The Use of Bar Code Technology in Grading to Improve Student Anonymity and Reduce Identity-Based Bias

Haeran Jae and John F. Cowling

This paper studies the use and benefits of bar codes for providing greater student anonymity and enhancing grading fairness. Two studies are reported in this manuscript. Study 1 found that using bar codes to obscure the identity of students is more difficult than using other common methods for identifying students such as using names or numbers. Study 2 revealed that although most students supported greater anonymity in grading, many students opposed anonymity because they felt that it reduces the social process that also influences grade judgments, a process that they perceived to work in their favor.

Introduction

Increasingly, marketing employers are demanding that students graduating from college and applying for positions with marketing firms are able to demonstrate high levels of communication skills such as writing, speaking, and listening, because such skills are seen as more important for functioning adequately in the workplace than discipline-specific knowledge (Gaedeke, Tootelian, and Schaffer 1983; Kelley and Gaedeke 1990). A focus group comprising marketing professionals revealed that written communication skills are the most desired among various communication skills required for new hires in the marketing professions (Taylor 2003). Consequently, many business schools are encouraging instructors to include writing assessments in their curriculums to prepare students for the competitive job market (Gruenberg and Lasher 2006).

Instructors face a major difficulty when they include writing assignments. Unlike multiple-choice quizzes or objective exams, written assignments present the challenge of how to avoid subjectivity in grading. In addition, studies have found marketing students often fear that instructors are not always fair when they assign grades to assignments that contain the element of subjectivity (Houston and Bettencourt 1999; Schmidt et al. 2003). Recognizing the need to grade students objectively, educators often attempt to identify and, as far as possible, remove bias from the grading process. Instructors are able to fairly and objectively grade their students' work only to the extent that they can recognize and counteract their natural tendencies toward favoritism or partiality in assessing students. Such prejudices have been shown to be influenced, often subliminally, by such characteristics as *names* (Erwin and Calev 1984), *gender* (Haswell and Tedesco 1991), *beauty* (Landy and Sigall 1974), *race* and *ethnicity* (Piche et al. 1977, 1978; Wen 1979), *quantity of writing* (Arthur 1976), and even *handwriting* (Leaman 1985). Such biases occur not only in teaching but in everyday interchanges: we judge others in our schools, in the workplace, on the street. Predisposition is at work in all human endeavors, so as human beings we cannot be entirely free of bias. Thus instructors, influenced by prejudice and partiality, may inadvertently measure student progress unfairly.

Technology has provided education with many enhancements such as email, word processing, and online computer adaptive tests. Conspicuously absent from these technological augmentations is a system for helping instructors objectively grade student writing and project assignments. This paper presents the use and the benefits of the technology of bar coding as a method for assuring student anonymity and increasing the perception of fairness. Two studies are conducted to investigate how effectively the bar code might be used to assure anonymity and to determine whether students would perceive that the bar code enhances fairness.

HAERAN JAE (Ph.D., the University of Kentucky) completed her Ph.D. in marketing in 2006. She is currently Assistant Professor of Marketing at the Virginia Commonwealth University. She has published papers in *Journal of Consumer Affairs* and *Marketing Management Journal* and presented papers at professional meetings of the American Marketing Association, Asia Pacific Advances in Consumer Research, American Society of Business and Behavioral Sciences, and Atlantic Marketing Association. Her research interests include low literacy consumers and technology usage in the classroom. (email: hjae@vcu.edu)

JOHN F. COWLING (Ph.D., Indiana University) completed his Ph.D. in accounting in 1989. He is a Tyser Teaching Fellow in the Accounting and Information Assurance Department of the University of Maryland. He has published papers in *Accounting Horizons* and the *Journal of Accounting and Business Research* and presented papers at professional meetings of the American Accounting Association, American Academy of Accounting and Finance, Decision Sciences Institute, and American Society of Business and Behavioral Sciences. His research interests include financial accounting method choices, managerial accounting, and accounting education. (email:jcowling@rhsmith.umd.edu)

Marketing Education Review, Volume 18, Number 1 (Spring 2008).

Table 1
Bar Code Usage Procedure

1. Before the first class begins, the instructor uses the class roster to prepare a sheet of 20 peel-off bar code labels for each student.
2. The instructor distributes students their personal bar code sheet.
3. Students place their individual labels on their essays, exams, projects, and quizzes in lieu of their names or student identification numbers.
4. Instructor grades the papers, unaware of students' identity.
5. After all papers have been assigned grades, instructors use a scanner to determine the students' names, which the instructor adds to the papers.
6. Grades are recorded in the grade book.

Bar Code Use to Facilitate Student Anonymity

The bar code has been used in various business settings such as inventory tracking, shipping, accounting, receiving, payroll clocking, and accounts payable (Sadhwani and Tyson 1990). Bar coding is also used in many academic institutions to identify students and faculty and is considered the most recognized form of automatic identification (Markland, Vickery, and David 1995). Bar codes can provide a form of identification unique to the individual yet unreadable except by bar code scanners. In the grading process, bar codes can help instructors who wish to assure that students' identity is unknown and therefore does not influence the grade assigned to written projects.

An instructor who wishes to use bar codes in the classroom could use the following procedures shown in Table 1.

Thus an instructor is prevented from knowing the student's identity until grading is completed and marks have been assigned. Only then is the identity of the writer revealed. Other identity concealment methods, such as the use of letters and numbers, are much more easily recognized by the grader. Consider, for example, the following representations of a name:

GEORGE WASHINGTON
007-12-4792

As can be seen, a name can be easily memorable, especially if it is associated with a face, as is normally the case with students when an instructor follows the traditional class roll and student name procedure. Although Social Security numbers or student identification numbers provide a degree of anonymity, they may also be recognizable, especially after repeated use over a semester, but also because a particular string of numbers may be memorable, such as the "007" in the number above. By contrast, the bar code representation appears to be much harder to memorize or associate with a particular person.

The bar code grading method could be implemented with relatively large classes as well as small classes as long as instructors are concerned about subjective bias in grading students' written essays or projects. The cost of bar code software (Wasp Barcode Technologies Fontware, $73), scanner (Wasp Barcode Technologies, $132), and peel- off bar code labels (an average cost of $0.30 per student label page containing 20 labels) is affordable and usage of the bar code method is simple and easy. For multiple classes, instructors need only add the purchase of more peel-off bar code labels while using the same bar code scanner and bar code font software.

Fairness in Grading

In examining the usefulness of implementing a bar code grading system, several aspects should be considered. Instructional fairness can be divided into grade fairness, procedural fairness, and interactional fairness (Houston and Bettencourt 1999). Grade fairness is concerned with students receiving a grade that fairly represents their input into a course. Procedural fairness is focused on the procedures that an instructor uses to assess performance. Interactional fairness has to do with the quality of interpersonal interactions with students. "Bias suppression and neutrality" (Houston and Bettencourt 1999, p. 85), that is, the suppression of identity-based bias, is a prime component of procedural and interactional fairness.

This paper is concerned with procedural and interactional fairness as viewed from both the instructor and student viewpoints. It is implicitly assumed the achievement of greater procedural and interactional fairness

will lead to improved grade impartiality. Procedural fairness is essentially the capability of delivering neutrality in the grading process. This capability is examined from both instructor and student viewpoints. If a system does not have the capability to deliver a fairer grading process, then the student perceptions as to its fairness are somewhat irrelevant. Thus, the first research hypothesis (RH) is the following;

RH1: The use of bar codes suppresses identity-based bias.

The other side of the procedural fairness in using bar codes as identifiers lies in student perceptions. If students do not perceive that a bar code system improves fairness, then the instructor has failed to enhance students' confidence in the grading process. To address student feelings as to what method would provide greater anonymity and thus greater procedural fairness, the following hypothesis is posed to test student perceptions:

RH2: Bar code identity-recording method provides greater anonymity during the grading process as compared to SSN and written name identity-recording methods.

However, as we consider ways to increase anonymity and avoid bias, we must consider this question: Do students really want fairness? Do they want anonymity? To test whether students care about anonymity in grading, the issue of interactional fairness from the student perspective is raised and it leads to the following research hypothesis:

RH3: Students prefer greater anonymity during the grading process for assignments such as written papers and projects.

Method

Study 1

As a test of differences in the capability of people to learn or memorize the association between faces and their identifiers (RH1), an experiment was conducted in which the participants were tested over several weeks for retention and recognition. The design of the study was 3 (identification method: bar codes, names, social security numbers) X 5 (time period: five class periods) and both factors were within subject factors. The dependent variable is the correct number of faces matching with identification method (Groninger 2006) where participants must match each identification method to the corresponding face.

Procedure

The participants were students in an MBA class (n=15), and the test was conducted twice a week for a total of five class periods. Graduate students were chosen over undergraduates because their ages and life experiences make them more similar to instructors. Participants were asked to study a data sheet they were presented and to memorize its contents: the pictures, names, social security numbers (SSNs), and bar codes of eight "students" (pictures taken from a university year book at the library). In each subsequent class, the subjects were given (1) a sheet with pictures and blank spaces for each of the three identifiers (name, SSN, and bar code), (2) a sheet containing the names, SSNs, and bar codes, with each set individually scrambled. The participants were instructed to attempt to complete the blank picture page with the proper identifiers. To enhance motivation the results were tallied and reported back to the participants at the start of the next session. In addition, after each class a new copy of the original identifier data sheet was provided to the participants as an aid to memorization.

Bar Code Instrument

We used the bar code called Code 39, which consists of narrow and wide bars. Each character encoded in Code 39 consists of nine elements: five bars and four spaces (Lippman and Hafer 1997), thus making a string of characters such as a name unreadable by human visual inspection. Though there are many bar code symbologies, such as the Universal Product Code, Interleaved 2 of 5, Codabar, and Code 128, Code 39 was chosen because it is currently the most widely used industrial bar code (CodeFacts 1997).

A Code 39 bar code TrueType font for Windows applications was chosen. It contained four scalable Code 39 bar code font sets, with and without human readable representation (Skandata.tff BarCodes 1999). A basic starter kit containing bar code font set and wand scanner were used to implement the use of bar codes (BarCode Reading and Printing 1999). The only other item necessary was a set of peel-off labels for the instructor to use for printing bar codes.

Study 2

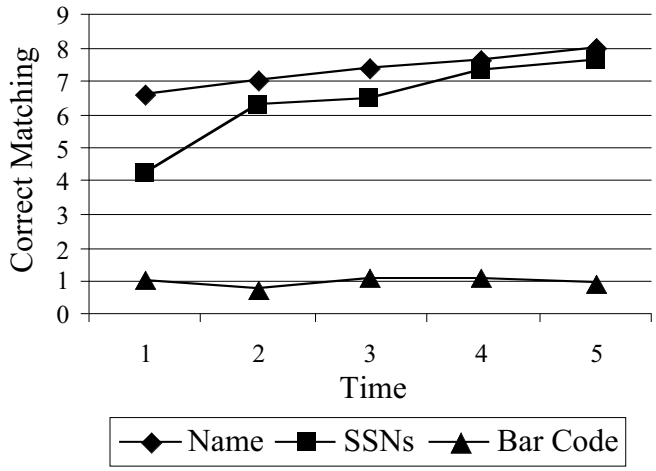
To examine how students view the issue of procedural and interactional fairness of anonymity in grading (RH2 and RH3), a class of marketing undergraduate students in a large eastern U.S. university (n=62) participated in a study observing the use of bar coding in assigning grades to five essays submitted throughout the semester. The actual bar code implementation was the same delineated in the bar-code-use section of the paper. After a semester, participants were surveyed as to their feelings about the procedural fairness of bar

Table 2
Test of Face Matching Task of 8 "Students'" Identifiers

	Time 1	*Time 2*	*Time 3*	*Time 4*	*Time 5*
Names	6.6*	7.0	7.4	7.6	8.0
	(1.7)**	(1.3)	(1.8)	(.81)	(.0)
Social Security Numbers	4.2	6.3	6.5	7.3	7.6
	(2.3)	(1.8)	(2.2)	(1.2)	(.8)
Bar Codes	1.00	0.7	1.1	1.00	0.9
	(.9)	(.7)	(.6)	(.6)	(.8)

*** Indicate the mean number of correct matching out of 8 identifiers.**
**** Standard Deviation.**

Figure 1
Face Matching Test of 8 "Students"



code use (RH2), and then separately surveyed as to their perception of the interactional fairness of bar code use (RH3).

Results

Study 1

RH1 predicts whether the instructor has the capability to suppress identity-based bias via the use of bar codes. The results of testing RH1, which tests the capability of delivering fairness found, using the MBA students as a proxy for instructors, that the ability to memorize and properly associate the identifiers with their corresponding "student" faces was clearly more accurate for some identifiers than others (Table 2). Given eight "student" persons, over a period of five classes the participants demonstrated rapid progress in remembering and correctly associating the names and numbers.

General Linear Model (GLM) for repeated measure was conducted for statistical analysis. There was a main effect of the use of three identification methods F (2, 15) = 5.04, $p < .001$. In the face-matching test, the bar code method showed significantly less recognition than other two methods. There was a main effect of the time F (4, 15) = 5.373, $p < .05$. As the time progressed, participants were better able to match the faces using all three identification methods. However, there was a significant interaction effect between the time period and the identification method, F (7, 15) = 5.957, $p < .001$. While participants' face-matching skills were significantly improved with the use of name and SSN (name: F (4, 15) = 2.59, $p < .05$, social security number: F (4, 15) = 8.01, $p < .001$), their face matching skills were not significantly

Table 3
Survey Question: Which Identifier Method Provides Greater Anonymity during the Grading Process?

Category	*Choice* (%)*
Names	4 (6.4)
Social Security Numbers	13 (20.9)
Bar Codes	45 (72.5)
Total	62 (100)

*χ^2 (2) = 44.9, $p < .01$

Table 4
Survey Question: Do You Prefer Increased Anonymity in the Grading Process for Written Papers and Projects?

Category	*Choice* (%)*
Yes	33 (53.2)
No	29 (46.8)
Total	62 (100)

*$p > .05$

enhanced over the time periods when the bar code was used: F (4, 15) = .65, $p > .05$. After several rounds, all participants could match the faces with the proper names. The nominal SSNs were also relatively easy to memorize and associate. However, the bar codes of the "student" names proved to be much harder. Figure 1 depicts the result from the study 1.

Thus, the use of bar codes in the grading process can be seen as a way to make the grading process fairer because it can provide greater anonymity to students by reducing the instructor's ability to inadvertently determine who wrote a paper or project.

Study 2

The second research question, RH2, involves student perceptions as to which method of recording a student's identity provides greater anonymity. The results in this case clearly supported that students perceived that bar codes provided greater anonymity in the grading process (Table 3). Chi-square test reveals a strong preference among the three methods: students perceived that the use of bar codes would provide greater anonymity (χ^2 (2) = 44.9, $p < .01$).

Interactional fairness from the student perspective was tested in RH3 by asking students whether they preferred a greater level of anonymity in grading. The results were somewhat mixed, with a majority of the students indicating that they preferred having greater anonymity in the grading process (Table 4). However, an almost equal number did not prefer to increase anonymity. Binominal test shows no statistically significant difference in their preference for anonymity in the grading process ($p > .05$).

While this result seems unlikely, one must consider students' views. We asked whether students preferred to increase anonymity. In several cases they answered "No": they did *not* prefer anonymity in the grading process. In fact, they indicated a desire to make the grader aware of their identity because they felt that a "good student" could and should benefit from being known. They viewed interactional fairness to be a social process as much as an academic process and felt that an anonymous grading system would eliminate the social aspect of the grading process—to their disadvantage. They thus viewed grades as a function of both academic and social skills, and viewed unfavorable the possibility of removing one of their "skill sets" from the equation.

Conclusion

Grading the work of others is a subjective exercise even under the best of circumstances. Instructors try to be fair, unbiased, and objective, but the basic element of our humanity prevents us from attaining a truly objective state. Any attempts to increase objectivity still carry the risk of graders' personal biases. The results from the two studies provided support for the positive benefit of bar codes in reducing identity-based bias in grad-

ing and providing increased assurance that the grader is proceeding in a fair and unbiased manner.

However, the results should be interpreted with caution. The current study only implemented the bar code grading method during one academic semester. Since it presents only limited evidence on the effectiveness of the bar code grading method, implementation over multiple semesters will be necessary to draw more conclusive results. Future research could investigate not only students' but also instructors' perceptions of the bar code grading method to examine whether there are any objections to the method due to lack of personalized feedback.

Marketing instructors are increasingly requiring writing assignments as a necessary part of marketing curriculums designed to prepare students to compete in the industry. Because instructors must make every effort to maintain their objectivity when they engage in such a subjective activity as grading written assignments, and knowing that humans are subject to subconscious bias, instructors may find that the use of bar codes enables them to judge students' work impartially. In addition, the use of bar codes may enhance students' perception that the grading process is conducted fairly.

References

Arthur, James (1976), "Teaching at a Distance," *ERIC No.150458*, 7, (November), 49-54.

BarCode Reading and Printing (1999), http://www.skandata/com/starter.html (accessed January 24, 1999).

Brown, Ashley and Lisa T. Fall (2005), "Using the Port of Entry Report as a Benchmark: Survey Results of On-the-Job Training among Public Relations Internship Site Managers," *Public Relations Review*, 31 (June), 301-304.

CodeFacts—Bar Code Symbologies (1997), http://www.dimension-x.com/cf-bcsym.htm (accessed October 12, 1997).

Erwin, Phillip G. and Avraham Calev (1984), "The Influence of Christian Name Stereotypes on the Marking of Children's Essays," *The British Journal of Educational Psychology*, 54 (June), 223-227.

Harari, Herbert and John W. McDavid (1973), "Name Stereotypes and Teachers' Expectations," *Journal of Educational Psychology*, 65 (October), 222-225.

Gaedeke, Ralph M., Dennis H. Tootelian, and Burton F. Schaffer (1983), "Employers Want Motivated Communicators for Entry-Level Marketing Position: Survey," *Marketing News*, 17 (August), 1.

Groninger, Lowell (2006), "Variables Influencing Memory Over Long Periods of Time for Recently Learned Face-Name Pairs," *American Journal of Psychology*, 119 (Summer), 175-191.

Gruenberg, Diane and Nancy Lasher (2006), " The School of Business and Writer's Place Partnership at The College of New Jersey, *Writing Center Journal*, http://projects.uwc.utexas.edu/praxis (accessed September 7, 2007).

Haswell, Richard H. and Janis E. Tedesco (1991), "Gender and the Evaluation of Writing," Paper Presented at the Annual Meeting of the National Council of Teachers of English, November.

Houston, Mark B. and Lance A. Bettencourt (1999), "But That's Not Fair! An Exploratory Study of Student Perceptions of Instructor Fairness," *Journal of Marketing Education*, 21 (August), 84-96.

Kelley Craig A, and Ralph M. Gaedeke (1990), "Student and Employers Evaluation of Hiring Criteria for Entry-Level Marketing Positions," *Journal of Marketing Education*, 12 (December), 64-71.

Landy, David and Harold Sigall (1974), "Beauty Is Talent: Task Evaluation as a Function of the Performer's Physical Attractiveness," *Journal of Personality and Social Psychology*, 29 (March), 299-304.

Leaman, Hayden L. (1985), "An Analysis of Students' Writing," in *Directions an Misdirections in English Evaluation*, ed. Evans, P.J.A., Canada: The Canadian council of Teachers of English, 82-85.

Lippman, Peter and Steve Hafer (1997), "Bar Codes: An Introduction," http://mgfx.com/info/cases/laundry/laun002.htm (accessed February 15, 1997).

Markland, Robert E., Shawnee K. Vickery, and Robert A. Davis (1995), *Operations Management: Concepts in Manufacturing and Services*, New York: West Publishing Company.

Piche, Gene. L., Mitchell Michlin, Donald Rubin, and Allen Sullivan (1977), "Effects of Dialect-Ethnicity, Social Class and Quality of Written Compositions on Teachers' Subjective Evaluations of Children," *Communication Monographs*, 44 (March), 60-72.

———— , Donald Rubin, Lona J. Turner and Mitchell L. Michlin (1978), "Teachers' Subjective Evaluations of Standard and Black Nonstandard English Compositions: A Study of Written Language and Attitudes," *Research in the Teaching of English*, 12 (November), 107- 118.

Sadhwani, Argon T. and Tyson Thompson (1990), *Financial Managers' Guide to Selecting and Implementing Bar Codes*, New Jersey: National Association of Accountants, 33-34.

Schmidt, Thomas. A., Mark B. Houston, Lance A. Bettencourt, and Paul D. Boughton (2003), "The Impact of Voice and Justification on Students' Perceptions of Professors' Fairness," *Journal of Marketing Education*, 25 (August), 177-186.

Skandata.ttf (1999), "BarCodes for Access, Excel, Word, etc," http://www.skandata.com/ttf.html (accessed January 24, 1999).

Taylor, Kimberly (2003), "Marketing Yourself in the Competitive Job Market: An Innovative Course Preparing Undergraduates for Marketing Careers," *Journal of Marketing Education*, 25 (August), 97-107.

Wen, Shin-Sung (1979), "Racial Halo on Evaluative Rating: General or Differential?" *Contemporary Educational Psychology*, 4 (January), 15-19.