

# BLS WORKING PAPERS



U.S. DEPARTMENT OF LABOR  
Bureau of Labor Statistics

---

OFFICE OF RESEARCH  
AND EVALUATION

Informal Training: A Review of Existing Data and Some New Evidence

Mark A. Loewenstein and James R. Spletzer

Working Paper 254  
June 1994

---

The authors would like to thank Marilyn Manser, Michael Pergamit, and Jonathan Veum for helpful comments. The views expressed here are those of the authors and do not necessarily reflect the views of the U.S. Department of Labor or the Bureau of Labor Statistics.

## **Formal and Informal Training:**

### **Evidence from the NLSY**

May 11, 1998 (revised from June 1994 version)

Forthcoming: Research in Labor Economics

Mark A. Loewenstein  
Bureau of Labor Statistics  
2 Massachusetts Ave NE, Room 4130  
Washington D.C. 20212

Phone: 202-606-7385  
E-Mail: [Loewenstein\\_M@bls.gov](mailto:Loewenstein_M@bls.gov)

James R. Spletzer  
Bureau of Labor Statistics  
2 Massachusetts Ave NE, Room 4945  
Washington D.C. 20212

Phone: 202-606-7393  
E-Mail: [Spletzer\\_J@bls.gov](mailto:Spletzer_J@bls.gov)

The views expressed here are those of the authors and do not necessarily reflect the views of the U.S. Department of Labor or the Bureau of Labor Statistics. We thank John Bishop, George Jakobson, Duane Leigh, an anonymous referee, and participants at the November 1996 ILR-Cornell Institute for Labor Market Policies Conference “New Empirical Research on Employer Training: Who Pays? Who Benefits?” for helpful comments on a previous draft of this paper.

## **ABSTRACT**

Although economists have long been aware of the importance of a worker's on-the-job human capital investments, current knowledge about the quantity of on-the-job training and its returns is still relatively scant. This paper analyzes the formal and the informal training information from four commonly used surveys, paying particular attention to the 1993 and 1994 data from the National Longitudinal Surveys of Youth. After accounting for differences across surveys with regard to their sample population and the reference period over which training is measured, the formal training responses appear quite consistent across data sets. The same cannot be said for informal training, and the variation in the incidence of informal training across surveys appears to be due to unsatisfactory routing patterns in the household survey questionnaires. Nevertheless, the new 1993 and 1994 NLSY informal training data appears to be capturing quite a bit of human capital accumulation that is missed by the formal training questions. When used together, the formal and informal training measures can explain much, but not all, of an individual's within job wage growth.

## 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.

The National Longitudinal Surveys of Youth (NLSY) have been obtaining information on formal training for some time. Used in conjunction with the wealth of information that the NLSY contains on individual demographic characteristics, employment history, schooling, and ability, these data offer a great advantage for the study of the acquisition of and the returns to training. The NLSY included questions about informal training for the first time in 1993. These questions were then repeated in the 1994 survey. In this paper, we analyze the formal and the informal training information from the 1993 and 1994 NLSY data.

We begin with a general critique of the training information in four commonly used surveys: the Current Population Survey (CPS), the National Longitudinal Survey of the High School Class of 1972 (NLS-72), the Employer Opportunity Pilot Project (EOPP), and the National Longitudinal Surveys of Youth (NLSY). We highlight how differences in training incidence and duration across surveys can be explained by sample differences, different reference periods, and differences in question wording. We conclude that the formal training responses appear to be quite consistent across all four surveys, but that the CPS and NLS-72 are missing most informal training (while the pre 1993 National Longitudinal Surveys of Youth make no attempt to measure informal training).

With this comparison as background, we analyze the new informal training data in the 1993 and 1994 NLSY. We find that the routing pattern in the survey limits the usefulness of the new NLSY informal training data for estimating the incidence and duration of informal training. Nevertheless,

the NLSY informal training data do capture a sizable number of episodes of skill upgrading that the formal training questions miss.

We then turn to an analysis of the relationship between wages and training. Our intent here is twofold. First, to estimate the separate effects of formal and informal training and, second, to determine the effect of omitting such a potentially important variable as informal training, which is unavailable in some data sets. We use both the NLSY and the EOPP datasets in our wage growth analysis. Interestingly, when used together, the formal and informal training measures explain much, but certainly not all, of the wage growth experienced by individuals in our data. We then conclude our analysis with a discussion of how individuals learn and become productive at their jobs, and we offer our opinion of how surveys might best measure this human capital accumulation.

## **II. A Critical Review of What is Currently Known about Training**

As mentioned in the introduction, much of our lack of knowledge regarding on-the-job training is attributable to the fact that much of this 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. The dollar cost is elusive not only because the time spent by supervisors and other workers is not logged, but also because the worker's productivity is also likely to be reduced while in training...

Several existing surveys have attempted to obtain explicit information about whether workers have participated in various training activities, and if so, how much time is devoted to these

training spells.<sup>1</sup> The questions used to measure training in several of the most widely used surveys are summarized in Table 1.

The Current Population Survey (CPS) is one source of information on both formal and informal training.<sup>2</sup> This information comes 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?" Analysis of the data reveals that forty-four percent of workers in the CPS indicated that they had received training. These individuals were then asked, "Did you take the training in school, a formal company training program, informal on the job, [and/or] other?" Further analysis of the data indicates that the incidence of informal training is sixteen percent.

The National Longitudinal Survey of the High School Class of 1972 (NLS-72) is a second data set with information on formal and informal training.<sup>3</sup> 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?" Forty-six percent of individuals indicated that they had participated in some type of training program. These individuals 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

---

<sup>1</sup> The existing training measures can be divided into two categories. Some surveys attempt to measure the explicit costs of training by inquiring about the incidence and duration of various training activities. Other surveys ask how long it takes workers to become fully productive in their jobs as a means of measuring the implicit costs of training via the time devoted to "learning by doing." This paper focuses on explicit measures of training. We will return to a discussion of the learning by doing approach in the conclusion.

<sup>2</sup> The CPS is a monthly survey of approximately 60,000 households that provides information for the Bureau of Labor Statistics' monthly report on the nation's employment and unemployment situation. In January 1983 and January 1991, the survey obtained supplementary information about individuals' training. These training data have been used by Bowers and Swaim (1994), Constantine and Neumark (1994), Lillard and Tan (1992), Loewenstein and Spletzer (1997a), and Pergamit and Shack-Marquez (1987). The sample we use in this paper is that used by Loewenstein and Spletzer (1997a).

<sup>3</sup> The NLS-72 is a Department of Education survey of 22,652 people who were high school seniors during the 1971-72 academic year. 12,841 of the individuals in the initial survey were re-surveyed in 1986, and training information was obtained in this 1986 follow-up survey. See Altonji and Spletzer (1991) for

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, or other." Further analysis of the data reveals that the incidence of informal training is twenty percent.

A third public use data set with information on training is an employer survey that was carried out in conjunction with the Employment Opportunity Pilot Project (EOPP).<sup>4</sup> Unlike the CPS supplement and the NLS-72 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. Each employer was asked "Is there formal training, such as self-paced learning programs or training done by specially trained personnel ...?" In addition, referring to the first three months of employment, the employer was asked about the total number of hours a) "the average new employee spends in training activities in which he or she is watching other people do the job rather than doing it himself," b) "management and line supervisors spent away from other activities giving informal individualized training or extra supervision to (the) typical worker," and c) "co-workers who are not supervisors spent away from their normal work giving informal individualized training or extra supervision to (the) typical worker." The incidence of formal training is thirteen percent [question 2 in table 1], and the probability that a new worker spends some time watching others, receiving informal

---

further details and a complete analysis of the incidence and returns to training. The sample we use in this paper is that used by Altonji and Spletzer (1991).

<sup>4</sup> The training questions are asked in the second of a two-wave longitudinal survey; the sample in the second wave survey consists of 2,625 employers. See Barron, Black, and Loewenstein (1987, 1989, 1993) and Bishop (1988, 1991) for further details of the EOPP and an analysis of training and wages. The sample we use in this paper is that used by Loewenstein and Spletzer (1997b). The training questions in Barron, Berger, and Black's (1997) recent surveys for the Small Business Administration and for the Upjohn Institute are very similar to those in the EOPP survey and (when comparable) yield similar estimates of incidence and duration.

training from management and line supervisors, or receiving informal training from co-workers is ninety-six percent [questions 1, 4, and 5 in table 1].

The National Longitudinal Survey of Youth (NLSY) is a fourth data set with information on training.<sup>5</sup> Individuals who have worked during the last year are asked: “Since [date of the last interview] did you attend any training program or any-on-the-job training program designed to help people find a job, improve job skills, or learn a new job?” An analysis of the 1993 and 1994 data indicates that average annual incidence of formal training is seventeen percent. The informal training data from the 1993 and 1994 NLSY surveys will be described in the next section of this paper.

We have summarized the incidences of formal and informal training from the various surveys in the top panel of Table 2. One sees that the incidence of formal training varies from approximately fifteen percent in the EOPP and the NLSY to approximately forty-five percent in the CPS and the NLS-72. The variation in informal training incidence across data sets is even greater than the variation of formal training incidence, ranging from sixteen to twenty percent in the CPS and the NLS-72 to ninety-six percent in the EOPP. The large variation in training incidence across surveys is somewhat disconcerting at first glance, but upon further reflection is not so surprising since the surveys differ in their sample population, in the reference period over which training is

---

<sup>5</sup> The NLSY is a dataset of 12,686 individuals who were aged 14 to 21 in 1979. The sample size was reduced to 11607 in 1985 when interviewing of the full military sample ceased, and in 1991, the sample was further reduced to 9964 persons when the economically disadvantaged white supplemental sample was eliminated. These youths have been interviewed annually since 1979, and the response rate has been 90 percent or greater in each year. In each year between 1988 and 1994, the NLSY has collected detailed information on formal training. Between 1979 and 1986, information was only obtained on formal training spells that lasted longer than one month. Analysis of the 1993 data indicate that 81.6 percent of training spells completed during the year are less than or equal to four weeks in duration. There were no training questions in the 1987 survey. The NLSY data have been used extensively to examine the relationship between training, tenure, wages, and mobility: see Lynch (1991a, 1991b, 1992) and Royalty (1996) for an analysis of the early years of the NLSY data, see Loewenstein and Spletzer (1996, 1997a, 1997b, 1998) and Veum (1993, 1995) for an analysis of the more recent years.

measured, in the concepts covered by the use of the word training, in whether the survey respondent is an employee or employer, and in the routing patterns in their questionnaires.

Some of the variation in training incidence can likely be explained by the fact that the various surveys have different sample populations. While the CPS sample is a representative cross section of the employed, the workers in the NLSY sample used here are aged 27-38, and the workers in the NLS-72 are aged 31 and are all high school graduates.<sup>6</sup> And the EOPP survey asks about the training received by the most recently hired worker. A sample of workers whom employers most recently hired will tend to have a disproportionate number of younger and higher turnover workers. While the relationship between age and training is uncertain, one would certainly expect higher turnover workers to be less likely to receive training (for example, see Loewenstein and Spletzer (1996, 1997a) for a theoretical discussion of this point). In addition, the EOPP survey deliberately oversampled employers with a relatively high proportion of low wage workers. This last consideration would also lead one to expect a lower training incidence in the EOPP data, as there is pretty strong evidence across data sets that workers in higher training positions receive higher wages.

While differences in sample composition may explain some of the difference in training incidence among the surveys, it surely cannot possibly explain most of it. One way to see this is to take advantage of the large sample size of the CPS survey and attempt to “replicate” the other sample populations of the other various surveys. The results of this exercise can be seen in the bottom panel of table 2. Note that restricting the age group in the CPS sample has little effect on training incidence. In contrast, restricting the sample on the basis of tenure has a marked effect on training incidence. For example, when one restricts the sample to have tenure of three months or

---

<sup>6</sup> Our computations of incidence use unweighted data, and therefore do not adjust for survey non-response. The mere fact that workers in the NLS-72 went through the trouble of filling out a long and

less, the incidence of formal training falls by over half from 44 percent to 20.5 percent, a figure that is much closer to the EOPP formal training incidence of 13 percent. However, this reduction in training incidence is not so much due to a sample composition effect as it is to a training reference period effect.

As can be seen from table 2, the reference period in the training questions varies across surveys. While the CPS and the NLS-72 ask about all past training in the current job, the NLSY asks about training in the past year and the EOPP asks about training in the first three months of the job. Loewenstein and Spletzer (1997a) use the longitudinal aspect of the NLSY survey to transform the NLSY training question from a “last year” concept to a “current job” concept. They find that while the annual incidence of formal training for persons in their third or fourth year of tenure is 18 percent, 35 percent of persons in their third year of tenure have received formal training in their current job and 43 percent of persons in their fourth year of tenure have received formal training in their current job. These constructed statistics from the NLSY are remarkably similar to those from the CPS -- see Loewenstein and Spletzer (1997a).<sup>7</sup> Thus, a sizable part (if not all) of the higher

---

detailed mail survey means that the NLS-72 sample used here is undoubtedly unrepresentative of the population it is meant to portray.

<sup>7</sup> Individuals with more than one year of tenure are not a random sample of workers who started the job. In cross-sectional data, this matching process between workers and employers could generate the observed positive relationship between tenure and the probability of ever having received training even if all training occurs at the start of the job. Loewenstein and Spletzer (1997a) show that delayed formal on-the-job training is the norm rather than the exception, which implies that the positive cross-sectional relationship between tenure and the probability of ever having received training is not entirely due to sample composition.

The analysis in Loewenstein and Spletzer (1997a) also provides some empirical evidence relating to recall bias. The effects of recall bias on the probability of correctly reporting the incidence of training are likely to be more serious for workers with greater tenure because the greater the period of time between a worker's last training spell and the survey date, the more likely the worker is to have forgotten that he received training. The finding that the probability of ever having received training increases with tenure indicates that delayed training dominates any potential recall bias. Furthermore, the problem of recall bias is mitigated by the findings of Mincer (1988), Altonji and Spletzer (1991), Lynch (1992), and Loewenstein and Spletzer (1996), who find that training is positively correlated over time, implying that workers who are trained early in their job tenure are likely to be retrained periodically over time.

formal training incidence in the CPS and the NLS-72 can clearly be traced to the fact that their reference period is much longer.

The formal training questions in the various surveys differ in another important way. The questions in the NLS-72 and, especially the CPS, are broader in that they allow formal schooling to be included as training. Questions about formal schooling are asked in another part of the survey and are not explicitly part of the training data collected in the NLSY. Similarly, the training question in the EOPP also appears to exclude formal schooling. Our analysis of the CPS and the NLS-72 indicates that if schooling (as measured by CPS question 2a in table 1 and NLS-72 question 2e in table 1) is excluded as a training category, the incidence of training (as measured by CPS question 1 in table 1 and NLS-72 question 1 in table 1) falls by twenty percent in the CPS (from 44.1 percent to 35.5 percent) and by six percent in the NLS-72 (from 45.7 percent to 42.8 percent). This difference in concepts regarding what constitutes training further helps to reconcile the difference between the CPS and the NLS-72 relative to the EOPP and the NLSY formal training measures.<sup>8</sup>

To summarize, when one takes into account the differences in sample populations, differences in reference periods, and differences in concepts underlying the definition of formal training, the formal training responses appear quite consistent across data sets. The evidence from the various surveys suggests that approximately 45 percent of workers have received formal training while on

---

<sup>8</sup> Note that the CPS training question in table 1, “Since you obtained your present job did you take any training to improve your skills?” does not explicitly ask about “formal training”. However, the wording, “take any training to improve your skills” certainly implies formal training. Rather than treating affirmative responses to question 1 as an indicator of formal training in the CPS, one might argue that we should take affirmative responses to the follow up question 2b, “Did you take the training in a formal company training program?” as an indicator of formal training. In this case, the concept of the CPS formal training question would be narrower than the formal training concepts implied in question 2 of table 1 for the EOPP survey. After adjusting for the longer reference period in the CPS, formal training in the CPS as measured by this alternative construct would be lower than in the EOPP. Similar comments apply to the NLS-72 and the NLSY formal training measures.

their current job, and the annual incidence of formal training appears to be about 17 percent. What can we conclude about the incidence of informal training?

While the incidence of informal training is sixteen percent in the CPS and twenty percent in the NLS-72, it is ninety-six percent in the EOPP. Thus, in spite of their longer reference period and the notable difference in sample populations (higher tenure and higher wage samples), the incidence of informal training is markedly lower in the CPS and the NLS-72 than in the EOPP. One possible explanation might lie in the fact that the EOPP is an employer survey, while the CPS and the NLS-72 are individual surveys. After all, there may well be some ambiguity as to whether the time that a supervisor spends with a new worker constitutes training or merely supervision and monitoring. The low incidence of reported informal training in the employee surveys might lead one to suspect that workers simply underestimate the amount of informal training that they receive from supervisors and co-workers. Interestingly, however, in a survey funded by the Upjohn Foundation, Barron, Berger, and Black (1997) ask the EOPP type training questions of both new workers and their employers. Although conclusions from this survey should be tempered by its small sample size, it is noteworthy that while workers' responses are only imperfectly correlated with those of their employers, employers' training estimates are not appreciably higher than those of their workers. Indeed, there is an alternative explanation for the low incidence of informal training in the CPS and the NLS-72.

We believe quite strongly that the peculiar routing patterns in the CPS and the NLS-72 surveys can explain their relatively low incidences of informal training. For example, in the CPS, only if an individual answered that he had taken training to improve his skills was he routed into a follow-up question that allowed him to indicate that he received informal training. It is likely that an individual who received informal training, but who did not actively take formal training, would not respond yes to the initial incidence question. The same point applies to the routing pattern in the NLS-72 survey.

Besides their routing patterns, the actual wording of the informal training questions may also play a role in the CPS and the NLS-72's low incidence of informal training. The CPS does not give the respondent any indication as to what is meant by informal training and the NLS-72 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 the NLS-72 surveys. Indeed, conditional on receiving informal training, the average length of an informal training spell is 233 hours in the NLS-72 while the mean number of total hours devoted to informal training (the sum of watching others, informal training by supervisors, and informal training by managers) is only 143 in the EOPP.<sup>9</sup> However, this comparison is misleading. Recall that the EOPP and the NLS-72 have different reference periods. Because EOPP only asks about training during the first three months of employment, training spells that last longer than 12 weeks will be censored. In fact, evidence from Barron, Berger, and Black's (1997) SBA survey suggests that about one-third of all spells in the EOPP are censored. Interestingly, when one performs the experiment of censoring spells in the NLS-72 at twelve weeks, the mean number of hours of informal training falls to 116, which is roughly comparable to that in the EOPP. In fact, as seen in figure 1, the distributions of the informal training hours are nearly identical in the two data sets.<sup>10</sup> For completeness, we present the formal training durations

---

<sup>9</sup> This EOPP statistic may well be an overstatement because of possible double counting across the individual training components. The first training question in Table 1 occurs in a different part of the survey than the last four questions. Interestingly, this possible problem does not occur in the SBA survey, and the mean duration of training in the SBA survey is very similar to that in the EOPP survey.

<sup>10</sup> The conclusion that the distributions of the informal training durations are similar in the EOPP and the NLS-72 is simplistic in that we have not attempted to control for differences across the surveys. For example, even after censoring the NLS-72 durations at 12 weeks, we would still expect the reference period to have an effect on the comparison. Since the NLS-72 is asking about all training that has accumulated while on the current job whereas EOPP is asking only about training in the first three months, one would expect the mean weeks to be longer in the NLS-72, and thus one would expect the

(conditional on positive incidence with censoring at 12 weeks) in figure 2. The distributions of formal training hours are remarkably similar across surveys.

In conclusion, one has to be extremely skeptical of the informal training information in the CPS and the NLS-72. One strongly suspects that these surveys are simply missing most informal training. Indeed, because it is hard to imagine a job that does not have *some* informal training, especially at the start of the job, the EOPP incidence of 96 percent appears quite reasonable. Thus, while the existing household surveys appear to be doing a reasonable job measuring formal training, their information on informal training appears to be woefully inadequate.

### **III. The New NLSY Informal Training Data**

#### **IIIa. The Survey 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, and then repeated these questions in the 1994 survey. 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, and is asked in the employer supplements. 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.

Referring to the duties the worker currently does, the survey leads into the training questions at the start of the job by asking, "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, he is then asked

---

probability of censoring at 12 weeks to be higher in the NLS-72 (however, only 23 percent of NLS-72 informal training durations are 12 weeks or longer). Another effect of the longer reference period in the

about how he learned to perform his job duties. He is asked whether he participated in classes or seminars, whether his supervisor and/or coworkers showed him how to do his job, or whether he used self-study materials. An individual who responds that he received a particular type of 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 refer to this training as "Start Job Training." The start job training questions are presented in the left-hand column of table 3.<sup>11</sup>

As shown in table 3, 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. This routing pattern is specific to the 1993 survey only, and was changed in 1994 so that all individuals were asked the start job training questions. The effects of this change will be examined in the empirical work below.

After completing the formal training questions, an individual in the 1993 and 1994 NLSY is also asked 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 work rules for reasons other than new government regulations.

---

NLS-72 is that respondents might recall the spell of informal training with the highest intensity as measured by hours per week.

<sup>11</sup> To avoid cluttering table 3, we have taken some liberties when presenting the NLSY informal training questions: we do not present certain intervening questions nor do we present the questions for "other" training.

If the respondent answers that there has been a change at work that made it necessary to learn new job skills, then he is asked whether he learned these skills by participating in classes or seminars, whether his supervisor and/or co-workers showed him how the changes at work would affect his job, or whether he made use of self-study materials. 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 3. Note that they parallel the questions about "Start Job Training."

We will often use the label "informal training" to distinguish the two new sequences of training questions from the sequence of formal training questions.<sup>12</sup> This is partly motivated by the fact that the "New Skills Training" questions in particular are designed to measure the more informal types of training that were not already recorded in the preceding 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."

The new NLSY informal training questions have some features in common with the training questions from the EOPP survey and some features in common with the CPS and the NLS-72 training questions. Similar to the EOPP survey, the new NLSY questions ask explicitly about various sources of training: classes and seminars, instruction provided by supervisors and/or co-workers, and self-study. In contrast, the CPS and the NLS-72 only ask about an individual's

---

<sup>12</sup> Although we label "Start Job Training" and "New Skills Training" as informal training, these new NLSY training questions are ideal for analyzing topics such as workers' responses to technological

"informal" training, leaving the definition of informal up to the respondent. The new NLSY training questions are similar to the NLS-72 questions in that both employ incidence screener questions when attempting to measure duration: individuals are asked to report the time 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.

The new NLSY informal training questions also have a much more serious variant of the incidence screener. Specifically, the question about the percentage of duties that the individual was able to perform adequately and the question on whether changes occurred at work can also be interpreted as incidence screener questions. In the 1993 survey, individuals who were able to perform all their duties adequately at the start of the job are not routed into the detailed start job training questions. In both the 1993 and 1994 surveys, individuals who did not experience changes at work within the past 12 months are not routed into the detailed training questions. The routing patterns implicit in these new question sequences assume that these individuals have not received training and almost certainly diminishes their usefulness as a source of information regarding on-the-job skill acquisition.

The incidence screener is likely to be especially problematic in the case of Start Job Training. Even workers who have the requisite skills to initially perform their duties adequately may receive job orientation help from supervisors and co-workers. And training may make workers who can perform their tasks adequately even more productive. In contrast, most New Skills Training is likely to fit into one of the classifications specified in the changes at work question, although one should be worried that this question may miss some episodes of skill upgrading not accompanied by a major change in an individual's job duties.

---

change, government regulation, and workplace transformation. In particular, see Leigh and Gifford

### IIIb. Descriptive Statistics of the NLSY Informal Training Data

In Table 4a, we present descriptive statistics concerning the incidence and duration of Start Job Training. The top panel is based on data from 1993, and the bottom panel is based on data from 1994. The key distinction between these two years is dictated by the routing pattern of the Start Job Training questions. In 1993, only individuals who responded that were able to perform less than 100 percent of their duties adequately at their new job were asked the training questions, whereas in 1994, all individuals with a new job answered the training questions.<sup>13</sup>

In 1993, a worker was only asked about his Start Job Training if he indicated that he was not initially able to perform all of his current job duties. As presented in column 2 of table 4a, nearly all workers (98.18 percent) in their first year of tenure who were not initially able to perform all of their job duties received Start Job Training. This incidence rate appears to be closer to that from the EOPP data rather than that from the CPS or the NLS-72 data. Of course, 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, only 27.10 percent of those persons in their first year of tenure in 1993 received training at the start of their job (see column 1 of table 4a), an incidence rate that is closer to that in the CPS and the NLS-72 rather than that in EOPP. Therefore, the new 1993 NLSY informal training questions do not help us resolve the existing confusion regarding how well household surveys measure the incidence of informal training.

---

(1996).

<sup>13</sup> In 1993, the question regarding what percentage of duties an individual performed adequately was asked of all persons. In many cases, this is a retrospective measure since only one quarter of working individuals in the 1993 survey indicated that they have been in their job less than one year. In 1994, this question was asked only of persons who had started a new job or started new duties within the previous year. In order to make the responses consistent across surveys, we have restricted the data in each year to those individuals who are in their first year of tenure.

As shown in the bottom panel of Table 4a, 79.89 percent of workers in 1994 received Start Job Training. This percentage is calculated from all workers in their first year of tenure, regardless of whether they could or could not initially perform all of their current duties adequately. Comparing the top and bottom panels of table 4a leads to the conclusion that the implicit presumption in the 1993 routing pattern that only individuals who could not initially perform all of their duties correctly receive Start Job Training is clearly incorrect. Many of the individuals who indicated that they could initially perform all of their duties adequately did, in fact, receive some Start Job Training in 1994. Thirty-two percent of individuals in 1994 were not fully comfortable at the start of their job, and the incidence of Start Job Training for these persons is 96.51 percent. These statistics are very similar to the ones for 1993. What we are able to compute from the 1994 data, but not from the 1993 data, is that the incidence of Start Job Training is 72.15 percent for the 68 percent of individuals who were fully comfortable at the start of their job (the 79.89 percent figure in the bottom panel of table 4a is a weighted average of 96.51 percent and 72.15 percent). It is worth noting that, as one would expect, individuals who were not initially fully comfortable have a higher incidence of informal training than those individuals who could initially perform all of their duties adequately.

Although the 80 percent incidence rate of informal training at the start of the job in the 1994 NLSY data is not quite as high as the 96 percent incidence rate in EOPP, it is much closer to the EOPP figure than the 17 percent and 20 percent incidence rates in the CPS and NLS72. Apparently, workers are able to recognize when they are receiving informal training and will provide this information when asked if the survey questions are phrased appropriately. This conclusion is reinforced when one notes that most of the start job training that workers received is of the more informal kind. In fact, only about 1 percent of workers in the first year of tenure indicated that they received start job training in the form of classes and seminars. Instead, most of

their start job training was in the form of supervisors or coworkers showing them how to do their work.

Conditional on a worker having received training at the start of his or her job, the quantities of training received are also reported in table 4a. Looking at the bottom panel with the 1994 data, the mean training received at the start of the job was 16 hours per week for 6 weeks, resulting in a mean of 96 total hours. The standard deviation for total hours is 176.64, which reflects the fact that the distribution of total hours has a long right hand tail. Comparing the top and bottom panels of table 4a, it is noteworthy that even individuals who could initially perform all their job duties adequately received a substantial amount of informal training at the start of the job. It is also reassuring to note that individuals who could not initially perform all of their job duties adequately receive slightly more training (in 1994, individuals who were not fully comfortable and received positive training received an average of 124 hours, while who were fully comfortable and received positive training received an average of 78 hours).

The top panel of table 4b presents the incidences and durations of New Skills Training spells, where "New Skills Training" refers to the training that was received in the previous twelve months for the subsample that experienced changes at work requiring new skills. We see that 91.74 percent of those who reported changes at the workplace reported having received training.<sup>14</sup> However, the routing pattern of both the 1993 and the 1994 NLSY questionnaires implicitly assumes that workers who did not experience changes at the workplace requiring the learning of new skills did not receive any new skills training in the past year. Under this assumption, one would conclude that 40.43 percent of all workers received new skills training in the current year. Unlike the Start Job Training questions, this routing pattern was not "fixed" in 1994 and thus we

---

<sup>14</sup> Recall that this training is distinct from the formal training captured in the regular section of the questionnaires.

have no test of how many individuals received New Skills informal training during the previous year.

The incidence and duration of formal training are presented in the bottom panel of table 4b (the wording of the formal training questions is given in table 1). We see that 17.25 percent of workers received formal training in the current year. This is less than half the incidence rate of New Skills training over the same reference period. Furthermore, one may note that the mean completed formal training spell is approximately as long as the mean new skills training spell (48.19 hours versus 56.74 hours).<sup>15</sup> This similarity of mean total hours serves to highlight the importance of the new "informal" training questions for improving our understanding of human capital accumulation. The "New Skills Training" questions appear to be capturing a sizable number of both short and long episodes of skill upgrading that are missed by the formal training questions.

A common finding in the training literature is that training tends to be provided to more educated workers having greater ability. Is the same thing true of informal training in the NLSY? A second question concerning incidence has to do with whether formal and informal training tend to be substitutes or complements. Table 4c presents estimates of training incidence equations, where the reported probit coefficients (and the associated standard errors) are the estimated effects of the explanatory variables on the probability of training at the sample means. Asterisks indicate statistical significance at the five percent level. Our discussion begins by focusing on the incidence

---

<sup>15</sup> We should note that we do not know whether or not a "New Skills Training" spell is completed by the date of the interview; if the training spell is still ongoing, then the number of weeks measure will be right censored, and thus the mean hours statistic will probably be downward biased. On the other hand, formal training durations are only asked for completed spells; durations of formal training spells ongoing at the date of the interview are not recorded, and thus the mean hours statistic will also be downward biased if the ongoing spells are on average longer duration spells. Furthermore, the statement in the text that the mean total hours of formal training is roughly comparable to the mean total hours of new skills training hours is quite sensitive to how one treats outliers in both the formal and the informal training duration distributions. We have omitted the roughly two percent of formal and informal training durations that are clearly outliers.

of new skills training and formal training, the focus of our wage growth analysis in the next section.

The columns titled “New Skills Training” and “Formal Training” report results from equations in which the dependent variable is a 0-1 variable indicating whether or not an individual receives new skills training or formal training, respectively. We should remind the reader that we are forced to assume that individuals who indicated that they did not experience a workplace change received no new skills informal training. Stated differently, since 92 percent of those who experienced a workplace change received new skills training, we are essentially estimating equations for experiencing a workplace change and interpreting these as training equations.

The coefficients in the “New Skills Training” column of table 4c indicates that jobs that offer formal training are also likely to offer informal training. The fraction of persons who receive both new skills training and formal training in the same year is .2153 higher than the fraction of persons who receive only new skills training, and this differential represents 53 percent of the mean of the informal training probability. As we will point out in the next section, this strong positive correlation between formal and informal training in the current year has important implications for our understanding of the effects of formal and informal training on wage growth.

Not only does formal training have a positive and significant coefficient in the new skills training equation and vice versa, but the various demographic and job characteristic variables have similar effects in the two equations. The incidence of new skills and formal training both increase with ability as measured by the armed forces qualifying test (AFQT) score. 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. All previous studies have found that training increases with education, although this relationship may become negative for those with graduate school. We obtain the same result here: the probability of receiving both formal training and new skills training is higher for persons with education beyond high school.

Loewenstein and Spletzer (1996, 1997a) have shown that formal training is not all concentrated at the very beginning of an employment relationship, but persists throughout. We obtain the same result in our current sample: the positive coefficient on tenure and the negative coefficient on tenure squared indicates that the incidence of formal training actually increases with tenure, although at an decreasing rate. Interestingly, the same is true of new skills training. And finally, it is now well established in the literature that larger firms offer more training. This result is confirmed here. The incidence of formal and new skills training are both positively related to establishment size. The probability of training is also higher at a multisite firm. This latter effect is particularly large in magnitude: the coefficients on multiple site firms are equal to roughly one quarter of the means of the dependent variables.

Turning to informal training at the start of the job, recall that the 1993 NLSY implicitly presumes that individuals who can initially perform all of their job duties adequately do not receive Start Job Training. This routing pattern was changed in 1994, and we use the 1994 data to estimate the probit equations in table 4d. In column 1, the 0-1 dependent variable is whether or not the individual can perform all of his job duties adequately. This specification is intended to replicate the routing pattern in the 1993 Start Job Training data, where individuals who were fully comfortable are assumed to have not received training. Note that variables indicating whether an individual receives formal training and new skills training have significantly positive coefficients in

this equation, as does the individual's AFQT score. The effects of the other explanatory variables are not significantly different from zero.

The probit equation in column 2 of Table 4d analyzes the determinants of informal training at the start of the job, where the informal training questions are asked of all persons (as defined in the bottom panel of table 4a). The probit equation in column 3 analyzes the determinants of not performing all job duties adequately conditional on receiving informal training. Note in particular that AFQT has no effect on receiving informal training during the first year of tenure, but has a very large positive effect on the probability that an individual is not initially able to perform all of his job duties. These results suggest quite strongly that informal training at the start of the job does not appear to be selectively given to certain individuals (quite a different conclusion than new skills training and formal training which occur at all years of tenure), but conditional on receiving informal training at the start of the job, more able individuals are routed into more demanding jobs where they might not be fully comfortable.

#### **IV. Training and Wage Growth**

The recent availability of data with explicit information on the incidence and duration of training has led to the growth of a literature examining the relationship between training and wages. The papers in this literature find that employer provided training is positively related to wages and wage growth. However, as we noted earlier, most if not all public use individual based datasets do not appear to accurately measure the totality of formal and informal training. Our goal in this section is to use the both the recent NLSY data (despite its flaws) and the EOPP data to estimate how much of wage growth can be accounted for by existing measures of formal and informal training.

To fix ideas, suppose the log real wage of a worker  $i$  who is in his  $t^{\text{th}}$  year of tenure at employer  $j$  is given by

$$(1) \quad W_{ijt} = \gamma_t + \sum_{\tau=1}^t \beta_{\tau} T_{ij\tau} + \delta_T \sum_{k=1}^{j-1} \tilde{T}_{ik} + \sum_{\tau=1}^t \alpha_{\tau} I_{ij\tau} + \delta_I \sum_{k=1}^{j-1} \tilde{I}_{ik} + c_1 X_i + c_2 X_{ij} + c_3 X_{ijt} + u_i + v_{ij} + \varepsilon_{ijt}$$

where  $\gamma_t$  is a tenure specific effect on wages common to all individuals and all jobs,  $T_{ij\tau}$  is a variable indicating whether individual  $i$  received any formal training in his  $\tau^{\text{th}}$  year of tenure at his current job  $j$ ,  $\tilde{T}_{ik} \equiv \sum_{\tau} T_{ik\tau}$  is the total number of times that individual  $i$  received formal training at his  $k^{\text{th}}$  employer,  $I_{ij\tau}$  is a variable indicating whether individual  $i$  received any informal training in his  $\tau^{\text{th}}$  year of tenure at his current job  $j$ ,  $\tilde{I}_{ik} \equiv \sum_{\tau} I_{ik\tau}$  is the total number of times that individual  $i$  received informal training at his  $k^{\text{th}}$  employer,  $X_i$  is a vector consisting of individual-specific variables (such as ability, race, or gender),  $X_{ij}$  is a vector of match-specific variables (such as employer size), and  $X_{ijt}$  is a vector of observable variables that can vary within a match over time (such as the individual's marital status). Using a standard decomposition of the error term,  $u_i$  is an individual fixed effect that captures the net wage effect of unobserved person-specific variables,  $v_{ij}$  is an individual-job match effect, and  $\varepsilon_{ijt}$  is a transitory mean zero error component that is uncorrelated with both the explanatory variables and the fixed effects.

Note that in equation (1), we allow for the possibility that formal training and informal training might have different effects on wages. These different effects could arise from possibly unobserved differences in intensity, duration, or content of the different training programs. Furthermore, following Loewenstein and Spletzer (1996), we index the  $\beta$  and the  $\alpha$  coefficients by tenure, thereby allowing the effects of formal and informal training on the wage to vary in different years of tenure. And finally, following the discussion in Loewenstein and Spletzer (1998), we allow for the possibility that training in previous jobs may have different wage effects than training

in the current job because training may be specific and/or past employers may have attempted to extract some of the returns to general training.

As pointed out initially by Barron, Black and Loewenstein (1989) and more recently by Loewenstein and Spletzer (1996), the generally established finding that more able workers are more likely to receive training coupled with the fact that the controls for observable individual heterogeneity ( $X_i$ ) are imperfect measures for ability will cause OLS estimates of the training coefficients in equation (1) to be biased. That is, a positive correlation between the individual fixed effect  $u_i$  and training will lead to upward biased training coefficients. Furthermore, it is likely that there will be more training when the job match is better. In this case, the positive correlation between the unobserved quality of the job match,  $v_{ij}$ , and training will be an additional source of bias.

We can eliminate the individual fixed effect bias by estimating a wage growth equation. Specifically, taking first differences of equation (1), we obtain

$$(2a) \quad W_{ijt} - W_{ijt-1} = (\gamma_t - \gamma_{t-1}) + \beta_t T_{ijt} + \alpha_t I_{ijt} + c_3(X_{ijt} - X_{ijt-1}) + (\epsilon_{ijt} - \epsilon_{ijt-1})$$

for individuals with tenure  $t \geq 2$  in job  $j$ ,

$$(2b) \quad W_{ij1} - W_{ij-1\mathfrak{S}} = (\gamma_1 - \gamma_{\mathfrak{S}}) + \beta_1 T_{ij1} + \sum_{\tau=1}^{\mathfrak{S}} (\delta_T - \beta_\tau) T_{ij-1\tau} + \alpha_1 I_{ij1} + \sum_{\tau=1}^{\mathfrak{S}} (\delta_T - \alpha_\tau) I_{ij-1\tau}$$

$$+ c_2(X_{ij} - X_{ij-1}) + c_3(X_{ij1} - X_{ij-1\mathfrak{S}}) + (v_{ij} - v_{ij-1}) + (\epsilon_{ij1} - \epsilon_{ij-1\mathfrak{S}})$$

for individuals with tenure  $\mathfrak{S}$  in job  $j-1$  and tenure 1 in job  $j$ .

Equation (2a) is the wage growth that occurs within a job, and equation (2b) is the wage growth that occurs across jobs. Note that the individual specific  $X_i$  variables have been differenced out of both wage growth equations (2a) and (2b), and furthermore, the match-specific variables  $X_{ij}$  have been differenced out of the within job wage growth equation (2a).

In the within job wage growth equation (2a), the positive correlation between  $T_{ijt}$  and  $(u_i + v_{ij})$  does not cause any problems for OLS estimation because the error components  $u_i$  and  $v_{ij}$  are first differenced away.<sup>16</sup> However, only the individual fixed effect and not the match specific fixed effect has been eliminated in the across job wage growth equation (2b). Also note that any empirically identifiable effect of training -- both formal and informal -- that occurs in the first year of tenure is differenced away in equation (2a) but remains in equation (2b); this is important if one believes that informal training is more important at the start of the job rather than later in the job.<sup>17</sup>

We will analyze the wage growth of job stayers and job movers separately. From the discussion above, estimating a wage growth equation for job stayers using only information on training during the current year will provide consistent estimates of the effect of training on wages in the later years of tenure. However, estimating a wage growth equation for job movers requires a complete history of training in the previous job and will yield possibly biased effects of the potentially more important training at the start of the job.

#### **IVa. Within Job Wage Growth**

---

<sup>16</sup> Loewenstein and Spletzer (1996) show that a substantial amount of training occurs well after the match has started. It is possible that belated training may be correlated with the arrival of information indicating a good worker-firm match, which could cause OLS training coefficients to be biased upward. However, the results from Loewenstein and Spletzer's instrumental variable estimation indicates that this is not a serious problem.

<sup>17</sup> We cannot measure job stayers' returns to first-year training because we do not have a good measure of an individual's starting wage: although the NLSY inquires about the wage at the start of the job, our analysis of these data suggests that this variable may contain more noise than information. The wages that we use to calculate wage growth are wages on the primary job at the date of the survey interview. We should point out that we are classifying a person as having one year of tenure if he has been on his current job between 1 and 52 weeks at the time of the interview and having two years of tenure if he has been on his current job between 53 and 104 weeks at the time of the interview. Since formal training is measured over the previous year, our measure of second year formal training would include training from the 2nd through the 53rd week of tenure for someone in his 53rd week of tenure at the interview date. For someone in his 104th week of tenure at the interview date, second year formal training would include training from the 53rd through the 104th week of tenure. The same point applies to new skills training.

In this section, we shall concentrate on the within job wage growth equation (2a). The tenure specific intercepts  $\Delta \mathbf{g}_t \equiv \mathbf{g}_t - \mathbf{g}_{t-1}$  measure mean wage growth after controlling for formal and informal training. According to the basic human capital model, the tenure specific intercepts should be zero if all productivity enhancements are attributable to training. However, the tenure specific intercepts will be positive if either the measures of formal training  $T_{ijt}$  and informal training  $I_{ijt}$  that we observe in the data are imperfect measures for the training that actually occurs in the job, or if training does not account for all wage growth within the job. This latter possibility will occur if wages grow for reasons unrelated to productivity. As suggested by Lazear (1981), one such reason may be an effort by employers to prevent shirking.<sup>18</sup>

Most (if not all) individual based data such as the CPS, the NLS-72, and the early waves of the NLSY do not have independent measures of both formal and informal training.<sup>19</sup> As such, the estimates of the return to formal training are based on wage equations that omit informal training from the wage regression and thus possibly suffer from omitted variable bias.

Anticipating the empirical work to come, assume that the training measures  $T_{ijt}$  and  $I_{ijt}$  in the data are  $\{0,1\}$  incidence variables. Also, for purely expository convenience (all specifications in the empirical work control for observable heterogeneity), assume that there are no explanatory variables in the within job wage growth equation. Then one can show that the OLS estimates of  $\beta_t$  and  $\Delta \gamma_t$  from equation (2a) when informal training  $I_{ijt}$  is omitted are

$$(3a) \quad \hat{\beta}_t = \beta_t + \left[ \frac{\text{cov}_t(I_{ijt}, T_{ijt})}{\text{var}_t(T_{ijt})} \right] \alpha_t$$

<sup>18</sup> Indeed, Lazear and Moore (1984) went so far as to suggest that “most of the slope in age-earnings profiles is accounted for by the desire to provide incentives, rather than by on-the-job training.”

<sup>19</sup> As discussed in section II, the CPS and the NLS-72 do ask about informal training, but the routing patterns of the questionnaire suggest that these measures are of dubious value.

$$(3b) \quad \Delta \hat{\gamma}_t = \Delta \gamma_t + \alpha_t \text{mean}_t(I_{ijt}) - \text{mean}_t(T_{ijt}) \left[ \frac{\text{cov}_t(I_{ijt}, T_{ijt})}{\text{var}_t(T_{ijt})} \right] \alpha_t$$

where  $\text{mean}_t(\cdot)$ ,  $\text{cov}_t(\cdot, \cdot)$  and  $\text{var}_t(\cdot)$  are the mean, covariance and variance measured “within” the  $t^{\text{th}}$  year of tenure.<sup>20</sup>

Equation (3a) illustrates that the sign of the bias in  $\hat{\beta}_t$ , the estimated return to formal training, depends on both the covariance between formal and informal training and  $\alpha_t$ , the effect of informal training on wages. As we showed in the previous section, the measures of formal and “informal” New Skills training in the NLSY are positively correlated within a given year of tenure. Therefore, if  $\alpha_t$  is positive,  $\hat{\beta}_t$  is upward biased. Furthermore, equation (3b) illustrates that the OLS estimate of the tenure specific intercept  $\Delta \gamma_t$  will also be upward biased if  $\alpha_t$  is positive.<sup>21</sup>

Equations (3a) and (3b) provide the motivation for our empirical work. Specifically, omitting informal training in a within job wage growth equation will bias both the estimated return to formal training and the tenure specific intercepts. A comparison of these coefficients from a specification that excludes informal training with the coefficients from a specification that includes informal training will empirically describe both the sign and the magnitude of this omitted variable bias.

---

<sup>20</sup> That is, letting  $N_t$  denote the number of observations where an individual is in the  $t^{\text{th}}$  year of tenure of tenure,  $\text{mean}_t(I_{ijt}) = \left( \frac{1}{N_t} \right) \sum_{i=1}^{N_t} I_{ijt}$ ,  $\text{mean}_t(T_{ijt}) = \left( \frac{1}{N_t} \right) \sum_{i=1}^{N_t} T_{ijt}$ ,  $\text{var}_t(T_{ijt}) = \text{mean}_t(T_{ijt})[1 - \text{mean}_t(T_{ijt})]$ , and  $\text{cov}_t(I_{ijt}, T_{ijt}) = \left( \frac{1}{N_t} \right) \sum_{i=1}^{N_t} T_{ijt} I_{ijt} - \text{mean}_t(T_{ijt})\text{mean}_t(I_{ijt})$ .

<sup>21</sup> This statement is obvious if we rewrite equation (3b) as:

$$\Delta \hat{\gamma}_t = \Delta \gamma_t + \left[ \frac{\left( \frac{1}{N_t} \right) \sum_{i=1}^{N_t} I_{ijt} (1 - T_{ijt})}{\left( \frac{1}{N_t} \right) \sum_{i=1}^{N_t} (1 - T_{ijt})} \right] \alpha_t.$$

With this knowledge, we will be able to better interpret estimates of the return to formal training that arise from specifications that omit informal training.

To estimate equation (2a) one needs measures of wage growth, formal training, and informal training. Since the NLSY new informal training questions were asked in 1993 and 1994, we obtain our sample for estimating the within job wage growth equation (2a) by pooling the training data from 1993 and 1994 and the wage data from 1992 through 1994. Given that the tenure for this within job wage growth sample ranges up to 20 years, we can conceivably estimate 19 tenure specific intercepts, 19 formal training coefficients, and 19 informal training coefficients. Not only would this be too many coefficients to report, but many of the coefficients would be estimated very imprecisely. We have chosen to compromise and aggregate the sample into two distinct groups:  $tenure=2$  and  $tenure>2$ ; this specification allows training earlier in the job to have a different wage effect than training later in the job (recall that we cannot estimate the  $tenure=1$  coefficients in the within job equation). Investigation of the data with 19 different tenure effects does not lead one to reject this specification.

The means for the explanatory variables in the within job sample are presented in Table 5. We see that 15 percent of the individuals in the sample are in their second year of tenure, and the other 85 percent are beyond their second year of tenure. The incidence of formal training in the second year of tenure is 16.7 percent ( $.0254/.1524$ ), and the average annual incidence of formal training beyond the second year of tenure is 18.8 percent ( $.1592/.8476$ ). In light of our discussion in the previous section, we will use the New Skills Training as our measure of informal training. As is evident from the table, 38 percent of individuals in their second year of tenure receive new skills

training, while 44 percent of individuals who are beyond their second year of tenure have received new skills training in the past year.<sup>22</sup>

From the first regression in table 5, we see that real wages grow by approximately four and a half percent between the first and second year of tenure, and by approximately two and half percent per year beyond the second year of tenure. These averages include the wage growth of both those who received training during the previous year and those who did not receive training. In the second regression, we add controls for formal training. Real wages of those who do not receive training in their second year of tenure grow by three and a half percent, whereas real wages of those who receive training in their second year of tenure grow by approximately nine percent ( $.0363 + .0554$ ).

In column 3 of table 5, we add controls for the informal training as measured by the new skills questions in the 1993 and 1994 NLSY. Persons who receive informal training clearly have wage growth that is significantly greater than persons who have not received this training. The estimated coefficient for informal training in the second year of tenure is over three percent, and is statistically greater than zero. The estimated coefficient for informal training beyond the second year of tenure is considerably smaller – a little more than one percent – but still statistically different from zero.

A noteworthy feature of the estimation results presented in Table 5 is the relatively low return to training beyond the second year of tenure. As mentioned above, the return to a spell of informal training in the second year of tenure is nearly two percentage points higher than the return to informal training later in the job. This differential is even greater for formal training. According to equation (3) in table 5, the estimated return to a spell of formal training in the second year is over

---

<sup>22</sup> The fact that the average annual incidence of informal training is well below 100 percent is not in and of itself bothersome since we are only looking at individuals who are in at least their second year of tenure.

four and a half percent, but the return to a spell of formal training beyond the second year is essentially zero; the same pattern holds in the other equations. One possible explanation for the relatively low return to training spells that occur later in the match is that these spells may be of shorter duration. However, this hypothesis is not supported by the data. Later spells do not appear to be shorter in length than earlier spells. Furthermore, the estimated return to an hour of training is lower for training beyond the second year of employment.<sup>23</sup>

The existence of diminishing returns to training is another possible explanation for our finding that the return to training falls sharply beyond the second year. Loewenstein and Spletzer (1996) have shown that training incidence is highly correlated over time: individuals who have received training in the past are significantly more likely to receive training in the future. In this case, diminishing returns would cause the estimated return to training to fall with tenure. A final explanation is that the division of the returns to training between an employer and a worker may change with tenure. Because individuals with longer tenure have demonstrated that they place a relatively high valuation on their current job, the employer may be able to extract much of the returns to their training. Knowing this, he should also be more willing to pay the cost of training.

We argued earlier that the estimated return to formal training and the tenure specific intercepts will be biased upward if one does not control for informal training. The estimation results in table 5 bear this out. In the second year of tenure, the estimated formal training coefficient declines by 16 percent from .0554 to .0465 when controlling for informal training, and the estimated tenure specific intercept declines by 31 percent from .0363 to .0252. That is, in a wage growth equation

---

<sup>23</sup> Estimation results using  $\ln(\text{hours})$  of training are similar to those obtained using training incidence, but keep in mind that unlike formal training, the NLSY does not provide information on whether a spell of informal training is completed or still ongoing. This is especially serious when using duration rather than incidence as the explanatory variable in a wage growth equation because longer spells are more likely to be ongoing than shorter spells.

with no informal training variables, about one-third of the estimated tenure specific intercept and one-fifth of the estimated return to training is omitted variable bias.

Our empirical work in table 5 is related to the earlier work of Lynch (1992). Lynch hypothesizes that the returns to tenure -- an implied statistically significant 3.12 percent per year in her sample -- may be capturing other unmeasured factors such as informal on-the-job training. This is indeed what our estimates in table 5 imply, where we demonstrate that the return to tenure falls dramatically when controls for informal training are added to the wage equation. Interestingly, Lynch finds that the estimated return to tenure is unaffected by the inclusion of the formal training variables in the wage equation. This is quite different from our results, where a comparison of columns 1 and 2 in table 5 illustrates that the return to the second year of tenure falls by 21 percent when we control for formal training. One explanation for this difference may be the improved quality of the recent NLSY formal training data relative to the early waves of the NLSY survey.<sup>24</sup>

Besides the 1993-1994 NLSY, the only other publicly available data set with reasonably complete information on training is EOPP. Estimated wage growth equations using the EOPP data are presented in Table 6. The dependent variable is the natural log of the hourly wage paid to the typical worker after two years minus the natural log of the hourly wage paid to the typical worker at the start of the job. The key explanatory variables are the amounts of time spent in formal and informal training during the first three months of employment, where the estimate of formal training comes from the employer's response to question 3 in Table 1 while informal training comes from his responses to questions 1, 4 and 5 in Table 1. We may note that the EOPP results

---

<sup>24</sup> One immediate difference between Lynch's data and our data is that her measure of formal training only records spells that are four weeks or longer in duration. When we replicate this definition of formal training in our sample, the return to the second year of tenure only falls by 5 percent (from .0457 to .0434, as compared to the 21 percent decline from .0457 to .0363 that we document in table 5). This illustrates

are quite similar to those using the NLSY: adding the informal training variable to a regression that only includes formal training has the effect of reducing the coefficient on formal training by 12 percent and the intercept by 16 percent.

As discussed above, the NLSY's informal training variable may have substantial measurement error. This means that one-fifth is a lower bound estimate of the upward bias in the estimated formal training coefficient caused by omitting informal training from the wage growth equation. However, in this connection, it is important to note that formal training itself may be measured with considerable error, which by itself will lead to downward bias in the estimated OLS formal training coefficient. In fact, Loewenstein and Spletzer (1996) have estimated that in their 1988-1991 NLSY sample, 38 percent of the individuals in their second year of tenure who truly received formal training did not report this training, and 8 percent who did not receive formal training falsely reported having received such training. These estimates imply a very substantial downward measurement error bias in the OLS formal training coefficient.<sup>25</sup>

While the net effect of measurement error on the estimated formal training coefficient in column 3 of Table 5 is ambiguous, it is fairly safe to presume that mismeasurement of formal and informal training will both cause the intercept to be biased upward.<sup>26</sup> This has important implications for one's view of the labor market. The regression in column 3 indicates that the log real wages of persons who do not receive any formal or informal training are growing on average by two and a half percent between the first and the second year of tenure. This estimate is both

---

the importance of the short spells of training that are recorded in the post 1987 NLSY surveys but omitted from the pre 1987 NLSY surveys.

<sup>25</sup> While instrumental variables estimation is the standard method of correcting for measurement error, instrumental variables estimates are not consistent when the explanatory variable measured with error (in our case, training) can only take on a limited range of values. Loewenstein and Spletzer (1996) obtain their estimates of measurement error by comparing the relative magnitudes of the OLS and the IV training coefficients.

<sup>26</sup> If the probability that workers falsely report training that did not occur is sufficiently high, one can construct cases where the intercept is actually biased downward. However, these situations appear unlikely in practice.

economically significant and statistically different from zero. One might be tempted to argue that this positive coefficient is capturing wage growth that is occurring for reasons other than human capital accumulation. For example, employers may be delaying compensation for incentive purposes. However, if training is measured with considerable error, it is not necessary to resort to sources other than human capital accumulation to explain the positive intercept in the wage growth equation. The positive intercept in the wage growth equation may simply be a mixture of the small if not zero wage growth of those not investing in human capital and the large positive returns accruing to the human capital investment that we are not correctly measuring.

Finally, one might be concerned that the positive returns to training that we are measuring in column 3 of table 5 are proxying for unobserved factors that are omitted from the wage growth equation. In this explanation, our positive returns to both formal and informal training might be nothing more than the effects of unobserved characteristics that are positively associated with both training incidence and wage growth. We have conducted a simple sensitivity analysis that leads us to reject this argument. If there were a fixed effect in wage growth, we should be able to at least partially proxy for this effect by including fixed individual characteristics such as race, gender, and AFQT score in the wage growth regression. However, the estimates in column 4 of table 5 show quite strongly that the inclusion of these variables has essentially no effect on the training coefficients. Furthermore, the race, gender, and AFQT coefficients are neither individually nor jointly statistically significant.

#### **IVb. Across Job Wage Growth**

Estimating the across job wage growth equation (2b) requires not only a measure of informal training in the first year of the new job, but also a complete history of informal training in the previous job. Unfortunately, we have only two years of informal training in the NLSY. If we insist on a complete history of informal training in the previous job, we can only estimate wage

growth equations for individuals who change jobs in two consecutive years. Besides the problem of small sample size (our wage growth equation would only have 319 observations), the resulting sample would be very atypical, leading to concerns about potential selection bias. We have thus chosen to estimate a wage growth equation for all individuals who are in their first year of tenure and to treat past training as an omitted variable. As mentioned above, another possible bias stems from the presence of unobservable match effects in the worker's new and old jobs ( $v_{ij}$  and  $v_{ij-1}$  in equation (2b)). A correlation between these effects and training will cause the estimated training coefficients to be biased.

The estimated across job wage growth equations are presented in Table 7. Using the New Skills Training as our measure of informal training, the estimated returns to formal and informal training for persons in their first year of tenure are positive and roughly similar in magnitude to the estimated returns in table 5. However, the standard errors are quite high, so that the estimated coefficients are not significantly different from zero. Importantly, the estimated formal training coefficient declines by 14 percent when adding controls for informal training, and the negative intercept in column 2 doubles in magnitude when adding informal training in column 3. Although the across job wage growth equations are beset with multiple sources of bias, these specifications suggest that similar to the within job wage growth equations, the new NLSY informal training measures explain quite a bit of wage growth above and beyond that measured by the formal training measure.

## V. Conclusions and Discussion

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, much of this research has used a composite measure of training, and attention has not been given to any possible differences between formal and informal training.

This current paper was largely motivated by the findings of Lynch (1992) and Loewenstein and Spletzer (1996). Specifically, after controlling for formal training in a wage growth regression, is it possible that the remaining return to tenure is due to the unobserved informal training that occurs over the duration of a job match? This issue is at the heart of the human capital model, and is the main difference in alternative theories of wage growth. The addition of informal training questions to the 1993 and 1994 National Longitudinal Surveys of Youth makes it possible to examine the relationship between wages, formal training, and informal training.

As we described in section 3 of this paper, the routing pattern of the NLSY survey instrument is consistent with the assumption that roughly two-thirds of workers do not receive any informal training. This implicit assumption is at odds not only with the empirical estimates of incidence from the EOPP survey, but also with one's intuition that every job contains at least some element of informal training. Indeed, the change between 1993 and 1994 in the routing pattern for the NLSY Start Job Training questions (but unfortunately not for the New Skills Training questions) confirms that most workers receive some informal training at the start of their job. Even taking into account this problem with the routing patterns, our analysis suggests that the new 1993 and 1994 NLSY informal training data are measuring quite a bit of human capital accumulation that is missed by the formal training questions. This conclusion is consistent with our wage analysis, where we have found that both formal and informal training are positively related to wage growth.

We have presented our wage growth equations in the context of the basic human capital model, where all productivity enhancements on the job are attributable to training. Our empirical

estimates are quite supportive of this theory: used together, formal and informal training can explain a sizable amount of within job wage growth. It is worth noting that this result is not confined to the NLSY data -- similar findings arise when one analyzes the EOPP data. However, even after controlling for formal and informal training, the tenure specific intercepts in the NLSY wage growth equations remain substantially positive. While this is consistent with the hypothesis that wages grow for reasons unrelated to productivity, it also may be caused by measurement error in the training variables. Indeed, our analysis of training incidence in this paper and the results in Loewenstein and Spletzer (1996) both indicate that the NLSY training data are plagued with quite extensive amounts of measurement error.

Our measurement error finding leads to the issue of labeling. The analysis in this paper indicates quite strongly that there is a distinction between formal and informal training. But the question remains: are the NLSY and EOPP measures of formal and informal training exhaustive? We believe that it may be useful to distinguish between three types of human capital accumulation on the job: formal training, informal training, and learning by doing. 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 (1989) 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 other training, EOPP and the Panel Study of Income Dynamics both 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. 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 formal and informal training during the first three months of employment are similar for men and women. Interestingly, the new NLSY informal training questions also ask about learning by doing. As reported in Table 3 (question 61AA), the NLSY asks every worker who indicates that he could not initially 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?" An extensive analysis of the relationship between the measures of training and learning by doing -- in both the NLSY and the other data sets -- remains a topic for future research.

## References

- Altonji, Joseph G. and James R. Spletzer. 1991. "Worker Characteristics, Job Characteristics, and the Receipt of On-the-Job Training." *Industrial and Labor Relations Review*, pp. 58-79.
- Barron, John M., Mark C. Berger, and Dan A. Black. 1997. "How Well do We Measure Training?" *Journal of Labor Economics*, pp. 507-528.
- Barron, John M., Dan A. Black, and Mark A. Loewenstein. 1987. "Employer Size: The Implications for Search, Training, Capital Investment, Starting Wage, and Wage Growth." *Journal of Labor Economics*, pp. 76-89.
- Barron, John M., Dan A. Black, and Mark A. Loewenstein. 1989. "Job Matching and On-the-Job Training." *Journal of Labor Economics*, pp. 1-19.
- Barron, John M., Dan A. Black, and Mark A. Loewenstein. 1993. "Gender Differences in Training, Capital, and Wages." *Journal of Human Resources*, pp. 343-364
- Becker, Gary S. 1962. "Investment in Human Capital: A Theoretical Analysis." *Journal of Political Economy*, pp. 9-49.
- Bishop, John H. 1988. "Do employers Share the Costs and Benefits of General Training?" Unpublished paper, Cornell University.
- Bishop, John H. 1991. "On-the-Job Training of New Hires." In *Market Failure in Training?* edited by David Stern and Jozef M. M. Ritzén. Springer-Verlag, Berlin.
- Bowers, Norman and Paul Swaim. 1994. "Recent Trends in Job Training." *Contemporary Economic Policy*, pp. 79-88.
- Brown, Charles. 1989. "Empirical Evidence on Private Training." In *Investing in People*, Background Papers, Vol.1, Washington D.C.: Commission on Workforce Quality and Labor Market Efficiency, U.S. Department of Labor, pp. 301-320.
- Constantine, Jill M. and David Neumark. 1994. "Training and the Growth of Wage Inequality." NBER Working Paper #4729.
- Lazear, Edward P. 1981. "Agency, Earnings Profiles, Productivity, and Hours Restrictions," *American Economic Review*, pp. 606-620.
- Lazear, Edward P. and Robert L Moore. 1984. "Incentives, Productivity, and Labor Contracts." *Quarterly Journal of Economics*, pp. 275-296.
- Leigh, Duane E. and Kirk D. Gifford. 1996. "Workplace Transformation and Worker Upskilling: Evidence from the National Longitudinal Survey of Youth." Unpublished paper, Washington State University.
- Lillard, Lee A. and Hong W. Tan. 1992. Private Sector Training: Who Gets It and What Are Its

- Effects? *Research in Labor Economics*, pp. 1-62.
- Loewenstein, Mark A. and James R. Spletzer. 1996. "Belated Training: The Relationship Between Training, Tenure, and Wages." Unpublished paper, Bureau of Labor Statistics.
- Loewenstein, Mark A. and James R. Spletzer. 1997a. "Delayed Formal On-the-Job Training." *Industrial and Labor Relations Review*, pp. 82-99.
- Loewenstein, Mark A. and James R. Spletzer. 1997b. "General and Specific Training: Evidence and Implications" Unpublished paper, Bureau of Labor Statistics.
- Loewenstein, Mark A. and James R. Spletzer. 1998. "Dividing the Costs and Returns to General Training." *Journal of Labor Economics*, pp. 142-171.
- Lynch, Lisa M. 1991a. "The Role of Off-the-Job vs. On-the-Job Training for the Mobility of Women Workers." *American Economic Review*, pp. 151-156.
- Lynch, Lisa M. 1991b. "The Impact of Private-Sector Training on Race and Gender Wage Differentials and the Career Patterns of Young Workers." Report #NLS 92-8, Bureau of Labor Statistics.
- Lynch, Lisa M. 1992. "Private Sector Training and the Earnings of Young Workers." *American Economic Review*, pp. 299-312.
- Mincer, Jacob. 1962. "On-the-Job Training: Costs, Returns, and Some Implications." *Journal of Political Economy*, pp. 50-79.
- Mincer, Jacob. 1988. "Job Training, Wage Growth, and Labor Turnover." NBER Working Paper #2690.
- Pergamit, Michael R. and Janice Shack-Marquez. 1987. "Earnings and Different Types of Training." Bureau of Labor Statistics Working Paper #165.
- Royalty, Anne Beeson. 1996. "The Effects of Job Turnover on the Training of Men and Women." *Industrial and Labor Relations Review*, pp. 506-521.
- Veum, Jonathan R. 1993. "Training among young adults: who, what kind, and for how long?" *Monthly Labor Review*, pp. 27-32.
- Veum, Jonathan R. 1995. "Sources of Training and their Impact on Wages." *Industrial and Labor Relations Review*, pp. 812-826.

**Table 1: Training Questions in the CPS, NLS-72, EOPP, and NLSY Surveys**

**Current Population Survey (CPS)**

- 1) Since you obtained your present job did you take any training to improve your skills?
- 2) Did you take the training in
  - a) school,
  - b) a formal company training program,
  - c) informal on-the-job,
  - d) other

**National Longitudinal Survey of the High School Class of 1972 (NLS-72)**

- 1) 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?
- 2) Indicate each type of training benefit or program you participated in. Then record the number of hours per week and the total number of weeks:
  - a) formal registered apprenticeship (your state or labor union)
  - b) employer-provided job training during hours on employer premises
  - c) informal on-the-job training (e.g., assigned to work with someone for instruction or guidance, etc.)
  - d) employer-provided education or training during working hours away from employer premises
  - e) tuition aid and/or financial assistance for attending educational institutions after working hours
  - f) other

**Employer Opportunity Pilot Project (EOPP)**

- 1) During the first three months, how many total hours does the average new employee spend in training activities in which he or she is watching other people do the job rather than doing it himself?
- 2) Is there formal training, such as self-paced learning programs or training done by specially trained personnel, for people hired in ...'s position, or is all the training done as informal on the job training?
- 3) During the first three months of work what was the total number of hours spent on formal training such as self-paced learning programs or training done by specially trained personnel of your typical worker in ...'s position?
- 4) ...during their first three months of work, what was the total number of hours management and line supervisors spent away from other activities giving informal individualized training or extra supervision to your typical worker in ...'s position?
- 5) During the first three months of work what was the total number of hours co-workers who are not supervisors spent away from their normal work giving informal training or extra supervision to your typical worker in ...'s position?

**National Longitudinal Survey of Youth (NLSY)**

- 1) Since [date of the last interview], did you attend any training program or any on-the-job training designed to help people find a job, improve job skills, or learn a new job?
- 2) Which category best describes where you received this training?
  - a) business school
  - b) apprenticeship program
  - c) a vocational or technical institute
  - d) a correspondence course
  - e) formal company training run by employer or military training
  - f) seminars or training programs at work run by someone other than employer
  - g) seminars or training programs outside of work
  - h) vocational rehabilitation center
  - i) other (specify)

**Table 2: Incidence of Training  
EOPP, NLSY, NLS-72, and CPS Surveys**

Survey	Sample	Respondent	Reference Period	Formal Training Incidence	Informal Training Incidence
EOPP	Workers aged 16-64, Tenure $\leq$ 3 months	Employer	First Three Months of Job	13.4%	95.8%
NLSY	Workers aged 27-38 Tenure unrestricted	Worker	Last Year	17.3%	
NLS-72	Workers aged 31, Tenure unrestricted	Worker	Current Job	45.7%	19.7%
CPS	Workers aged 16-64 Tenure unrestricted	Worker	Current Job	44.1%	16.3%

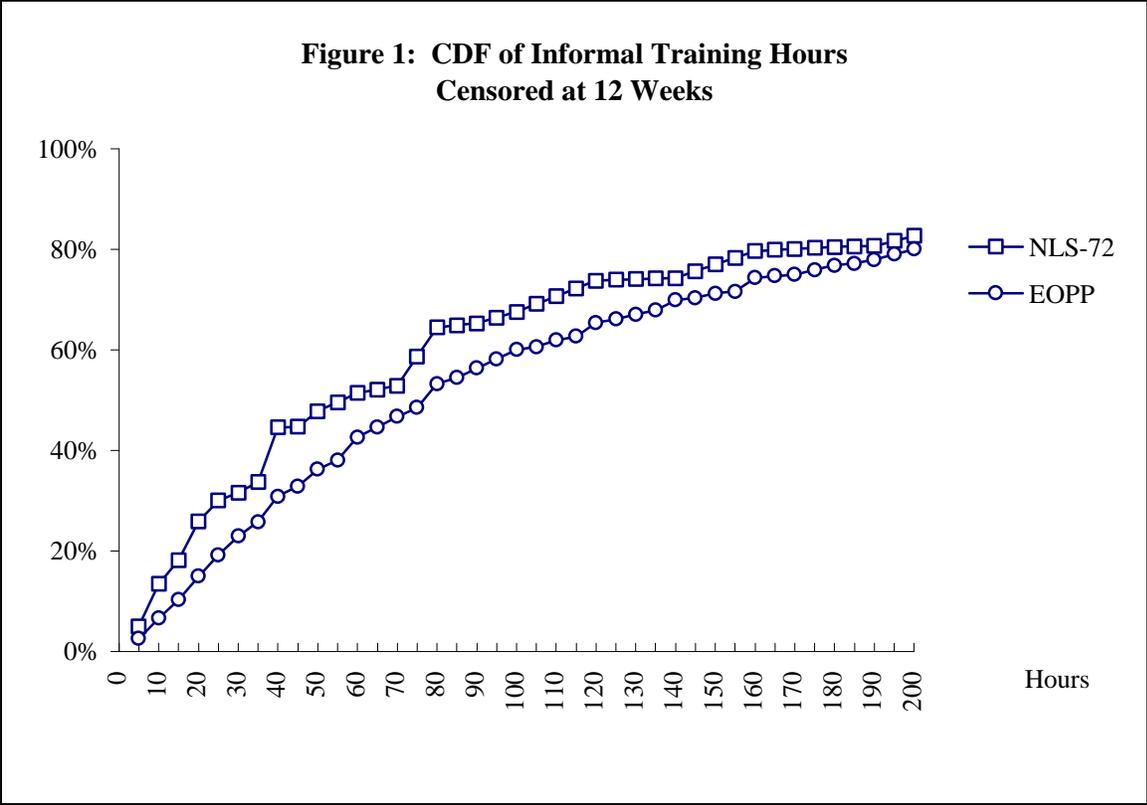
EOPP: 1982 survey, unweighted data. Formal training measured from question 2 in table 1. Informal training measured from questions 1, 4, and 5 in table 1. Source: authors' calculations.

NLSY: 1993-1994 surveys, unweighted data. Formal training measured from question 1 in table 1. Source: authors' calculations.

NLS-72: 1986 survey, unweighted data. Formal training measured from question 1 in table 1. Informal training measured from question 2c in table 1. Source: authors' calculations.

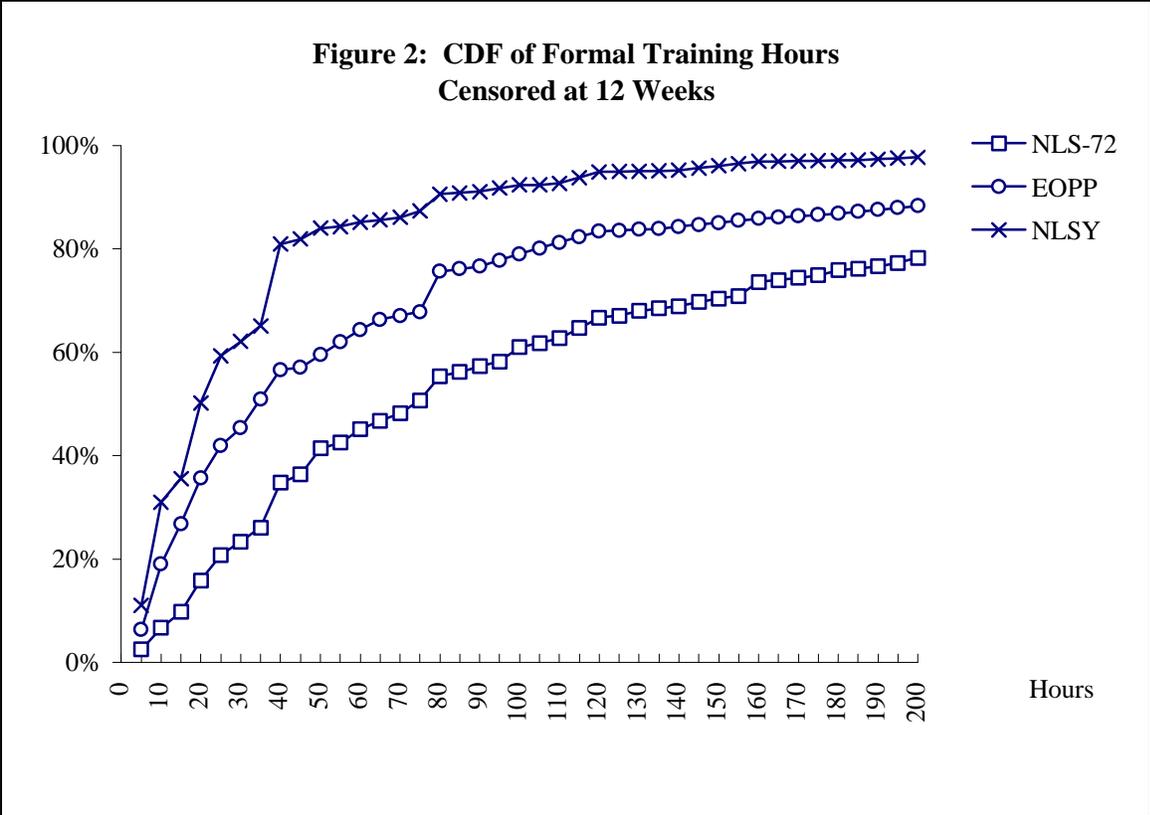
CPS: January 1991 survey, unweighted data. Formal training measured from question 1 in table 1. Informal training measured from question 2c in table 1. Source: authors' calculations.

Survey	Sample	Respondent	Reference Period	Formal Training Incidence	Informal Training Incidence
CPS	Workers aged 16-64, Tenure $\leq$ 3 months	Worker	Current Job	20.5%	9.7%
	Workers aged 27-38 Tenure unrestricted	Worker	Current Job	45.5%	16.8%
	Workers aged 31, Tenure unrestricted	Worker	Current Job	43.6%	17.3%



NLS-72: 1986 survey, unweighted data. Informal training measured from question 2c in table 1.  
 Mean=116.0 hours. Source: authors' calculations.

EOPP: 1982 survey, unweighted data. Informal training measured from questions 1, 4, and 5 in table 1.  
 Mean=140.0 hours. Source: authors' calculations.



NLS-72: 1986 survey, unweighted data. Formal training measured from question 1 in table 1.  
 Mean=132.7 hours. Source: authors' calculations.

EOPP: 1982 survey, unweighted data. Formal training measured from question 3 in table 1.  
 Mean=80.3 hours. Source: authors' calculations.

NLSY: 1993-1994 surveys, unweighted data. Formal training measured from question 1 in table 1.  
 Mean=40.0 hours. Source: authors' calculations.

**Table 3: Informal Training Questions in the 1993 NLSY**

Start Job Training

60A) 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?

<100%: Continue to 61AA

=100%: Exit Informal Training Questions

61AA) How long did it take before you were fully comfortable doing this kind of work for [employer name] on your own?

63) There are a variety of ways that people learn to do their jobs. Please think about the [time in 61AA] when you were learning to perform your job duties for [employer name]. In learning how to perform these duties, did you participate in any classes or seminars?

Yes: Continue to 65C

No: Skip to 67

65E) Over how many weeks did you attend these classes or seminars?

65F) During the [65E] weeks that you attended these classes or seminars, how many hours per week did you spend in them?

67) Who explained or showed you how your job tasks should be done. Was it your supervisor, your coworker(s), or both?

"Supervisor": Continue to 67E

"Coworker(s)": Skip to 67L

"Both": Ask 67E and 67L

"Neither": Skip to 68

67E) Over how many weeks did you spend time with your supervisor learning how to do this kind of work?

67F) During the [67E] weeks you spent time with your supervisor learning how your job tasks should be done, how many hours per week did you spend?

67L) Over how many weeks did you spend time with coworkers learning how to do this kind of work?

67M) During the [67L] weeks you spent time with coworkers learning how your job tasks should be done, how many hours per week did you spend?

New Skills Training

36A) From time to time changes occur at work that make it necessary to learn new job skills. On this card are a number of examples. As I read each example, tell me whether these changes have required you to learn new job skills in the past 12 months?

Yes: Continue to 39

No: Exit Informal Training Questions

39) As a result of these changes at work, did you participate in any classes or seminars to learn how the changes would affect how you do your job?

Yes: Continue to 39D

No: Skip to 40

39D) Over how many weeks did you attend these classes or seminars?

39E) During the [39D] weeks that you attended these classes or seminars, how many hours per week did you spend in them?

40) Who explained or showed you how these changes at work would affect how you do your job. Was it your supervisor, your coworker(s), or both?

"Supervisor": Continue to 40C

"Coworker(s)": Skip to 40G

"Both": Ask 40C and 40F

"Neither": Skip to 41

40C) Over how many weeks did you spend time with your supervisor learning how the changes would affect how you do your job?

40Ca) During the [40C] weeks you spend with your supervisor learning how to do your new duties, how many hours per week did you spend?

40G) Over how many weeks did you spend time with coworkers learning how the changes would affect how you do your job?

40H) During the [40G] weeks you spent time with coworkers learning how the changes would affect how you do your job, how many hours per week did you spend?

**Table 3 (continued)**

68) In learning to do the kind of work you are now doing, did you make use of any self-study material or self-instructional packages, such as manuals, workbooks, or computer-assisted teaching programs?

Yes: Continue to 68E

No: Skip to 69A

68E) Over how many weeks did you spend time using self-teaching packages?

68F) During the [68E] weeks when you were using self-teaching packages, how many hours per week did you spend?

69A) Besides what we've talked about so far, 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]?

41) In learning how these changes at work would affect how you do your job, did you make use of any self-study material or self-instructional packages, such as manuals, workbooks, or computer-assisted teaching programs?

Yes: Continue to 41C

No: Skip to 42A

41C) Over how many weeks did you spend time using self-teaching packages?

41D) During the [41C] weeks when you were using self-teaching materials, how many hours per week did you spend?

42A) Besides what we've talked about so far, can you think of anything else that you did that helped you learn how the changes would affect your job?

**Table 4a: Descriptive Statistics, 1993-1994 NLSY data**

1993 Start Job Training	Incidence <sup>a</sup>	Incidence <sup>b</sup>	Means Conditional on Receiving Training		
			Hours/Week	# Weeks	Total Hours
Total	27.10%	98.18%	18.85 (14.97)	6.68 (9.15)	123.60 (194.10)
Classes/Seminars	0.38%	1.36%	24.00 (16.00)	1.33 (0.58)	26.67 (12.22)
Supervisor Show You	19.57%	70.91%	19.05 (16.93)	2.50 (3.32)	47.84 (69.44)
Coworkers Show You	19.57%	70.91%	21.58 (17.21)	3.93 (5.26)	87.63 (136.77)
Self-Study	12.92%	46.82%	12.61 (13.07)	4.33 (7.81)	56.18 (138.91)

Data restricted to those in their first year of tenure. Standard deviations in parentheses. "Other" training not reported.

<sup>a</sup> Sample Size=797 (Those who initially performed less than 100% are assumed to have not received training).

<sup>b</sup> Sample Size=220 (Those who initially performed less than 100% of their current duties adequately).

1994 Start Job Training	Incidence	Means Conditional on Receiving Training		
		Hours/Week	# Weeks	Total Hours
Total	79.89%	16.12 (14.28)	6.11 (10.40)	96.05 (176.64)
Classes/Seminars	1.11%	12.13 (9.55)	7.00 (10.03)	24.63 (13.38)
Supervisor Show You	57.28%	15.18 (15.51)	3.12 (5.84)	51.69 (132.65)
Coworkers Show You	46.32%	18.63 (16.10)	3.55 (5.43)	69.11 (118.87)
Self-Study	24.55%	12.26 (12.44)	5.54 (8.70)	66.26 (142.63)

Data restricted to those in their first year of tenure. Standard deviations in parentheses.

"Other" training not reported. Sample Size=721.

**Table 4b: Descriptive Statistics, 1993-1994 NLSY data**

New Skills Training	Incidence <sup>a</sup>	Incidence <sup>b</sup>	Means Conditional on Receiving Training		
			Hours/Week	# Weeks	Total Hours
Total	40.43%	91.74%	13.24 (26.99)	5.51 (13.51)	56.74 (168.15)
Classes/Seminars	9.79%	22.22%	11.50 (13.44)	2.23 (5.32)	18.35 (35.50)
Supervisor Show You	25.67%	58.24%	7.32 (10.36)	2.56 (6.82)	22.02 (114.27)
Coworkers Show You	13.25%	30.05%	10.11 (12.83)	3.04 (7.11)	30.94 (98.05)
Self-Study	19.99%	45.35%	8.08 (10.32)	4.45 (9.66)	33.66 (115.74)

Standard deviations in parentheses. "Other" training not reported.

<sup>a</sup> Sample Size=9362 (Those not requiring new skills are assumed to have not received training).

<sup>b</sup> Sample Size=4126 (Those for whom workplace changes required new skills).

Formal Training	Incidence	Means Conditional on Receiving Training		
		Hours/Week	# Weeks	Total Hours
Total	17.25%	18.76 (14.98)	3.15 (5.74)	48.19 (126.87)
Apprentice, Business School, Voc-Tech	1.53%	13.74 (12.00)	7.86 (11.35)	78.38 (183.27)
On-the-Job Training	7.64%	20.28 (15.73)	2.86 (4.52)	50.17 (108.74)
Inside Seminars	3.31%	17.60 (13.90)	3.03 (6.35)	36.24 (70.93)
Outside Seminars	3.82%	18.52 (14.00)	2.42 (4.52)	38.35 (107.25)

Standard deviations in parentheses. Sample Size=9362. "Other" training not reported.

Training durations reported only for spells not ongoing at the date of the interview.

**Table 4c: Training Incidence Regressions, 1993-1994 NLSY data**

	Mean	New Skills Training	Formal Training
1 if Formal Training	.1725	.2153 * (.0139)	
1 if "New Skills Training"	.4043		.1181 * (.0075)
AFQT (Ability)	65.59	.0013 * (.0003)	.0013 * (.0002)
1 if Female	.4687	.0269 * (.0110)	.0302 * (.0078)
1 if Hispanic	.1830	.0407 * (.0157)	-.0020 (.0113)
1 if Black	.2763	-.0039 (.0146)	-.0059 (.0105)
1 if Education <12	.0936	-.0347 (.0206)	-.0789 * (.0186)
1 if Education 13-15	.2410	.0657 * (.0138)	.0414 * (.0097)
1 if Education =16	.1430	.0606 * (.0172)	.0533 * (.0117)
1 if Education >16	.0819	.0292 (.0218)	.0400 * (.0147)
1 if Multiple Site Employer	.7143	.0953 * (.0124)	.0471 * (.0093)
Ln(Firm Size)	4.146	.0158 * (.0027)	.0070 * (.0019)
Tenure (years)	5.205	.0242 * (.0043)	.0112 * (.0032)
Tenure Squared	44.91	-.0013 * (.0003)	-.0007 * (.0002)
Sample Size	9362	9362	9362
Mean of Dependent Variable		.4043	.1725

Probit coefficients (standard errors) refer to the effect of the explanatory variable on the training probability evaluated at the sample mean. \* implies statistically significant at the 5% level.

Start Job Training regressions are restricted to those in their first year of tenure. New Skills Training regressions and Formal Training regressions are based on the full sample.

All equations include an intercept, age, enrollment status, a quadratic in experience, marital status, number of children, number of previous jobs, indicators for government employment and part-time employment, union, local area unemployment rate, urban residence, and SMSA.

**Table 4d: Training Incidence Regressions, 1994 NLSY data**

	Mean	Perform <100% of initial duties adequately	Informal Training	Perform <100% of initial duties adequately conditional on Informal Training
1 if Formal Training	.0915	.1786 *	-.0040	.2619 *
		(.0599)	(.0550)	(.0758)
1 if "New Skills Training"	.2469	.0934 *	.1723 *	.0397
		(.0403)	(.0410)	(.0475)
AFQT (Ability)	61.66	.0037 *	.0012	.0041 *
		(.0010)	(.0008)	(.0012)
1 if Female	.4105	.0136	.0262	.0083
		(.0374)	(.0321)	(.0449)
1 if Hispanic	.1567	.0792	.0411	.0785
		(.0557)	(.0478)	(.0687)
1 if Black	.3093	.0058	.0446	-.0089
		(.0486)	(.0402)	(.0598)
1 if Education <12	.1290	-.1070	-.0200	-.1259
		(.0641)	(.0467)	(.0772)
1 if Education 13-15	.2205	-.0895	-.0936	-.0670
		(.0487)	(.0388)	(.0592)
1 if Education =16	.1207	-.0023	.0307	-.0197
		(.0623)	(.0581)	(.0734)
1 if Education >16	.0735	.1000	.0499	.1124
		(.0742)	(.0721)	(.0883)
1 if Multiple Site Employer	.6019	-.0013	.0207	-.0189
		(.0376)	(.0311)	(.0451)
Ln(Firm Size)	3.465	.0150	.0137	.0131
		(.0094)	(.0080)	(.0115)
Sample Size	721	721	721	576
Mean of Dependent Variable		.3065	.7989	.3837

Probit coefficients (standard errors) refer to the effect of the explanatory variable on the training probability evaluated at the sample mean. \* implies statistically significant at the 5% level.

All equations include an intercept, age, enrollment status, a quadratic in experience, marital status, number of children, number of previous jobs, indicators for government employment and part-time employment, union, local area unemployment rate, urban residence, and SMSA.

**Table 5: Within Job Wage Growth Regressions, NLSY data**

	Mean	(1)	(2)	(3)	(4)
<b>Tenure=2</b>					
Intercept	.1524	.0457 *	.0363 *	.0252 *	.0260 *
		(.0061)	(.0066)	(.0077)	(.0077)
Formal Training	.0254		.0554 *	.0465 *	.0452 *
			(.0152)	(.0156)	(.0156)
“Informal” Training	.0581			.0327 *	.0324 *
				(.0119)	(.0119)
<b>Tenure&gt;2</b>					
Intercept	.8476	.0247 *	.0236 *	.0188 *	.0194 *
		(.0034)	(.0036)	(.0041)	(.0041)
Formal Training	.1592		.0050	.0019	.0009
			(.0062)	(.0063)	(.0063)
“Informal” Training	.3719			.0120 *	.0111 *
				(.0050)	(.0050)
Gender, Race, AFQT		No	No	No	Yes

1992-1994 NLSY. Sample size=7745. Dependent variable is log real wage growth. Mean (standard deviation) of dependent variable in the second year of tenure is .0499 (.2395); Mean (standard deviation) of dependent variable beyond the second year of tenure is .0291 (.1859). OLS regression coefficients, standard errors in parentheses. \* implies statistically different from zero at the 5% level of significance (two tailed test).

All equations control for, in first differences, marital status, number of children, enrollment status, highest grade completed, and the local area unemployment rate. All equations also include an indicator for year.

Gender, Race, and AFQT are defined as deviations from sample means.

**Table 6: Within Job Wage Growth Regressions, EOPP data**

	Mean	(1)	(2)	(3)
Intercept		.3816 *	.3876 *	.3237 *
		(.0591)	(.0587)	(.0606)
Formal Training Ln(1+Hours)	.4257		.0209 *	.0184 *
			(.0045)	(.0045)
“Informal” Training Ln(1+Hours)	4.140			.0151 *
				(.0038)

1982 EOPP. Sample size=1527. Dependent variable is log real wage growth measured over the first two years of employment. Mean (standard deviation) of dependent variable is .1889 (.2109). OLS regression coefficients, standard errors in parentheses. \* implies statistically different from zero at the 5% level of significance (two tailed test). All equations control for a quadratic in age, a quadratic in experience, education, gender, union, seasonal employment, employer size, and industry and occupation.

**Table 7: Across Job Wage Growth Regressions, NLSY data**

	Mean	(1)	(2)	(3)	(4)
<b>Tenure=1</b>					
Intercept		-.0025 (.0138)	-.0071 (.0143)	-.0144 (.0155)	-.0141 (.0156)
Formal Training	.1074		.0383 (.0309)	.0331 (.0312)	.0328 (.0315)
“Informal” Training	.2730			.0262 (.0217)	.0263 (.0218)
Gender, Race, AFQT		No	No	No	Yes

1993-1994 NLSY. Sample size=1509. Dependent variable is log real wage growth. Mean (standard deviation) of dependent variable is .0256 (.3721). OLS regression coefficients, standard errors in parentheses.

\* implies statistically different from zero at the 5% level of significance (two tailed test).

All equations control for, in first differences, marital status, number of children, enrollment status, highest grade completed, the local area unemployment rate, SMSA, urban residence, an indicator for private or government employment, multiple site employer, and union status. Gender, Race, and AFQT are defined as deviations from sample means.