two measures of newspaper readership, readership of a specific newspaper (RBS) and total newspaper readership (TRBS). We have developed our measures using data from the IMPACT study consisting of 37,036 responses from consumers living in 101 newspaper markets. We find that our measures are highly reliable. We evaluated criterion validity by correlating readership with churn and examining differences across generations. Both analyses indicated that RBS and TRBS are both reliable and valid measures of readership. Because RBS and TRBS include multiple items, our measures would seem to span the entire domain of the readership behavior better than any single critical question. The components of RBS and TRBS have been used by other authors as critical-question measurements of readership, which further supports our claims of validity. RBS has a higher correlation with churn than any of the individual components of RBS, which is consistent with our claim that RBS is more reliable than any critical question. Future research could further compare the empirical performance against other measures.

Our research is more generally applicable to industry as well as academic studies. Many daily newspapers in the U.S. and Canada have added the RBS questions to their periodic readership tracking surveys and are measuring both RBS and "read yesterday." Although advertisers currently do not accept RBS as the standard measure of readership, RBS has many other potential applications in a newspaper organization. For example, RBS will be a more sensitive metric than the dichotomous read-yesterday question for tracking the effects of product changes or marketing interventions. RBS would also seem to be the better metric for advertisers. Fundamentally, advertisers care about the number of people who see their ads. Time, frequency, and completion would seem to be better indicators of the likelihood of someone seeing an ad than whether or not someone read yesterday or paid circulation.

In conclusion, we return to the implications of this work for consumer research in general. Just as RBS is superior to a single question approach, we contend that behavior scores should be used in consumer research where the dependent variable of interest is behavior. Behavior should be viewed as a theoretical construct. Behaviors can be expressed in alternative ways and no one measure can fully capture this.

Behavior dependent variables should be measured as theoretical constructs just as other variables are.

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