Measuring Occupation: A Comparison of 1970 and 1980 Occupation Classification Systems of the Bureau of the Census

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> Very little has been said about coding and tabulating errors. (Benjamin, 1950)
>
> Relatively little attention has been focused on errors stemming from the coding process. (Crittenden and Hill, 1971)

Errors in the coding of open-ended material have rarely been studied. In part this is because closed-ended questions have come to dominate survey research (Smith, 1987; Converse and Schuman, 1984). In part it is because coding is often seen as a routine, clerical task. It is widely considered to be a "mere" data processing procedure by most analysts and technically uncomplicated (and thus uninteresting) by most methodologists. Models of total survey error (Andersen, Kasper, and Frankel, 1979) typically acknowledge coding errors as one error component, but rarely devote any attention to its actual assessment. Similarly, little concern has been directed towards reducing such error. In fact, among the small methodological literature on coding error, more attention has been addressed to the issue of developing a statistic to measure coding reliability (Scott, 1955; Cohen, 1960; Funkhouser and Parker, 1968; Krippendorff, 1970; Craig, 1981) than to either assessing coding error or reducing it (Benjamin, 1950; Crittenden, 1971; Crittenden and Hill, 1971; Montgomery and Crittenden, 1977; Woodward; 1948).

Within this area of neglect, occupational coding has fortunately received relatively more attention. Interest in occupational coding has come from two sources. First, social scientists have long considered social stratification of central importance to their disciplines and have judged occupation as a key stratification variable. Second, the Bureau of the Census has long considered occupation to be a core demographic. Both many social scientists and the Census have come to the conclusion that the preferred way to collect occupation (and industry) is to ask people to describe their jobs, mentioning what their job is called and detailing their main duties. These reports are then used to code the occupation into one of several hundred categories according to a categorizations developed by the Census. Once Census occupational codes are assigned many other variables can be matched to the codes (e.g. NORC prestige, Duncan SEI, DOT scores for people, data, things, etc.).

Coding open-ended accounts of jobs into hundreds of occupational categories is a complicated and costly task. The Census has pioneered in developing procedures to make this coding task more reliable. Since 1960 the Census has published and updated a series of alphabetical and classified guides to assist in the coding of occupation (U.S. Bureau of the Census, 1971a; 1971b; 1981; 1982). Alphabetical volumes allow coders to look up job titles and in conjunction with industry and class of employment (self/private/government) codes to identify the proper occupation code. Classified indexes list all job titles that fall within each occupation code and are a good source for

checking whether the case fits in with the range of jobs covered by the code. The Census has also carried out a quality assessment program to assess and improve coding reliability (Mack, 1983; Van Ummersen, 1987; 1988). In recent years the Census has also developed an automated occupational coding system that combines the manual, look-up volumes previously developed with a computerized, expert-system approach which they believe will improve coding reliability (Appel, 1987; Hale, 1988).

Social scientists have thankfully adopted the volumes developed by the Census and have shown interest in using the Census' automated system, but have rarely involved themselves with the issues of coding reliability and quality assessment. In fact the major input of social scientists to the study of occupational coding has come from attempts to simplify the current practice by switching to some form of interviewer or respondent coding (Bauman and Chase, 1974; Eckhardt and Wenger, 1975; Taylor, 1975; McTravis, 1974; Winch, Mueller, and Godiksen, 1969). Besides demonstrating the strengths and weaknesses of various alternative occupational coding procedures, this research has also shed light on the general problem of occupational coding.

Despite the notable efforts of the Census and others to improve the measurement of occupation, it remains difficult material to record and code. Errors rates remain high (Appel, 1987; Hale, 1988; Van Ummersen, 1987; 1988; Taylor, 1975; Eckhardt and Wegner, 1975; Winch, Mueller, and Godiksen, 1986) despite significant improvements in recent years in the coding error level associated with a) a fuller understanding of sources of error, b) improved quality assessment and feedback procedures, and c) use by the Census and others of computerized look-up programs and even more sophisticated expert systems.

1970 and 1980 Occupational Codes Compared

As part of the General Social Survey's (GSS) transition from the 1970 Census occupation (and industry) classification system to the notably modified 1980 system, the GSS in 1988 arranged for the coding of all occupational data (for respondent, father, and spouse) into both the 1970 system (used from 1972 to date on the GSS) and the new 1980 system. The 1970 and 1980 codings were done independently by separate coders. Coders received a half-day's training from an experienced occupational coder and that coder as well as the coding supervisor were consulted throughout the coding period as difficult cases and other questions arose. The 1970 coding was all done by a single coder and two coders did the 1980 coding.

Because we were cognizant of the difficulties of occupational coding, we were concerned that the 1970 and 1980 codes assigned might not be compatible. When dual-coding using the same coding scheme (e.g. either the 1970 or the 1980 occupational classification systems), a consistent or compatible code is the identical code (e.g. a plumber being coded as a 522 under the

1970 system both times). When using two different coding systems, a compatible code is one that correctly classifies an occupation under each system or, to think of it another way, as the codes that match or overlap between the two systems. For example, a plumber would be a 522 under the 1970 coding system and would probably be a 585 in the 1980 coding scheme, but might also be a 557, 587, or 633. No other 1980 codes would match a 1970 code of 522. Fortunately the Census had completed a large-scale, dual coding of occupations and developed detailed, comparison tables that matched 1970 and 1980 codes. These tables listed each 1970 code that fell within each 1980 code (and vice versa) and in addition showed the distribution of each of the matching codes (Census, 1987).

We compared all 1970 and 1980 occupational combinations on the GSS and flagged for inspection all combinations that did not appear in the Census tables.[1] These cases were then recoded by research assistants under the direction of the principal author. The research assistants coded both 1970 and 1980 codes, but did not check to see if their codes were consistent with permissible Census combinations. After this preliminary recoding, a second comparison to the Census tables was made and all still inconsistent combinations were brought to the attention of the principal author. He coded each according to 1970 and 1980 codes and then looked them up in the Census tables to see if the combinations were accepted by the Census. For the few cases still in conflict with the Census table, one of two final decisions was made, either 1) the coding was deemed correct and the combination was added to those recognized as acceptable by the Census[2] or 2)

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[1] This is not a full coder reliability check since we are not independently coding all cases. First, we are looking at only cases inconsistent with the Census tables. This omits from inspection any coding errors that occur yet which led to consistent combinations. Errors of this type are undoubtedly fairly rare however, since usually only a few 1970 codes matched a particular 1980 code and the vast majority of possible code combinations were not acceptable combinations. Second, as described below the recoding that we performed was ultimately designed to come up with correct codes and not coding reliability measures for the inconsistent cases.

[2] In the end only nine new combination were added to the Census matches. They were as follows:

1970 Code	1980 Code
12	49
31	234
76	208
180	479

a change was made in one or both of the codings and this change resulted in an acceptable combination of 1970 and 1980 codes.[3]

The final number of changes made in codes are shown in Table 1. Looking in column one we see that the 1970 codes are more stable than the 1980 codes, although the differences are not great. The figure for both 1970 and 1980 represents the % of cases that were not changed at all (i.e. neither the 1970 nor the 1980 codes were revised). The second column shows the number of cases that were unchanged when occupations were collapsed into approximately a dozen major occupational categories employed by the Census (See Table 4 for details). Naturally the changes are fewer for the collapsed data since many of the recodes had been within the major groups. More surprising is the finding that fewer changes were made in the raw data for spouse and father than for respondent. Given that self-reports of occupations should be the best informed and thus the most accurate and complete, we had thought that respondent reports would be more accurately coded and would have fewer changes (i.e. corrections) than the more remote reports on spouse and father. One possibility is that respondents do not actually provide more detailed information, but our impression is that this is not the case. A second possibility is that the greater detail complicates the situation and actually makes self-reports harder to consistently code. This does appear to occur in at least some cases.

Sources of Error: Collecting and Coding

To evaluate the reasons for errors in coding we both carried out a qualitative assessment of reasons for miscodes and

194	198
245	269
622	724
694	869
903	19

In most cases the above matches appear clearly correct and represent rare occupations that probably did not occur in the Census dual-coded data set. In one or perhaps two cases we cannot be absolutely sure that the codes are correctly assigned because the job title was not recognized by one of the classification systems and the coded assigned our best approximation.

[3] At this point up to six different codes could exist for a case, the original 1970 and 1980 codes, the 1970 and 1980 codes assigned by the research assistant, and the same assigned by the principal author. In few actual cases had this many different codes been assigned. Most often three or four different codes had been assigned.

conducted a quantitative analysis of factors associated with error. The first source of error was inadequacies in the open-ended material recorded by the interviewers. Collecting the proper raw information is a difficult task for interviewers and the GSS includes more interviewer instructions (Q-by Qs) on how to administer the occupation/industry questions than on any other question. Despite this training the recorded job descriptions are sometimes too vague to permit clear and consistent coding.

The second source of error arose out of complexities in the occupational situation. In these cases the descriptions were adequate but actual complexities in the person's occupational situation made coding uncertain. In some cases two or more different jobs are listed and it is often unclear which is the main job and which the secondary employment (or in cases of recall which job had been the person's main job during a career). In other cases the person has one employment, but his/her job encompasses two or more tasks that would be coded into separate occupational categories. Of course many occupations involve doing more than one "job." A person may answer the phone, do word processing, handle filing, and schedule appointments. While each of these represent potentially different job codes, we recognize this mixture of tasks as defining a secretary. However, other people do different tasks that do not represent any commonly recognized job. For example, we had a "maintenance coordinator" who 1) set up dryers to dry circuit boards and 2) ordered spare parts needed to repair machinery. In addition, there are jobs that are on the cusp between different occupations. In particular, it was often difficult to ascertain whether a person was in a supervisory capacity or not. In general foremen, supervisors, managers, and the like get different codes than the workers under them. In many cases however a person may both be in charge of a group of workers, but still performing the same production tasks. Sometimes terms like head, senior, and leader are used to describe such persons. It is often unclear how to code such situations.

Third, there are errors arising from coders misinterpretating the job titles/descriptions or misusing the coding guides. Incomplete look-ups are quite common. For many titles there will be multiple possible codes listed and the selection of the correct code will depend on the consultation of the class of worker and/or industry codes. Coders sometimes ignore or misinterpret these auxiliary codes. Also, coders sometimes appear to misunderstand the true nature of the job and select a code that includes the title mentioned in the person's job description (or what appears to be a close approximation), but which actually describes an entirely different task. Classic examples are the confusing of locomotive engineers and mechanical engineers, firemen and stationary firemen, and chemists and pharmacists.
In addition, coders sometimes fixate on one phrase or part of a job description and ignore the whole. For example, a secretary may be misclassified as a filing clerk, because that task is

mentioned first. Or a person such as an order clerk or a word processor may be mislabeled a computer operator because they report using a computer on their job. In other cases, the coder can not find the title listed and is unable to come up with a correct equivalent title that is listed. For example "key grip" does not appear and coders who fail to look under "grip" may be led astray. In other cases, coders sometimes seem to forget the distinction that the Census usually (but not always) makes between supervisors and "doers." Of course, as noted above, there are many borderline cases that are hard to assign.

Finally, in a small number of cases clerical and data entry errors such as the transposition of digits leads to miscodes.

Sources of Error: Correlated Factors

Besides critiquing the information and collecting process, we developed several hypotheses to explain errors. First, we thought errors might be associated with non-occupational aspects of the respondent. We considered that less educated respondents might give less complete occupational descriptions which might increase coding errors. Table 2 however shows no significant between coding errors and respondent's years of schooling, score on a vocabulary test, or interviewer's evaluation of comprehension. Next, we hypothesized that less cooperative respondents might give less complete and more difficult to code job descriptions. Again Table 2 shows no association between coding errors and either interviewer's evaluation of cooperation or willingness to give information on family income. We also considered that older respondents who might be recalling a job they held many years ago and who would definitely be remembering back many years to report on what their father's occupation was when they were growing up might give less complete reports. But Table 2 shows no such relationship. Finally, we thought that people giving Don't Know responses to attitude questions might be either less willing or less able to give complete occupational information. This hypothesis too is unsupported. In brief, non-occupational attributes of the respondent appear to have no impact on occupational coding error.

Second, we looked at occupational aspects of respondent, spouse, and father and how these might effect error in occupational coding. We thought that incomplete or vague information might lead to variable and incorrect coding. To check on this we divided all occupational categories into three types, 1) categories using "not elsewhere classified", 2) categories using "miscellaneous" or "not specified", and 3) all other categories. We hypothesized that occupations coded into the NEC and MISC/NS would include more vague and uncertain codes and that these would be more subject to corrections. Looking at initial codes we see that their level of stability (correctness) in each comparison (for respondent, spouse and father and for 1970 and 1980 classification) was lowest for the MISC/NS category. The revised codes were also lower except for respondent and spouse

using the 1980 system where the number of observations were less than 10. (In general the revised codes reduced the number of cases falling in MISC/NS codes.) The NEC category did not operate as expected however, since in each case for the 1970 codes and in three of the six comparisons for 1980 codes the stability of NEC codes were higher than the regular categories. We conclude that the quality of the material recorded that leads to the assignment of the MISC/NS categories do contribute to greater coding errors, but that this is not true for NEC categories.

Next, we looked at whether major occupational groups were associated with greater coding error. Table 4 shows the proportion of correctly coded cases for major occupational schemes by both what the cases were initially coded and how they were revised according to the reconciliation process described above. The table shows that within the 1970 classification system, correctness was low for Farm occupations and high for Sales occupations. Other differences were not consistent across person and/or initial vs. revised codes. This pattern tends to replicate for the 1980 classification scheme, although it is not quite as strong. In addition, Protective Services are more stable than most other major groups. This suggests that either the information recorded for certain major occupational groups is less adequate or the Census coding schemes more difficult to follow.

Impact of Corrections

Relatively few of the occupational changes involved major alterations in the prestige or social standing of the occupation. As Table 1 shows, many of the changes are within major occupation groups and most of the remaining changes were between similar categories (e.g. laborers and operatives, technicians and professionals). Nor does there appear to be much net shift in the prestige of occupations since about as many occupations seem to have moved up in status as moved down. In large part because most changes were across small social distances and off-setting in direction, no appreciable change occurs in the association of occupation with other stratification variables (education, respondent's income, family income, spouse's education, father's education, or relative income level of parental family) or attitudes related to social position (government help for poor and wealth redistribution). As Table 5 shows, revised 1970 codes are not better associated with such variables than the initial codes. For the 1980 codes the revised codes are only marginally better correlates than the initial codes. Even given the strong association between initial and revised codes, this general meager improvement is surprising, since error reduction usually strengthens associations. It in turn indicates that any impact on analysis from using the uncorrected, initial codes would be trivial.

Summary and Recommendations

Open-ended occupational information is difficult (and expensive) to both collect and code. Both the Census quality control studies, the social science literature, and this study indicate that a significant amount of error occurs in collecting occupation data. Fortunately this study as well as previous studies indicate that the impact on analysis is not great, in large part because the "distance" between the correct and incorrect codes are usually small (McTravis, 1964; Taylor, Bauman and Chase, 1974).

Despite this good fortune, it behooves us to try to improve the collection of occupational data. To do so changes should be made at both the interview and coding stage. To improve interviewer efforts we should 1) add a training exercise on recording occupational information to augment and reenforce the existing Q-by-Qs and 2) review occupational information during the editing stage to give remedial feedback to deficient interviewers.

To improve occupational coding we should 1) increase the amount of training, focusing not only on how to use the Census look-up guides but also on how to identify the key particulars in the title and description information, understanding the general organizing principles of the classifications systems (e.g. the difference in doers and supervisors), using the classification indexes to "validate" codes, and dealing with common problems (e.g. similar titles for dissimilar jobs, farm occupations, etc.), 2) create written rules for the handling of special problems such as two different occupations being mentioned and one occupation covering two (or more) distinct job codes, 3) use NORC's Computer-Assisted Coding to increase the accuracy and speed of coding and explore if the more sophisticated Census system is available for use, 4) double code a sample of 1970 and 1980 cases to calculate coder reliability and provide appropriate and timely quality assurance feedback, and 5) make more systematic use of a very experienced "supercoder" who would a) reconcile the disagreements arising from the coding reliability checks and b) automatically review any assignment that coders judged to be problematic or difficult. This supercoder might be allowed to consider auxiliary information from income, education, or other variables to help resolve difficult cases in which two different occupations are not distinguishable from the occupational information alone (Winch, Mueller, and Godiksen, 1969; McTravis, 1964).[4]

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[4] Another possibility is to program in as a inter-column cleaning specification a check that would accept only those combination of 1970 and 1980 codes recognized by the Census or added to their list, as we did above. Instead of proposing that we plan to use that as a post-coding quality check to assess whether the procedures

From these improvements it should be possible to notably improve the coding of occupation so a initial comparison of 1970 and 1980 codes as carried out in 1988 would show significantly fewer mismatches.

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recommended above do result in improvements.

Table 1

% of Initial Codes Unchanged After
1970/1980 Matching Review

	Raw Codes	Collapsed Codes
Respondent's Occupation		
1970	82.8 (1394)	91.1
1980	76.9	86.2
Both 1970&1980	69.5	
Spouse's Occupation		
1970	88.3 (736)	94.0
1980	78.2	86.3
Both 1970&1980	73.7	
Father's Occupation		
1970	87.8 (1259)	91.0
1980	77.4	88.3
Both 1970&1980	72.3	

Table 2

Non-Occupational Associates of Occupational Coding Errors

(Prob.)

	Associates						
Occupational Coding[1]	EDUC	WORDS	INT. COMP.	INT. COOP.	REF. INCOME	AGE	DKs
Respondent	.105	.906	.845	.675	.094	.509	.142
Father	.612	.756	.847	.281	.508	.283	.136
Spouse	.864	.756	.755	.488	.160	.069	.406

[1] Number of total corrections: 0=no correction, 1=1970 or 1980 corrected, 2=both 1970 and 1980 corrected.

Table 3

% No Changes by Type of Occupational Categories

	NEC	MISC/NS	Regular
Respondent			
Original 1970	75.6	54.3	68.1
Revised 1970	76.8	38.8	68.7
Original 1980	50.0	38.1	73.2
Revised 1980	62.7	(88.9)	70.2
Spouse			
Original 1970	85.9	48.0	71.1
Revised 1970	84.4	(63.2)	70.7
Original 1980	61.1	45.0	76.8
Revised 1980	75.9	(90.0)	73.2
Father			
Original 1970	76.2	54.5	71.9
Revised 1970	78.2	63.2	70.8
Original 1980	77.3	25.0	72.8
Revised 1980	79.6	(36.8)	71.8

NEC=Not Elsewhere Classified
MISC/NS=Miscellaneous/Not Specified
Percentages in parentheses are based on less than 20 cases

Table 4

% Unchanged by Major Occupational Groups

A. 1970

	Pro	Man	Sal	Clr	Skl	Opr	Lab	Farm	Ser	HH Ser
Respondent										
Initial	.619	.663	.905	.730	.686	.677	.532	.417	.777	.767
Revised	.627	.671	.809	.755	.698	.681	.521	.417	.755	.719
Spouse										
Initial	.711	.753	.939	.768	.679	.647	.760	.500	.810	.714
Revised	.738	.664	.885	.814	.686	.667	.792	.500	.821	.556
Father										
Initial	.769	.708	.929	.659	.737	.728	.700	.650	.769	---
Revised	.758	.728	.929	.659	.726	.720	.737	.642	.784	---

B. 1980

	Exc	Pro	Tec	Sal	Adm	HH Ser	Pro Ser	Oth Ser	Farm	Pre Prd
Respondent										
Initial	.671	.641	.526	.792	.742	.676	.815	.744	.433	.673
Revised	.667	.631	.612	.819	.739	.697	.815	.739	.433	.677
Spouse										
Initial	.702	.733	.423	.859	.798	.714	.800	.828	.600	.696
Revised	.725	.748	.611	.803	.805	.556	.842	.828	.563	.683
Father										
Initial	.835	.690	.643	.820	.600	---	.951	.724	.654	.745
Revised	.780	.777	.692	.802	.682	---	.929	.724	.647	.719

	Mac Opr	Trn Opr	Oth Opr
Respondent			
Initial	.753	.690	.563
Revised	.677	.664	.784

Spouse

Initial	.696	.714	.658
Revised	.636	.610	.857

Father

Initial	.612	.755	.616
Revised	.578	.787	.692

1970: Pro=Profession, Technical, and Kindred
Man=Managers and Administers
Sal=Sales
Clr=Clerical and Kindred
Skl=Craftsmen and Kindred
Opr=Operatives; Transportation Equipment Operatives
Lab=Laborers
Farm=Farm and Farm Managers; Farm Laborers and Farm Foremen
Ser=Service, Except Private Household
HH Ser=Private Household

1980: Exc=Executive, Administrative, and Managerial
Pro=Professional Specialty
Tec=Technicians and Related Support
Sal=Sales
Adm=Administrative Support, including Clerical
HH Ser=Private Household
Prot Ser=Protective Services
Oth Ser=Service except Protective and Household
Farm =Farming, Forestry, and Fishing
Pre Prd=Precision Production, Craft, and Repair
Mac Opr= Machine Operators, Assemblers, and Inspectors
Trn Opr=Transportation and Material Moving
Oth Opr=Handlers, Equipment Cleaners, Helpers, and Laborers

Table 5

Associates of Occupation (Collapsed by Major Groups)

Etas

	Educ	R's Inc.	Family Income	Help-Poor	Equal Wlth.	Sp. Educ.	Fa. Educ.	Fa. 'Inc.'
Respondent								
Int. 1970	.480	.325	.332	.132	.194	--	--	--
Rev. 1970	.479	.329	.325	.126	.186	--	--	--
Int. 1980	.446	.311	.332	.120	.171	--	--	--
Rev. 1980	.480	.356	.365	.130	.187	--	--	--
Spouse								
Int. 1970	--	--	.365	--	--	.480	--	--
Rev. 1970	--	--	.376	--	--	.481	--	--
Int. 1980	--	--	.388	--	--	.486	--	--
Rev. 1980	--	--	.389	--	--	.485	--	--
Father								
Int. 1970	--	--	--	--	--	--	.546	.357
Rev. 1970	--	--	--	--	--	--	.548	.358
Int. 1980	--	--	--	--	--	--	.510	.332
Rev. 1980	--	--	--	--	--	--	.527	.343

GSS Mnemonics: DEGREE, RINCOM86, INCOME86, HELPPOOR, EQWLTH, SPDEG, PADEG, INCOM16

All associations are statistically significant at the .05 level.

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