

**INFORMAL TRAINING:
A REVIEW OF EXISTING DATA AND
SOME NEW EVIDENCE**

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Mark A. Loewenstein
James R. Spletzer

Office of Research and Evaluation
Bureau of Labor Statistics
2 Massachusetts Ave NE, Room 4915
Washington D.C. 20212

Phone: 202-606-7391
Fax: 202-606-7421

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Abstract

Researchers' limited understanding of on-the-job human capital investments is partly explained by the fact that a great deal of on-the-job training is informal and difficult to measure. This paper reviews the informal training information in existing surveys, and then presents an extensive cross-sectional analysis of a new source of informal training data from the 1993 National Longitudinal Survey of Youth. Among other things, our findings indicate that the new informal training questions in the 1993 NLSY are picking up a sizable number of relatively short episodes of skill upgrading that the formal training questions miss. Our findings also suggest that formal and informal training are to some extent complementary, but formal training may have a higher return.

I. Introduction

As suggested some time ago by Becker (1962) and Mincer (1962), on-the-job training investments are likely responsible for a significant part of the wage growth that occurs in the early years of tenure. While economists have long been aware of the importance of on-the-job training, current knowledge about its quantity and its returns is still relatively scant. This is in large part due to the fact that much on-the-job training is informal.

In a paper comparing the training information in the early National Longitudinal Surveys, the January 1983 Current Population Survey Supplement, and the first wave Employment Opportunity Pilot Project survey, Lillard and Tan (1992) conclude that "only the more formal kinds of training tend to get reported but ... they appear to be reported consistently. In fact, our results using these measures are remarkably consistent despite the different types of information covered by the data sources, the different time intervals that they reflect, and the different groups of workers that they include." In contrast to formal training, whose incidence does not differ all that greatly across data sets, the incidence of informal training varies drastically across the few surveys that have tried to measure it.¹ Whereas 94 percent of newly hired workers in the second wave of the Employment Opportunity Pilot Project survey received informal training of some type (see Barron, Black, and Loewenstein (1987)), the incidence of informal training among 32

¹ The incidence of formal on-the-job training appears to be about 25 percent or slightly less. Using data from the Current Population Survey supplements, Pergamit and Shack-Marquez (1987) report that 14 percent of all workers have received formal company training on their current job, and Loewenstein and Spletzer (1993a) report that 17 percent of all workers have received formal company training on their current job. Altonji and Spletzer (1991) report that 28 percent of 32 year olds in the National Longitudinal Survey of the High School Class of 1972 have received formal employer provided on-the-job training while at their current job. Using data from the second wave of the Employment Opportunity Pilot Project survey, Barron, Black, and Loewenstein (1987) report that 13 percent of workers in their first three months of tenure receive on-site formal training. Using data they collected themselves with a questionnaire similar to that used in the Employment Opportunity Pilot Project, Barron, Berger, and Black (1993a) find that 25 percent of workers in their first four weeks of tenure receive on-site formal training. Finally, using data from the 1979-1983 surveys of the National Longitudinal Survey of Youth, Lynch (1992) reports that 4 percent of young non-college graduates receive on-the-job training that is four weeks or longer. However, using data from later years of the same survey that did not have a four week minimum for reported training, Veum (1993) reports that 24 percent of young adults receive company training between 1986 and 1991.

year olds in the National Longitudinal Survey of the High School Class of 1972 is 20 percent (as reported by Altonji and Spletzer (1991)), and the incidence of informal training in the Current Population Survey is 16 percent (as reported by both Loewenstein and Spletzer (1993a) and Pergamit and Shack-Marquez (1987)).

The National Longitudinal Survey of Youth (NLSY) survey included questions about informal training for the first time in 1993. Besides the usual questions about formal training in the current year, individuals were retrospectively asked about various types of formal and informal training when they started their job, and they were also asked about the various types of training they received during the current year because changes at work required that they learn new job skills. In this paper, we analyze the training data from the 1993 NLSY.

Before looking at the information in the 1993 NLSY, we first provide a general critique of the informal training information in existing surveys. In the process, we highlight the importance of differences in question wording (including employer based versus individual based questions and differences in routing patterns), sample differences, and censoring problems. We then turn to an extensive cross-sectional analysis of the 1993 NLSY data. We begin this analysis by examining the incidence and duration of informal training in the new NLSY survey. We next estimate incidence equations that enable us to determine the effects of gender, ability, and education on the likelihood of training. We then conclude the empirical analysis by estimating wage regressions.

Among other things, our findings indicate that the new informal training questions in the 1993 NLSY are picking up a sizable number of relatively short episodes of skill upgrading that the formal training questions miss. Our findings also suggest that formal and informal training are to some extent complementary, but formal training may have a higher return.

II. A Critical Review of What is Known about Informal Training

As mentioned in the introduction, much of our lack of knowledge regarding on-the-job training is attributable to the fact that much on-the-job training is informal. As Brown (1989) notes:

While there are difficulties in measuring formal training, what we would like to measure is relatively well-defined: an individual is either in a training program or not, formal training has an identifiable start and end, and one should *in principle* be able to determine either how many hours the worker spent or how many dollars the employer spent on any particular training program.

In contrast, informal training is produced jointly with the primary output of the worker, and is therefore more elusive. Workers learn from watching other workers, may share easier ways to do the work either while working or during breaks, and are indirectly instructed whenever a supervisor constructively criticizes their work. Knowing whether informal training is happening in any given week is difficult to determine; one hopes that for most workers it never ends.

Three surveys have to our knowledge attempted to obtain explicit information about whether workers have participated in informal training activities and, if they have, about how much time they have devoted to these activities. These surveys' training measures are summarized in Table 1. The Current Population Survey (CPS) is one source of information on informal training. In January 1983 and January 1991, the CPS obtained supplementary information about individuals' training. This information came from individuals' responses to two questions. First, individuals were asked, "Since you obtained your present job did you take any training to improve your skills?" Individuals who indicated that they had received training were then asked, "Did you take the training in school, a formal company training program, informal on the job, [and/or] other?" As reported by Pergamit and Shack-Marquez (1987) and Loewenstein and Spletzer (1993a), 16 percent of workers in the CPS receive informal training.

The National Longitudinal Survey of the High School Class of 72 (NLSHS72) is a second data set with information on informal training. In the 1986 follow-up survey, individuals who held a full-time job between October 1979 and February 1986 were asked the question, "Considering the most recent full-time job you have held, did you receive or participate in any

type of employer-provided training benefits or training programs?" Individuals who answered yes were then asked to indicate the number of hours per week and the total number of weeks that they spent in the following types of programs: "formal registered apprenticeship, employer-provided job training during hours on employer premises, informal on-the-job training (e.g., assigned to work with someone for instruction or guidance, etc.), employer-provided education or training during working hours away from employer premises, tuition aid and/or financial assistance for attending educational institutions after working hours, or other". As reported by Altonji and Spletzer (1991), 20 percent of workers indicate that they received informal training.

The third data set with information on informal training is an employer survey that was carried out in conjunction with the Employment Opportunity Pilot Project (EOPP).² The training questions are asked in the second of a two-wave longitudinal survey. Unlike the CPS supplement and the NLSHS72 survey, which did not attempt to obtain very detailed information about training activities in general and informal training in particular, the EOPP survey asked employers about several specific types of formal and informal training. After first requesting each employer to determine the last worker hired, the survey next asked questions about the training offered the typical worker in this individual's position. Specifically, employers were asked about the number of hours during the first three months of employment that a typical new employee in the position spends: a) "away from normal work activities filling out forms and being told about the company history, benefits, and rules" and b) "in training activities in which he or she is watching other people do the job rather than doing it himself." Later in the survey employers were asked about the total number of hours during the first three months of employment a) "spent on formal training such as self-paced learning programs or training done by specially trained personnel", b) "management and line supervisors spent away from other activities giving informal individualized training or extra supervision" and c) " co-workers who

² Barron, Berger, and Black's (1993a) recent survey for the Small Business Administration adopts basically the same methodology as EOPP and obtains similar estimates of training incidence and duration.

are not supervisors spent away from their normal work giving informal individualized training or extra supervision". As reported by Barron, Black, and Loewenstein (1987), the incidences of the various types of informal training activities are 61 percent for informal training by co-workers, 79 percent for watching others, and 87 percent for informal training by supervisors. Further calculation reveals that 94 percent of newly hired workers receive at least one of these three types of informal training.

Comparing the training information that is contained in the various surveys, we see that the incidence of informal training is notably higher in EOPP than in CPS and NLSHS72: while the incidence of informal training is .16 in the CPS supplement and .20 in the NLSHS72 survey, it is .94 in the EOPP survey. There are several important differences between the EOPP survey and the CPS and NLSHS72 surveys that may explain this result. First, and most obvious, while the CPS and NLSHS72 are surveys of individuals, EOPP is an employer survey, and an employer and a worker may have different notions about what constitutes training. For example, there may be some ambiguity as to whether the time that a supervisor spends with a new worker constitutes training or merely supervision and monitoring. Interestingly, however, Barron, Berger, and Black (1993b) have recently conducted a new survey that asks EOPP type questions of both new workers and their employers. While the workers' responses are only imperfectly correlated with those of their employers, employers' training estimates are not appreciably higher than those of their workers.

Second, the samples for the surveys are different. While the CPS sample is a representative cross section of the employed, the NLSHS72 sample consists only of 32 year olds who graduated High School and the EOPP questions pertain to those workers whom employers most recently hired. A sample of workers whom employers most recently hired will not be representative of all workers since it will tend to have a disproportionate number of younger and higher turnover workers. In addition, the EOPP survey deliberately oversampled employers with a relatively high proportion of low wage workers. Interestingly, this last consideration would lead one to expect a lower training incidence in the EOPP data, as there is strong evidence across data sets

that workers in higher training positions receive higher wages. One would also expect higher turnover workers to be hired for jobs that require less training.

The relationship between tenure and *reported* training is unclear a priori. If most training takes place early in the employment relationship, recall bias will be less serious for the shorter tenured workers EOPP inquires about, so that the lower informal training incidence in NLSHS72 and especially CPS could be due to the fact that workers with longer tenure have forgotten that they received informal training when they started their current job. Of course, unlike NLSHS72 and CPS, EOPP will not pick up belated training that occurs after the first three months of employment. Our analysis of the CPS data indicates that reported training is positively related to tenure, which suggests that the second effect is likely to dominate.

The third and perhaps most important difference between the surveys lies in the instruments used to measure training. In the CPS and the NLSHS72, individuals were first asked if they had received training. Only if they answered yes to this question were they asked whether they participated in informal training. Individuals who might not have thought that informal training was supposed to be counted as "training" would not have responded yes to the initial incidence question. In contrast, the EOPP survey does not employ an initial incidence question, but allows zero as an acceptable response to the question "... what was the total number of hours ...". Furthermore, while the CPS and NLSHS72 ask about "informal training," the CPS does not give the respondent any indication as to what is meant by informal training and NLSHS72 only lists one example. In contrast, the EOPP survey explicitly asks about different types of informal training (e.g., time the new hire spends watching others).

Given the differences in survey construction, one might expect that the EOPP survey would be likely to pick up short (and perhaps relatively insignificant) training spells that are missed by the CPS and NLSHS72 surveys. Indeed, conditional on receiving informal training, the average length of an informal training spell is 233 hours in NLSHS72 while the mean number of total hours devoted to informal training (the sum of watching others, informal training by supervisors, and informal training by co-workers) is only 129 in EOPP, and this number may well be an

overstatement because of possible double counting across the individual training components. However, this comparison is somewhat misleading because EOPP only asks about training during the first three months of employment. Training spells that last longer than three months will therefore be censored. In fact, about one-third of all spells in EOPP are censored. When one performs the experiment of censoring spells in NLSHS72 at three months, the mean number of hours of informal training falls to 116, which is roughly comparable to that in EOPP. Even more amazingly, the entire hours distributions appear to be nearly identical.

In summary, there are some important things that we have learned about on-the-job training from the existing surveys. For example, there is evidence that formal and informal on-the-job training are both associated with higher wages and higher wage growth, that workers with higher ability and education tend to be sorted into jobs offering more training, that women tend to fill jobs that offer shorter training spells, and that larger firms tend to offer more training. However, as the above discussion makes clear, our knowledge about informal training is still very limited. Comparisons across surveys are hampered by differences in the wording of training questions, different sample compositions, and censoring problems. The estimates of informal training incidence and duration vary significantly across surveys (for example, informal training incidence may lie anywhere between .16 and .94), so that it is hard to tell how important training actually is.

III. The 1993 NLSY Training Questions

In an attempt to improve our knowledge about informal on-the-job training, the National Longitudinal Survey of Youth (NLSY) began asking detailed questions about informal on-the-job training in the 1993 survey. The NLSY is a survey of individuals who were aged 14 to 22 in 1979. These youths have been interviewed annually since 1979, and the response rate has been 90 percent or higher in each year.³ The survey's wealth of information regarding individual demographic characteristics, employment history, schooling, and ability offers a great advantage for the study of the acquisition of and the returns to training.

While the NLSY has been obtaining information on formal training for some time -- see Lynch (1992) for a detailed description and analysis of the 1979-1983 surveys, and see Loewenstein and Spletzer (1993b) and Veum (1993, 1994) for a detailed description and analysis of the 1988-1991 surveys -- the questions regarding the harder to measure informal training appeared for the first time in 1993. The informal training information is collected in two different parts of the survey. The first section is intended to measure training at the start of the job. The second section is intended to measure training that occurred in the previous 12 months, and is asked immediately following the sequence of formal training questions. Besides asking about spells of training that are clearly informal, the new training questions also ask about spells of more formal training that might be missed by the sequence of formal training questions.

The survey leads into the training questions at the start of the job by first asking, "Earlier we talked about your main activities or duties for [employer name]. Thinking of the main activities or duties you do now, what month and year did you start doing this kind of work for [employer name]?" The survey then asks, "When you started doing this kind of work for [employer name], about what percentage of the duties you currently do were you able to perform adequately?" If an individual responds that he was not able to perform all of his duties adequately, then he is

³ The NLSY had an original sample size of 12686. This was reduced to 11607 in 1985 when interviewing of the full military sample ceased. In 1991, the sample was further reduced to 9964 persons when the economically disadvantaged white supplemental sample was eliminated. Starting in 1994, individuals will be interviewed every other year.

asked a lengthy sequence of training questions concerning how he learned to perform his job duties. In the rest of this paper, we will refer to this training as "Start Job Training." If the individual responds that he was able to perform 100 percent of his duties adequately when he started his current work, he is not asked the sequence of "Start Job Training" questions.

The remaining questions in the "Start Job Training" sequence have to do with the ways that individuals learned to perform their job duties, and are presented in the left-hand column of table 2. Participation in classes or seminars is the first training activity an individual is asked about (question 63 in table 2). An individual who answers that he participated in classes in order to learn how to do his job adequately is asked about the number of weeks and the number of hours per week that he attended classes (questions 65 in table 2). Next the individual is asked, "Who explained or showed you how your job tasks should be done? Was it your supervisor, your co-worker(s) or both?" He is then asked, "Did you make use of any self-study material or self-instruction packages, such as manuals, workbooks, or computer-assisted teaching programs?" Finally, the individual is asked, "Can you think of anything else that you did that helped you learn to do the kind of work you are doing for [employer name]?"⁴

The NLSY training questions have some features in common with the questions in the CPS and NLSHS72 surveys and some features in common with the EOPP questions. Similar to the NLSHS72, individuals in the NLSY are asked the number of hours and weeks they spent being trained only if they responded that they had received a specific type of training. The EOPP survey, on the other hand, encompasses both duration and incidence (zero hours of duration) in a single question by asking about the total hours spent in a particular type of training. One's initial suspicion is that the use of the incidence screener question in the NLSY will cause the survey to

⁴ As is true for an individual who indicated that he participated in classes or seminars, an individual who answers that his supervisor (co-workers) showed him how to do his job is asked the number of weeks and the number of hours per week that he spent with his supervisor (co-workers) learning how to do the job. Similarly, individuals are asked about the amount of time that they spent using self-teaching packages. However, they are not asked about the amount of time that they spent receiving "other" training.

miss short spells of training.⁵ Similar to EOPP, the NLSY asks explicitly about various sources of training: classes and seminars, instruction provided by supervisors and/or co-workers, and self-study. In contrast, the CPS/NLSHS72 only asks about an individual's "informal" training, leaving the definition of informal up to the respondent.

Individuals in the NLSY are asked not only about the training they received when they first started their current work, but later in the survey they are asked about any training they might have received in the previous 12 months that was not already recorded in the preceding sequence of formal training questions.⁶ After the respondent answers the formal training questions, the interviewer asks him whether he had to learn new job skills in the past 12 months because of any of the following changes at work:

- (His) employer introduced a new product or service
- (His) employer introduced new equipment and/or repair procedures
- (His) employer needed to upgrade employees' basic skills such as math, reading, or writing
- (His) employer needed employees to acquire or upgrade their computer skills
- Work teams were created or changed
- (His) work site was reorganized in other ways
- Changes have occurred in (his) employer's policies such as compensation, benefits, pensions, and safety
- New government regulations went into effect
- Changes have occurred in the work rules for reasons other than new government regulations.

⁵ One can also interpret the question about the percentage of duties that the individual was able to perform adequately as an incidence screener question: those individuals who were able to perform all their duties adequately are implicitly assumed not to receive training, and are thus not asked the duration questions. We will return to this issue more fully in the next section.

⁶ The questions about formal training, which were also asked in preceding years, are as follows. First, individuals are asked, "... since [the date of the last interview], did you attend any training program or any other on-the-job training designed to help people find a job, improve job skills, or learn a new job?" If the respondent answers yes to this question, he is asked, "Which category best describes where you received this training: business school, apprenticeship program, a vocational or technical institute, a correspondence course, formal company training run by your employer or military training, seminars or training programs at work run by someone other than employer, seminars or training programs outside of work, vocational rehabilitation center, or other?" The worker is then asked a series of questions, including "Altogether, for how many weeks did you attend this training [conditional on having completed training]?" and "How many hours per week did you usually spend in this training?" These training questions have been asked annually since 1988, and the resultant training measures have been analyzed by Loewenstein and Spletzer (1993b) and Veum (1993, 1994).

The worker is then asked, "Have there been any (other) changes in the past year than have made it necessary for you to learn new job skills?" If the respondent answers that there has been a change that made it necessary to learn new job skills, then he is asked whether he learned these skills by participating in classes, whether his supervisor or co-workers showed him how the changes at work would affect his job, whether he made use of self-study materials, whether he learned the new skills on his own, or whether anything else helped him learn how the changes would affect his job. The individual who responds that he received training is then asked how many weeks and how many hours per week he participated in the training activity. In the rest of this paper, we will frequently find it convenient to refer to this training as "New Skills Training." The questions about "New Skills Training" are listed on the right hand side of table 2. Note that they parallel the questions about "Start Job Training" except for the fact that own learning is added as a possible source of "New Skills Training."

We will sometimes use the label "informal training" to distinguish the two new sequences of training questions from the sequence of formal training questions. Note, however, that the categories "Start Job Training" and "New Skills Training" are both quite broad and that the individual training components are of varying degrees of informality. While training where supervisors or co-workers show an individual how to do his job corresponds quite closely to what is typically meant by "informal training," classes and seminars and possibly self-study might perhaps be thought of as "formal training." We will pay special attention to this in the empirical work to follow.

IV. Empirical Analysis of the 1993 NLSY Training Questions

In table 3, we present descriptive statistics concerning the incidence and duration of both informal and formal training in the 1993 NLSY. Our sample selection is quite straightforward. Of the 9008 individuals who answered the 1993 NLSY interview, we restricted the sample to the 7568 persons who were currently employed and answered the training questions. "Start Job Training" refers to the training received by the 36.13% of the individuals who indicated that they were not able to adequately perform all of their job duties when they started doing the work that they are currently doing. In many cases, this is a retrospective measure since only 24.8% of working individuals in the 1993 survey indicated that they have been in their job less than one year. "New Skills Training" refers to the training that was received in the previous twelve months for the 39.27% of the sample for whom changes occurred at work that required learning new skills. Recall that this measure involves training that was not measured in the regular section of the questionnaire designed to measure formal training. Finally, "Formal Training" refers to formal training spells that are measured by the formal training section of the 1993 questionnaire.

Of those persons who were not able to perform all of their duties adequately when they started their job, 26.54 percent indicated that they participated in classes or seminars, 66 percent responded that they were shown how to do their job by their supervisor, 65.92 percent stated that they were shown how to do their job by their co-workers, 48.08 percent answered that they spent time with self-study materials, and 23.66 percent said that they participated in some other type of training. The fact that the sum of the incidences for each type of training exceed 100 percent indicates that quite a sizable fraction of workers participated in more than one type of training at the start of the job.⁷

⁷ Although not reported in the table, we have also calculated the probability of receiving any given type of start job training conditional on receiving some other type of start job training. In most cases, the conditional and unconditional probabilities are nearly identical. For example, while 65.92 percent of individuals who were not initially able to perform all of their job duties adequately received training from a co-worker, 65.71 percent of individuals who receive training from a supervisor also receive training from a co-worker. We can conclude that having one type

We have obtained a "composite total" by aggregating across the individual training components (classes and seminars, supervisor training, training by co-workers, self-study, and other training). As seen in the top panel of table 3, 98.03 percent of those persons who were not able to perform all of their duties adequately when they started their job received this training. This appears to be closer to the informal training incidence in the EOPP data than the incidence in the CPS or NLSHS72 data (see table 1).⁸ However, because the NLSY training questions are asked of only a subset of workers, we do not really know the incidence of informal training for all workers. The implicit assumption in the routing pattern of the NLSY questionnaire appears to be that workers who were able to perform all of their duties adequately when they started their job received no informal training. Under this assumption that the 63.87 percent of workers who were able to perform all of their duties adequately when they started their job received no training, one would conclude that 35.43 percent of workers receive informal training at the start of their job (see table 3), which appears to be nearer to that in the CPS and NLSHS72 data. The top panel of Table 3 disaggregates this 35.43 percent statistic into its component parts.

Unfortunately, the new NLSY training questions do not resolve the existing confusion in the literature regarding the incidence of informal training. Our initial suspicion was that the individuals who reported that they were able to perform all of their duties adequately when they started their job were likely to have informal training spells of short, but positive, duration, while those individuals who indicated that they were not able to perform all of their duties adequately (the 36.13 percent of the sample for whom we do have training information) were likely to have spells of longer duration. However, analysis of the data indicates that the hours distributions of

of start job training does not significantly affect the probability of having another type of training.

⁸ While the reader might object to our grouping more formal start job training in the form of classes and seminars and self-study with less formal training from supervisors, co-workers and other sources, we should point out that our composite measure is essentially driven by these last three types of training. If we were to only include training supervisor training, co-worker training, and other training in our composite measure of start job informal training, we would still find that 93.78 of those persons who were not able to perform all of their duties adequately when they started their job received informal training at the start of their job.

informal training are similar in NLSY, NLSHS72 and EOPP once one controls for the fact that the training spells in the EOPP data are censored at three months. (For example, if one censors the NLSY start job training spells at three months, the mean length of an initial informal training spell is 125 hours; as noted earlier, an informal training spell has a mean length of 129 hours in EOPP and 116 hours in NLSHS72).⁹

Conditional on a worker having received training at the start of his or her job, the top panel of table 3 reports the quantities of training received. For the composite measure of start job training, the mean training received was 19.21 hours per week and 16.84 weeks, resulting in a mean of 293.70 total hours.¹⁰ The standard deviation for total hours is 632.65, which suggests that the distribution of total hours has a long right hand tail.¹¹ We will return to this point a little later. Disaggregating the composite measure start job training reveals that the mean number of hours per week ranges from 12.32 for self-study to 21.83 for being shown how to do your job by co-workers. The mean number of weeks ranges from 6.82 weeks for classes and seminars to 9.11 weeks for being shown how to do your job by co-workers. The mean number of total hours ranges from 89.61 hours for self-study to 198.08 hours for being shown how to do your job by co-workers.

The middle panel of table 3 presents the incidences and durations of new skills training spells. The incidences in the first column are computed over the 39.27 percent of the sample that reported that changes occurred at work that required them to learn new skills. The 91.08 percent incidence statistic for composite total tells us that 91.08 percent of those who reported changes at

⁹ The first quartile of the censored hours distribution is 25 hours in NLSY, 32 hours in EOPP, and 20 hours in NLSHS72. Second quartiles in the three data sets are 68 hours, 76 hours, and 60 hours. Third quartiles are 173 hours, 163 hours, and 148 hours. 90th percentiles are 351 hours, 318 hours, and 320 hours.

¹⁰ The quantity of "composite total" training does not include "Other" since durations were not asked for this type of training. The measure of our composite total incidence falls from 98.03 percent to 95.98 percent when "Other" is excluded.

¹¹ We should note here that in obtaining our sample we have omitted those observations that are clearly outliers (roughly two percent of all reported durations).

the workplace reported one of the following six activities: classes and seminars, supervisors or co-workers showing the individual how to do his job, self-study, own learning, or other. We should note that this is an under-estimate of training caused by workplace changes because individuals are instructed not to include training that was already reported in the formal training section of the questionnaire.¹²

Similar to training at the start of the job, the routing pattern of the NLSY questionnaire implicitly assumes that the 60.73 percent of workers who did not experience changes at the workplace requiring the learning of new skills did not receive any training in the past year. Under this assumption, one would conclude that 35.77 percent of all workers received new skills training in the current year (see the middle panel of table 3). The middle panel of Table 3 decomposes this composite measure into its component parts.

The middle panel of table 3 reports the quantities of the different types of new skills training, conditional on a worker's having received this type of training in the current year. These durations, whether measured by hours per week, number of weeks, or total hours, are much shorter than the training spells at the start of the job. The mean number of total hours of new skills training is 60.34 hours -- with the large standard deviation again suggesting a large right hand tail of the distribution. We should note that one problem in interpreting this duration measure is that we do not know whether or not a training spell is completed; if a training spell is still ongoing, then the number of weeks measure will be right censored (the same problem applies to start job training, albeit to an arguably much lesser extent).

The incidence and duration of formal training are presented in the bottom panel of table 3 (the exact wording of the formal training questions are given in footnote 6). In 1993, the formal

¹² However, when asked (in question 39A of table 2), 40.1 percent of workers who list classes or seminars in the new skills training section indicate that they already reported this training in the formal training section of the questionnaire. Our 19.55 percent measure of classes and seminars in table 3 only includes the spells that are not double counted. If we were to exclude classes and seminars from our composite total, we would still find that 88.19 percent of those reporting changes at the workplace received new skills training.

training questions were asked immediately prior to the new skills training questions. We see in the bottom panel of table 3 that 19.50 percent of workers received formal training in the current year. This is only about half as large as the percentage of workers for whom there occurred workplace changes necessitating that new skills be learned. With respect to the duration of completed formal training spells, the mean hours per week is 18.43, the mean number of weeks is 6.36, and the mean number of total hours is 110.95 (with a large standard deviation again suggesting a long right hand tail).

We note that a formal spell lasts a somewhat greater number of weeks than a new skills training spell (6.36 versus 5.59). In addition, the intensity of formal training as measured by hours per week is more than double the intensity of the more informal new skills training (18.43 versus 8.14). The combined effect is a mean number of total hours that is significantly higher for formal than informal training (110.95 hours versus 60.34 hours). This total hours difference is even greater when one looks at the median, with the median total hours of formal training (32 hours) being over twice as large as the median total hours of the more informal new skills training (15 hours).

The above comparisons should serve to highlight the importance of the new "informal" training questions for improving our understanding of skill upgrading (or continual learning, as it is sometimes referred to). The formal training questions obviously miss quite a sizable percentage of training that occurs. Based on incidence and duration, we can conclude that the new skills training questions in the 1993 NLSY are picking up a sizable number of relatively short episodes of skill upgrading that the formal training questions miss.

In order to assess our earlier assertion concerning the right hand tails of the training durations, table 4 presents additional information on the distributions. Recall that a start job training spell has a mean duration of 293.70 hours (see table 3). The third quartile for this duration measure is 260 hours, telling us that 75 percent of all reported durations are less than the mean. The long right hand tail of the total hours distribution is primarily the result of a skewed distribution for number of weeks. While the mean number of weeks is 16.84, the median number of weeks is 5.

(Median hours per week is 16, which is almost as high as the mean of 19.21.) The same pattern holds for all the separate types of training that individuals receive at the start of their job. The median number of weeks is 2 for classes and seminars, 1 for supervisors showing the individual how to do his job, 3 for co-workers showing the individual how to do his job, and 2 for self-study. These are all lower than the corresponding means in table 3.

We can infer from the above comparisons that the distributions of weeks and total hours of start job training and its components are highly skewed by some very long spells. Thus, it may well be appropriate for analysts and policy makers to discount the mean durations in table 3 in favor of the distributional statistics in table 4. The same conclusion holds for new skills training, albeit with less force given this training's much shorter mean duration (of course, as noted above, the relatively short reported duration may be partly due to the fact that some current year training spells are still ongoing). As reported in table 3, while the mean duration of a new skills training spell is 60.34 hours, median total hours is only 15.

V. Regression Analysis

a. Determinants of Training

Table 5a presents estimates of training incidence equations, where the reported probit coefficients are the effects of the explanatory variables on the training probability evaluated at the sample mean. Asterisks indicate statistical significance at the five percent level. Columns (1) and (2) report the results from an equation in which the dependent variable is a 0-1 dummy indicating whether or not an individual receives training at the start of the job, as measured by our composite total. We should remind the reader that we are forced to assume that individuals who indicated that they were initially able to do their work adequately received no training at the start of their job. Stated differently, since 98 percent of those who were not able to perform their duties adequately report having received training, we are essentially estimating equations for initially doing work adequately and interpreting these as training equations.

The coefficients in column (1) indicate that the incidence of initial training increases with ability as measured by the armed forces qualifying test (AFQT) score, and High School dropouts receive significantly less training at the start of the job relative to persons who graduated from High School but did not attend college.¹³ Note that besides demographic characteristics, we have also included several job characteristics in the various regressions. Working at a firm with multiple sites increases the probability of receiving training at the start of the job by approximately five and one-quarter percentage points (this effect is large in magnitude as start job training has a mean of only 35 percent), training increases with firm size, and unionized

¹³ All previous studies have found that training increases with education, although this relationship may become negative for those with graduate school. Interestingly, the theoretical prediction about the relationship between education and training is unclear. On the one hand, if education and training impart similar skills and if there are diminishing returns to these skills in production, then the return to training a more poorly educated person will be higher than the return to training a more highly educated one; this effect will be reinforced by the fact that the opportunity cost of a poorly educated person's time is lower than that of a more educated person. On the other hand, if training and education are complementary (which often seems to be the case), then there will be greater benefit from training more highly educated persons. In addition, education may serve as an indicator of ability and (as suggested by the positive AFQT coefficient) training and ability are likely to be complements in production .

workers receive less training at the start of the job. Column (2) differs from column (1) in that we have included controls for 7 industries and 8 occupations. Including the industry and occupation controls in the regression nearly doubles the negative gender coefficient, so that it now becomes significantly different from zero.

Columns (3) through (5) in table 5a report results from equations in which the dependent variable is a 0-1 dummy indicating whether an individual receives the composite measure of new skills training during the current year. Again, it is worth noting that we are forced to assume that individuals who indicated that there were no changes in their job receive no new skills training. Mincer (1988) and Altonji and Spletzer (1991) have presented evidence that for a given individual training incidence is correlated over time. What can we learn about the correlation of training over time from the training information in the NLSY? The only explanatory variables in the equation in column (3) are start job training and formal training in the previous year. Note that the receipt of either type of previous training significantly increases the probability of receiving new skills training, but controlling for incidence the effect of an additional hour of previous training is both small in magnitude and insignificant. Evaluated at the mean of total hours, a person who received start job training has a 20.6 percent higher probability of receiving new skills training [$.1979 + .0284*(293.70/1000)$], and a person who received formal training last year has a 19.6 percent higher probability of receiving new skills training. Adding demographic and employer controls reduces the magnitude of these effects, but they still remain statistically different from zero. In contrast to training at the start of the job, the gender coefficients in columns (4) and (5) indicate that females receive a higher incidence of new skills training. Higher ability persons and persons working at either multiple site firms or larger firms also receive more new skills training.

Columns (6) through (8) in table 5a report results from equations in which the dependent variable is a 0-1 dummy variable indicating whether an individual receives formal training in the current year. Whether or not control variables are included in the specification, the receipt of formal training in the previous year has a large and statistically significant effect on the

probability of current year formal training. The estimated formal training coefficient of .2651 in column (7) even exceeds the mean of the dependent variable. Evaluated at the mean hours of total training, the coefficients in column (7) imply that a person who has received formal training last year has a 24.7 percent higher probability of receiving formal training in the current year. In contrast, the start job coefficients in column (7) are small in magnitude and statistically insignificant. Interestingly enough, the demographic and job characteristic controls have similar magnitudes and signs in the formal training regression as they do in the new skills training regression.

Table 5b presents incidence equations for each of the separate training components. As with the composite measures, AFQT has a significantly positive effect on the incidence of each training component. Most of the other explanatory variables also have similar effects on the separate training components as on the composites. Two exceptions to this rule are post college education and gender.

While increased education is generally associated with more training, post college education only increases the more formal types of training and actually reduces informal training. In the case of start job training, persons with post-college education receive significantly more training in classes and seminars but significantly less instruction from co-workers showing them how to do their job. In the case of new skills training, individuals with a post college education receive more self-study and are more likely to engage in own learning, but receive less instruction from their supervisor showing them how to do their job.

The results in table 5a indicate that women are less likely to receive start job training and more likely to receive formal and new skills training in the current year, suggesting that women's training is more likely than men's to be delayed. From table 5b, we see that women's lower start job training primarily takes the form of their receiving less instruction from supervisors showing them how to do their job while women's increased new skills training is mainly due to their being more likely to participate in classes and seminars and in self-study. Taken in conjunction with

the positive formal training coefficient in table 5a, the pattern that emerges in table 5b is that women's training is more likely than men's to be both delayed and formal.

Our finding that formal training in the previous year is a significant determinant of the likelihood of receiving new skills training holds for each component of new skills training. However, while the receipt of training at the start of the job is a significant determinant of the likelihood of receiving instruction from one's supervisor and co-workers in the current year and on the likelihood of own learning, training at the start of the job has essentially no effect on the probability of participating in classes and seminars and on self-study during the current year. In light of start job training's insignificant effect on formal training in table 5a, this is consistent with our conjecture that training in the form of classes and seminars is more formal than training from supervisors or co-workers.

b. Returns to Training

Labor economists have reached a consensus both theoretically and empirically that training increases wages. The standard human capital model predicts that completed spells of training increase a worker's productivity and therefore his wage, and many of the studies cited in the references have shown this to be true -- see Altonji and Spletzer (1991), Barron, Black and Loewenstein (1987, 1989, 1993), Loewenstein and Spletzer (1993a, 1993b), Lynch (1992), Mincer (1988), and Pergamit and Shack-Marquez (1987). Beyond this simple important realization, however, lies an area of research that has only barely started to be investigated. One major question that we hope to shed some light on in this section is what are the returns to formal and informal training?

As far as we are aware, there is little previous research examining the differential effects that formal and informal training have on wages. Using CPS data, Pergamit and Shack-Marquez (1987) find that while formal training increases wages by 10.3 percent ($t=8.84$), informal training increases wages by only 1.9 percent ($t=1.79$). Unpublished regressions using Altonji and Spletzer's (1991) NLSHS72 data reveal that on-the-job training increases wages by 6.0 percent

($t=2.96$), off the job training increases wages by 12.1 percent ($t=5.45$), and employer financed education increases wages by 4.7 percent ($t=1.68$), but informal training has an insignificant negative effect on wages of 2.0 percent ($t=0.91$). Unpublished regressions using the EOPP data also indicate that formal training has a stronger effect on wages than does informal training (although both effects are positive and significant). In conclusion, while formal training significantly increases wages in all data sets, the effect of informal training tends to be smaller and is often insignificant.

Table 6a shows the results of using our NLSY data to estimate OLS wage equations where the dependent variable is the logarithm of the hourly wage rate. Again we should remind the reader that we are forced to assume that individuals who indicated that they were initially able to do their work adequately received no start job training and individuals who indicated that there were no changes in their job received no new skills training.

The explanatory variables in Column 1 of table 6a are 0-1 dummy variables indicating whether an individual has received the various types of training. The estimated coefficients indicate that individuals who received training at the start of the job have an hourly wage that is 7.66 [$\exp(.0738)=1.0766$] percent higher than that of those who did not start job training, individuals who received current year new skills training have an hourly wage that is 16.70 percent higher than that of those who did not receive such training, individuals who received formal training in the previous year have an hourly wage that is 9.75 percent higher than that of those who did not receive this training, and individuals who completed a formal training spell this year have a wage that is 14.99 percent higher than that of those who did not. Each of these estimates is statistically different from zero. The regression equation reported in column 2 includes hours spent in the different types of training as explanatory variables, thereby allowing the return to training to vary with the length of the spell. The estimated coefficients on hours of formal training are negative, implying that shorter spells of formal training actually have higher returns than longer spells. However, these hours effects are small in magnitude (note that the hours variables are divided by 1000) and not statistically different from zero. In contrast, hours

of start job training has a statistically significant positive coefficient, implying that longer spells of start job training have higher returns. Evaluated at the mean of total hours, the coefficients in column (2) imply that the average spell of start job training is associated with a 7.85 percent increase in wages [$\exp\{.0460 + .1008*(293.70/1000)\}$].

As originally pointed out by Barron, Black and Loewenstein (1989), a regression equation that does not control for differences in ability will produce upward biased estimates of the training coefficients because individuals who receive training are not a random sample of the employed. The incidence equations in table 5a confirm this selection effect -- recall in particular that high ability persons are more likely to receive training. To determine how this consideration affects the training coefficients, the wage regression in column 3 includes not only the training measures as independent variables, but also a multitude of demographic and job characteristic variables.

Comparing columns 2 and 3, we see that as expected the effects of training on the wage fall dramatically when individual and job characteristics are included as explanatory variables as a means of controlling for the heterogeneity that may exist between those who receive training and those who do not. For example, note that the coefficient on new skills training incidence falls to .0535, a 65 percent decline from the coefficient of .1515 without heterogeneity controls, and the coefficient on current year completed formal training incidence falls 63 percent from .1534 to .0572. The coefficients on new skills training and current year formal training incidence remain positive and statistically different than zero (as in the equation without heterogeneity controls, the coefficients on the hours of formal training last year and new skills training are not statistically different from zero). Interestingly, the coefficient on start job training incidence falls from .0460 to -.0339, and the coefficient on hours of start job training falls from .1008 to .0514. These estimates imply that long spells of initial training increase the current wage, but short spells of start job training actually lower the wage. The break-even point is 674 hours, which lies somewhere between the 75th and the 95th percentile of the total hours distribution (well above

the mean start job training duration of 293.70 hours, as reported in table 3), thereby implying that all but the very longest of initial training spells decrease the current wage.

Evaluated at the means of total hours, the coefficients in column (3) imply that receiving training at the start of the job decreases wages by 1.86 percent, receiving new skills training increases wages by 5.20 percent, receiving formal training last year increases wages by 4.11 percent, and having completed formal training during the current year increases wages by 5.57 percent. Adding industry and occupation controls in column (4) reduces these estimates to -3.47, 3.01, 2.68, and 3.62, respectively. The coefficients on the other explanatory variables are consistent with previous estimates in the economics literature: females have lower wages, married persons earn more (presumably because they work harder, are more able, and/or have lower turnover rates), wages rise with education and ability, and wages are higher for union members and for workers at larger firms and firms with multiple sites.

One of the more interesting conclusions from table 6a is that when one includes individual and job characteristic variables to control for the heterogeneity that may exist between those who receive training and those who do not, the return to most spells of training at the start of the job is negative, but the return to new skills training is positive and not that much less than the return to current year formal training. Since the two training measures that we have labeled as "informal" are composites, one naturally wonders how the returns to the training components compare with each other and, more specifically, exactly which training components are responsible for the negative coefficient on start job training. To answer these questions, we estimate equations in table 6b that are identical to those in table 6a except for the fact that we have replaced the composite informal training measures with the individual components.

Looking at column (3) of table 6b, we see that classes and seminars at the start of the job have a large positive impact on current wages, but except for a very few exceptionally long spells, training where supervisors and co-workers show the individual how to do his job have negative returns (in fact, the estimated returns are negative even in the specifications where we do not control for individual and job characteristics). With respect to new skills training, classes and

seminars, self study, and own learning all have significantly positive returns, except for a few unusually long spells. Training where supervisors show the worker how to do his job has a negative wage return, and training from co-workers has essentially a zero return when individual and job characteristics are included as controls.¹⁴

As pointed out above, our composite training measures are quite broad, encompassing forms of training that are quite varied. Classes and seminars, and perhaps self-study, should perhaps be thought of as "formal" training while training where supervisors or co-workers show an individual how to do his job seem to correspond quite closely to what is typically meant by "informal" training. The NLSY data indicate that like other "formal training," classes and seminars, and to a lesser degree self-study, have a relatively low incidence and a substantial return in the form of higher wages. Training from supervisors and co-workers has a much higher incidence, but also a higher duration variance. This training has a positive wage return only when the training spell is extremely long.

¹⁴ Because the training coefficients will pick up any worker heterogeneity that is not picked up in the demographic and job characteristic control variables, a possible explanation for our results is that employers may assign their more able workers to classes and have supervisors and co-workers provide help to their less able workers. Of course, it is difficult to reconcile this hypothesis with the fact that AFQT has a positive effect on the incidence of all types of training, both formal and informal.

VI. Conclusions

Although economists have recognized the importance of a worker's on-the-job human capital investments since the seminal papers by Becker (1962) and Mincer (1962), micro-datasets containing explicit measures of on-the-job training have started to become available only relatively recently. The existing data have been analyzed fairly thoroughly in a number of studies, and researchers agree that the human capital model's prediction that a worker's wage is positively related to past investments in his training is supported by the data, even after one controls for the fact that those who receive training have different characteristics than those who do not. However, researchers have not reached a consensus concerning the incidence or the duration of informal training.

While data from the Current Population Survey training supplements and from the National Longitudinal Survey of the High School Class of 1972 indicate that the incidence of informal training is approximately twenty percent, data from the Employment Opportunity Pilot Project Survey indicate that the incidence of informal training is about ninety-five percent. The most likely explanation appears to be the differences among the surveys in the wording of the training questions.

The National Longitudinal Survey of Youth is the major source of much of our current knowledge about formal training. However, the survey began asking questions about the harder to measure informal training only in 1993. The 1993 survey (along with the surveys to follow in the future) constitutes an important new source of information on informal training. The new NLSY training questions incorporate the detail of the EOPP employer survey (multiple sources of training such as classes or seminars, instruction from supervisors and/or co-workers, or self-study) within a survey of individuals. Used in conjunction with the wealth of information that the NLSY contains on individual demographic characteristics, employment history, schooling, and ability, the new informal training questions have the potential to significantly improve our knowledge about the acquisition and the returns to training

We have presented an extensive cross-sectional empirical analysis of the informal training information in the 1993 NLSY dataset in sections IV and V of this paper. The 1993 NLSY informal training measures appear to be picking up a sizable number of relatively short episodes of skill upgrading that are missed by the NLSY's formal training questions. And some important patterns in the NLSY data are consistent with those in other datasets: women receive training of shorter duration, workers at larger employers and with more education are more likely to receive training, training is more likely for workers with higher ability (as others have speculated, but have not had the appropriate data to verify explicitly), and current wages are positively related to past training.

Interestingly, our results indicate that the incidence of training is 98 percent for persons who were not able to perform all of their job duties adequately when they started their job and at least 91 percent for persons for whom changes at work within the past year required learning new skills. While these figures are consistent with the EOPP data, the routing patterns in the NLSY are such that the remaining two-thirds of workers are not asked any training questions, the implicit assumption being that they do not receive any informal training. If this assumption is correct, then the incidence of informal training is approximately 35 percent, which is only a little higher than the incidence of informal training in the CPS and the NLSHS72.

Our initial suspicion was that individuals who reported that they were able to perform all of their duties adequately when they started their job were likely to have informal training spells of short, but positive, duration, so that the NLSY's routing pattern would cause it to miss short spells of training. Surprisingly, however, the informal training durations for individuals in the NLSY who have received start job training are similar to the durations in the NLSHS72, and when censored at three months, to those from the EOPP. Another reasonable hypothesis is that although the NLSY (along with EOPP) is not systematically screening out spells of a given length, it is screening out certain types of spells. In future work, we plan both a more detailed comparison of the incidence and duration of the various types of training in the different data sets.

Our results indicate that for a given individual training incidence is correlated over time. Interestingly, formal training in the past year raises the probability of both formal and informal training in the current year, while informal training at the start of the job only raises the probability of informal training in the current year. The complementarity between past year formal training and current year training holds not only for our broad current year training components, but also for each of the separate training components.

Not surprisingly, when we decompose our start job and new skills training composites, we find that formal training has a much lower incidence than informal training. We also find that women's training is more likely than men's to be more formal. Interestingly, our regression results indicate that more formal training in the form of classes and seminars and self study yields a significantly higher wage return than informal training from supervisors and co-workers. In fact, informal training yields a positive wage return only when the training spell is extremely long. This may reflect the fact that informal training from supervisors and co-workers is not so important after all. Casual experience and intuition suggest that in many jobs most learning may not come from instruction from co-workers and supervisors, but simply from experience and experimentation. This "learning by doing" may well be what Brown had in mind when he stated that "one hopes that for most workers (training) never ends."

Although learning by doing is by its nature subjective and thus more difficult to measure than training, EOPP, the Panel Study of Income Dynamics, and the NLSY all contain measures of learning by doing. EOPP attempts to measure learning on the job by asking the question, "How many weeks does it take a new employee to become fully trained and qualified if he or she has no experience in this job, but has had the necessary school-provided training." A similar question appears in the PSID. As reported in Table 2 (question 61AA), the NLSY asks every worker who indicates that he could not perform 100 percent of his initial duties adequately the question, "How long did it take before you were fully comfortable doing this kind of work on your own?" Evidence of this variable's potential importance is provided by Barron, Black, and Loewenstein's (1993) finding that it explains a significant part of the gender wage gap -- even

though hours of training during the first three months of employment are similar for men and women.

Consistent with Barron, Black, and Loewenstein's finding with the EOPP data, analysis of the NLSY data also indicates that women are in jobs that require less time to be fully comfortable. In this respect, the learning by doing variable appears to be similar to informal training (see Table 5b).¹⁵ However, after controlling for the incidence and hours of start job training, the length of time until a worker is fully comfortable in his job still has a statistically significant positive effect on a worker's wage. This leads us to conclude that the learning by doing variable contains some information that is not picked up by the NLSY formal and informal training measures. An extensive analysis of the relationship between the measures of informal training and learning by doing -- in both the NLSY and the other data sets -- remains a topic for future research.

¹⁵ As is the case with both formal and informal training, there is a positive correlation between AFQT and the length of time until a worker is fully comfortable in his job. Interestingly, unlike both formal and informal training, learning by doing appears to be negatively related to firm size.

VII. References

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