Human Capital, Education, Achievement and Learning *

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Abstract This paper reviews the most important scientific and policy research in the area of human capital, education achievement and learning and discusses the need for a new nationally representative household panel for the United States to provide the research resources necessary to keep the United States at the forefront of scientific and policy research in this area. Excellent panel data incorporating recent advances in panel design and innovative measures are required for addressing the most important policy issues.

1 Introduction

The major household panels internationally all have large sections devoted to human capital, education achievement and learning. Within the broad framework of human capital there is overwhelming evidence of the importance of skills or abilities to lifetime success, most obviously in earnings, but also in many other outcomes relevant to policy makers. Increasingly human capital has been linked to areas such as health outcomes, marriage, fertility, social cohesion, immigrant assimilation, entrepreneurship and criminal behavior. This report discusses the need for a new nationally representative household panel for the United States to provide the research resources necessary to keep the United States at the forefront of scientific and policy research in the area of human capital, education achievement and learning. Section 2 discusses the most important current scientific and policy issues in this area. Section 3 assesses the need for a new household panel to address these issues. What information needs to be collected is discussed in Section 4, with a special emphasis on innovative measures to push forward the research agenda. Finally, Section 5 provides some conclusions and suggested priorities.

2 Most Important Current Scientific and Policy Issues

The most basic scientific and policy questions in the human capital area have always been and continue to be: how and why do skills or abilities vary across individuals, across countries and over time, often leading to large differences in lifetime success, and what is the role of policy in influencing these outcomes? Within the human capital framework the skills or abilities are interpreted as forms of human capital that are either "endowed" or "produced", though the distinction is becoming blurred as components of human capital previously considered as "endowments"are now often considered as themselves produced. The large amount of research devoted to how human capital is produced utilizes the idea of a human capital production function, and typically distinguishes between three phases of production: pre-formal schooling, formal schooling, and post-formal schooling.

Earlier research focussed on the formal schooling phase and produced a very large body of evidence on "rates of return" to various forms of schooling or on the "college premium." Economic

models were also employed to try and explain why schooling outcomes varied across individuals (or across countries, or over time) and how this variation might be influenced by policies such as taxation, public school expenditure, tuition subsidies or student loans. More recent research has devoted much more attention to the pre- and post-formal schooling phases, and their associated production functions. It has also devoted more attention to distinguishing between different types of skills or human capital. This has led to a new focus for the main scientific and policy questions as they relate to these pre- and post-schooling phases. These might be broadly summarized as follows:

- How important is early childhood investment? What does the human capital production function associated with this phase look like? What are the inputs and how should they be measured? How can we measure the outputs? Should the output measures be multidimensional, particularly with regard to distinguishing between the more traditional "cognitive" measures and the new "non-cognitive" measures? What role can policy play in influencing outcomes in this phase? Is policy intervention more effective in this phase than in later phases?

- What is the Relationship Between Skills, Tasks and Wages? How can different skills be measured? What determines the life-cycle evolution of a multi-dimensional portfolio of skills? How important is investment in this phase? What is the source of individual variation in this life-cycle evolution? Is it ability, effort, matching, or some combination? Can we go beyond a "black box" characterization of what the production function looks like for this phase? How do skills acquired in the schooling phase become skills used on the job during the school to work transition phase and how are they related? To what extent are skills transferable across different jobs? How can this be measured? Can some skills that are useful in some contexts actually reduce productivity in other contexts? What is the relationship between transferability, wage changes and job mobility? Is there a useful role for policy in this phase, for example, regarding job training or retraining programs?

- What happens to human capital, or a worker's skill portfolio, as a worker approaches retirement? Do all skills depreciate at the same rate? Do workers adjust the kind of jobs they do in the pre-retirement phase? How important is this for the path of earnings of older workers?

- Taking all phases together, from a policy point of view is the allocation of resources to each phase in the right balance and are they used in the most effective way? For example, should resources be shifted towards the earlier phase as more evidence appears on the value of early intervention? Are the very large resources devoted to the formal schooling phase used as efficiently as they could be? Should resources be shifted towards much later phases to help the increasing number of older workers adjust to a rapidly changing job market?

Research on multidimensional skill development and evolution in the pre- and post-schooling phases is still relatively new. Progress on improving our understanding in these phases is necessary for improving our advice to policy makers on the basic policy questions of what policies work, at which ages and for whom? However, more generally an increased focus on types of skills also provides potential for new research on several additional important questions:

- How do skills or skill portfolios of males and females differ on labor market entry and do they evolve differently? Have they converged over time?

- What sort of skills do immigrants bring to the labor market? Are they the same as native born? What is the contribution of immigrants to the country's stock of human capital? How does the arrival of large numbers of immigrants affect native born human capital?

- Can we expect an increasingly polarized labor market along skill type lines, or is this a temporary phenomenon that will disappear as workers adjust multi-dimensional skill portfolios?

- Are the skill portfolios of entrepreneurs substantially different from wage workers? How can they be measured? How are they produced? Is there a role for policy in stimulating the production of these types of skills?

2.1 Early Childhood Investment

Adults are diverse in skills and abilities, and this diversity accounts for a substantial amount of the interpersonal distribution of earnings and other socioeconomic outcomes. The importance of final educational achievement for so many life outcomes led most social scientists to focus on determinants

of individual schooling decisions during late adolescence and early adulthood. However, a growing body of empirical evidence from child psychology, neuroscience, sociology, and economics suggests that early childhood environments and investments play a central role in determining later schooling decisions and final success in the economy. Early childhood investments are increasingly recognized as particularly important in determining the course of a whole range of life-cycle outcomes including high school graduation, post-secondary enrolment, employment, health, income and wealth. As a result, one of the most important policy questions today is what to do about early childhood human capital investment, broadly interpreted. This includes the environment in which the child grows up as well as parental actions. Frontier research by economists in this area is connected to recent developments in education and neuroscience. Leading papers in the economics literature are Cunha and Heckman (2007) and Cunha, Heckman and Schennach (2010). The connection to the developmental neuroscience literature is described and discussed in Howard-Jones *et al.*(2012).

Until very recently, intergenerational models of families and children have collapsed the investment phases of early childhood and adolescence into a single period. This necessarily abstracts from important features of the skill formation process. As discussed in Cunha and Heckman (2007) and Howard-Jones *et al.*(2012), two key properties of the skill technology are complementarity and self-productivity. Complementarity implies that early skill investments raise the productivity of later skill investments, and vice versa. That is, skill inputs are synergistic over time. Self-productivity embodies the idea that skills acquired at one stage of development directly enhance skill levels at later stages. Acquired skills are persistent. Together, complementarity and self-productivity explain why skills beget skills, and understanding their implications is important for designing policy. Complementarity and self-productivity imply that remediation of early deficits (resulting from poor family or schooling environments) is very costly. As a result, college and post-school investments tend to offer the lowest economic returns to those who are most disadvantaged. By contrast, early investments tend to be most productive for the most disadvantaged. Late investments tend to exhibit a sharp equity-efficiency tradeoff while early investments do not.

Howard-Jones *et al.*(2012) discuss the neuroscience of the "learning begets learning" principle. They note that early years are foundational "in the sense that neural circuitry developing that

contributes to the ability to learn later in childhood. Also, neural plasticity diminishes with age for all individuals, with the neural and behavioural effects of some very early atypical experiences difficult to reverse in later years." (p. 23) However, they also suggest that, given their review of the literature, a "learning begets learning" principle falls short of what we know of development in several important ways, primarily in terms capturing what is a more complex picture in the currently specified, relatively simple, human capital production function. While a growing set of evidence on human capital interventions among young children, adolescents, and adults appears to support these broad principles, more theory is needed to better interpret the evidence and inform policy while more evidence is needed to better quantify the magnitudes or refine the specification of complementarity and self-productivity.

Cunha, Heckman and Schennach (2010) emphasize a distinction between cognitive and non-cognitive skills. In the neuroscience literature this is a controversial topic. The term "cognitive skills", as used in this economic literature refer to factors like IQ and other achievement tests. The "non-cognitive" skills refer to what psychologists sometimes consider as personality traits like motivation and the ability to work with others. Howard-Jones *et al.*(2012) refer to the cognitive/non-cognitive division as primitive and potentially confusing, arguing that few aspects of human behavior are devoid of cognition and that attempts to justify the division are not well founded on scientific understanding. The thrust of the argument is not that the focus of skill measurement should remain with traditional "cognitive skills" measurement like IQ or AFQT, but that broader groups of skills should be considered without the overly simplistic, or unhelpful simple cognitive/non-cognitive division. The specification for these skill sets, the optimal timing of parental and other investments for different skills, the form these investments might take (e.g. "How Often Child Goes on Outings at Ages 12", "How Often Mom Reads to Child During Year of Birth") are all important areas of future research.

2.2 Skills and Tasks

The vast majority of human capital literature focussed on human capital produced during the formal schooling phase. From the point of view of policy this research provided estimates of "rates of return"

to schooling. Estimating the true rate of return to schooling constitutes an enormous literature discussed and analyzed in Card (1999, 2001). The classic paper on optimal life-cycle accumulation of human capital, Ben Porath (1967), and the empirical analysis in Mincer (1974) also consider production of human capital in the post-schooling period. In the theoretical model of Ben Porath (1967), human capital is homogeneous. The theoretical model of Heckman, Lochner and Taber (1998) introduces heterogeneous human capital, but in a way that is homogeneous within education group. Similarly, the "canonical model" of wages and employment first introduced by Katz and Murphy (1992) to study the path of the college wage premium, and subsequently used extensively for a variety of relative wage premia analyses, specifies homogeneous human capital within two broad education groups.[1] The applications of these models typically use years of schooling or years of job market experience as proxies for human capital investments or of the human capital stock. The process of accumulation of human capital during the schooling phase has been extensively studied in terms of observed inputs leading to output of human capital "directly" observed in the form of test scores or qualifications such as BA degrees, as well as indirectly inferred from wages. The post schooling phase remains much more of a black box.

For the post-schooling phase there are some studies that parallel the schooling studies in the sense of trying to measure inputs, such as formal classroom training, or more general employer provided training. The output in this case, however, is almost exclusively in terms of wage changes rather than any "direct" measure of the output. This is a reflection of a basic observability or identification problem for human capital discussed and analyzed in Bowlus and Robinson (2012). Human capital, especially in the post school phase, is inferred from observed wages and the process by which it accumulates is largely a black box. A new literature on skills and tasks suggests the potential for a partial opening of the black box, at least in terms of more direct measures of human capital outputs.

Acemoglu and Autor (2011), in discussing problems with the canonical model in explaining some features of recent wage patterns, argue in favor of introducing skills and tasks in a more formal way into models of wage and employment determination. This approach is related to the more recent literature on specific human capital that uses measures of skills and tasks from sources such

[1]The model of Katz and Murphy (1992) was termed the "canonical model" in Acemoglu and Autor (2011).

as the *Dictionary of Occupational Titles* (DOT). Human capital specificity has been investigated in several recent papers. Neal (1995) and Parent (2000) investigated evidence for industry specific human capital, and contrasted this with the original focus in the literature on firm specific capital. Kambourov and Manovskii (2009) argue that human capital is specific to three-digit occupation rather than industry. Poletaev and Robinson (2008) present evidence to support the hypothesis that human capital is not narrowly specific to three digit occupation, but rather to a small number of basic skills. Moving to a skills and tasks approach requires data sets that go beyond recording standard industry and occupation codes to describe job skills.

Overall, the recent evidence places more importance on occupation or basic skill or task related human capital specificity, than on firm or industry specificity. In a very influential paper, Autor, Levy and Murnane (2003), introduced the idea of different types of human capital that were more or less easily substitutable for by computers, and hence differentially affected by the rapidly declining price of computing. All these developments suggest that progress could be made on a better understanding of the accumulation of human capital in the post-schooling phase with better measures of skills used, or task capabilities on the job at various points in a worker's career.

There are several problems with the current measures. First, almost all the research attempting to link job based data, like the DOT or the US Department of Labor's *Occupational Information Network* (O*Net), to worker careers have to combine job based data from one data set with worker job histories from another data set, so that the job based data is not specific to the individual. Data sources like the DOT record characteristics of jobs, not individuals, and do not contain individual worker characteristics. Typically, job based data are assigned to individuals in a panel on the basis of an occupation coding common to both the panel and the job based data source. The result is that all individuals coded into the same occupation in a panel have to be given the same job based data measures.[2] Robinson (2014) shows that there is a large amount of variation, even within the approximately 500 three digit census occupations, in job characteristics at the level of the 12741 DOT jobs.[3] Second, even if the skills or tasks were measured at the individual level, allowing for

[2]See, for example, Yamaguchi (2012) and Gathman and Schonberg (2010).

[3]Robinson (2014) calculates a measure of differences between jobs, based on the job characteristics from the DOT, and shows (Table 1) that the mean " distance" within three digit occupation across the DOT jobs, rather than being

variation within three digit occupation, the process by which the skills or task capabilities change over time still remains unclear.

The standard approach in the literature follows the past literature on firm, industry or occupation specific capital in assuming an accumulation process measurable by the tenure using the particular skill or task mix. This is very restrictive. It cannot deal with individual variation in on the job investment. In addition it misses accumulation in careers that involve skill mix changes. For example, consider the careers such as lawyer, professor or surgeon. These careers will tend to have the same occupation coding throughout the career. There are large wage differences at different stages of these careers which may reflect a general growth in all the skills used in the mix for a lawyer, professor or surgeon, keeping the mix roughly constant. Tenure measures may capture average growth in the skills in these careers, though they will not allow for individual variation in the rate of growth. However, now contrast these careers with that of an individual who starts as an automobile mechanic apprentice (one three digit code), then becomes an automobile mechanic (another three digit code), then becomes an assistant supervisor/mechanic in the service shop (another three digit code), then becomes supervisor, etc. Conventional tenure measures will not capture this at all as occupation specific skills are generally assumed to be lost after occupation switches. Moreover, how did the automobile mechanic acquire the different skill set associated with the supervisor/mechanic in the service shop?

Autor and Handel (2013) provide an example of what can be done if skills and tasks on the job can be measured at the individual level. They use data provided by the *Princeton Data Improvement Initiative* (PDII). The PDII provides detailed task data at the individual worker level. The PDII questions were adapted from the survey of Skills, Technology, and Management Practices (STAMP) and are described in Handel (2007). Autor and Handel (2013) document substantial variation within occupation using their self-reported individual level measures, consistent with the within occupation variation across DOT jobs reported in Robinson (2014). The value added of self-reported job tasks, that allow for differences *within* occupations, relative to occupation-level measures from sources like O*Net is assessed by Autor and Handel (2013) as follows. "We find that (1) *occupation-level* PDII

close to zero is about 50% of the distance across the three digit occupations.

measures have predictive power for earnings conditional on O*Net *occupation-level* measures; and (2) *person-level* PDII measures have predictive power for earnings conditional on both PDII and O*Net *occupation-level* measures. This suggests that tasks are a potentially valuable tool for characterizing individual jobs in addition to broader occupations, as is the conventional practice."[4] The preparatory work for the new household panel survey for Canada, the *Longitudinal and International Survey of Adults* (LISA), included a pilot survey containing self reported job based measures at the individual level based on O*Net style questions. Analysis of the pilot data suggests that these measures have explanatory power for wage differences within occupation, complementing the results in Autor and Handel (2013). Examples of these questions are provided in the Appendix.

The example of Autor and Handel (2013) shows what could be done on the measurement side to assign skills and task capabilities directly to individuals, but the process of accumulation remains a black box. To provide a possible avenue for making progress on this problem the preparatory work for the new household panel survey for Canada, LISA, proposed an piloted a series of self evaluation questions on skill accumulation that could be checked against observed wage and job skill and task measures.[5] In the first wave of LISA, these self evaluation questions first ask whether the individual's skills increased over the period since the last interview, and then probe for the specific way in which the skill increase occurred, ranging from traditional employer sponsored formal classroom training through a variety of formal and informal alternatives. In this way it is hoped that more light can be shed on the process by which multi-dimensional skill sets of individuals evolve over a variety of career types, especially for those where there is little evidence of formal training as conventionally measured in previous panels.

A shift to data on skills and tasks at the individual level in a panel data set also offers the potential to make progress on two other important issues: (1) understanding the problems for displaced workers and why some do much better than others following displacement, and (2) understanding of the school to work transition and why some people do better in the post-schooling phase than others. How much is due to ability, effort or matching. The displacement literature has already incorporated

[4]Autor and Handel (2013), p. S63.

[5]The plan for LISA is to collect the job-based skill and task data at the individual level in each wave of the panel which would provide the first panel data for documenting the evolution of skills and tasks over a career at the individual level.

a skills and tasks approach and shows the usefulness of this approach for explaining wage losses for displaced workers. Poletaev and Robinson (2008) and Robinson (2014) use multi-dimensional skill portfolios to show the importance of "distance" and "direction" of mobility following displacement in wage losses. However, much more could be learned about this important issue with a panel data set that provided individual worker skill portfolios.

There is a large literature on education "mismatch." More recently there is increasing concern with college graduates taking "non-college jobs" and pushing high school graduates out of the labor market altogether.[6] The standard approach in the over-education literature is to consider it as a mismatch between the worker and the job. Many college graduates are observed in non-college jobs according to some common measures. A significant fraction of college graduates start their job market careers in non-college jobs, but subsequently switch to college jobs. A common presumption in the previous literature is that these college graduates are initially mismatched with "non-college jobs" due to information induced frictions in the labor market and as a result will have worse outcomes over the life-cycle in the labor market.[7] An alternative view is that the labor market appropriately allocates workers according to characteristics that go beyond a simple dichotomy of those with and without a college degree. Under this view, given certain worker characteristics, workers that start their career in a non-college job may be appropriately allocated in the sense that they suffer no penalty relative to similar workers who start their career in a college job.[8]

From the point of view of policy on how best to respond to evidence on college graduates taking non-college jobs, it is important to know several things: (1) in what sense is it a mismatch that should be corrected if possible? (2) how costly is this for the worker? (3) is it a permanent or temporary phenomenon (4) how widespread is it? The issue of whether college graduates taking non-college jobs is permanent or transitory is also important. If this is something that takes place mainly at the beginning of a job market career and is not long lasting, even if it is a mismatch that if possible should be corrected, it will be of less concern to policy makers than if it were a permanent

[6]The over-education literature is surveyed in Hartog (2000). A recent paper that studies college graduates taking non-college jobs is Beaudry, Green and Sand (2013).

[7]A notable exception is Sicherman and Galor (1990) where over-education is an investment in work experience which provides promotion opportunities.

[8]The evidence of substantial variation in skills or tasks within three digit occupations by itself suggests that caution should be exercised in assuming college graduates in non-college "occupations" are necessarily mismatched.

phenomenon. A skills and tasks approach, including the incorporation of more non-traditionally emphasized "non-cognitive" skills such as motivation and the ability to show up on time, provides an opportunity to make significant progress on understanding these issues.

2.3 Skill Depreciation and Retirement

In standard human capital models there is a single rate of depreciation, though there is some disagreement on what is an appropriate value for this parameter. This may be a useful approximation for some broad issues of optimal investment paths, but may be a poor assumption for understanding the transition to retirement. The recent literature on retirement has revealed a complex pattern of retirement alternatives that vary with the characteristics of the worker. Many workers partially retire before full retirement. For many workers the type of jobs they do in the partial retirement phase can be quite different from their previous jobs.[9] While there have been a lot of estimates of a single rate of depreciation in standard Ben-Porath human capital models, there is little or no work on estimates of differential depreciation rates for different types of human capital. In addition, some types of human capital may be more or less susceptible to different kinds of health shocks that become increasingly frequent towards retirement ages.

Research in this area has been limited by the lack of data on detailed individual worker skills in a household panel. There are a number of data sources that include self evaluation of health caused limitations at home and at work, but no comprehensive picture of how a worker's skill vector may be evolving as workers approach the retirement or partial retirement phases. Given the aging population, this is an area where policy makers need to know more. The new LISA panel for Canada has included questions to address this.

2.4 Resource Allocation and Efficient Use

One of the most difficult issues for policy makers is getting the balance right in resource allocation over life-cycle phases. Heckman (2000) provides a detailed analysis of this problem and argues that the current balance for the United States does not put enough weight on the early phase: "At current levels of investment, American society under-invests in the very young and over-invests in mature

[9] See, for example, Ruhm (1990).

adults with low skills."[10] Heckman (2000) also argues that the informal on the job training that takes place in the post-formal schooling phase is neglected in policy discussion because it is not well measured. Estimates of post-school learning in Heckman, Lochner and Taber (1998) suggest that this is an important source of skill formation accounting for one third to one half of all skill formation in a modern economy.[11] A full answer to this problem requires better measures of skills in all the phases that will permit a better understanding of the returns to investments in all phases. As noted in the previous section, a skills and tasks approach combined with panel data on individual job skills offers some potential for progress on this problem for the more informal post-schooling phase.

A very large share of education resources goes to the formal schooling sector and a great deal of research has been devoted to examining ways to increase outputs in this phase through changing organization and incentives within schools. A large part of this research has used administrative data. Administrative data have been used to study many issues concerned with efficient use or resources and the effect of incentives in formal schooling systems. For example, Rivkin, Hanushek, and Kain (2005) used administrative data from the UTD Texas Schools Project to study the effects of teacher quality and class size on student outcomes. This administrative data set has a panel aspect in that students who switch public schools anywhere within the state of Texas can be followed just as those who remain in the same school or district. However, it contains only a limited number of student and family characteristics such as race, ethnicity, gender, and eligibility for a free or reduced price lunch. Administrative data have also been used to study school competition and charter schools. For example, Abdulkadiroglu *et al.* (2011) use the Massachusetts Students Information Management System (SIMS), merged with test scores from the Massachusetts Comprehensive Assessment System (MCAS) database, and Mehta (2013) uses administrative data from North Carolina from the North Carolina Education Research Data Center. Again, however, these data sets contains only limited information on student and family characteristics.

The research using administrative data has produced a great deal of useful information on the effects of changing organization and incentives within schools, but more could be learned with greater

[10] Heckman (2000), p.3.

[11] "Because much of this learning takes place in informal settings outside of educational institutions, it gets neglected by the educational technocrats and the politicians who equate skill formation with classroom learning."(Heckman (2000), p.5.)

information on student and family characteristics. For example, economic theory suggests that parental inputs, which have been shown to be important for student outcomes in other research, are likely to respond to these types of changes, but these are not available in administrative data. Other work in this area has been done using specialized panel surveys, such as the Early Childhood Longitudinal Study of Kindergartners (ECLS-K). For example, Fruehwirth, Navarro and Takahashi (2011) study the effects of grade retention, and Fu and Mehta (2014) study ability tracking. Both these studies show the benefit of being able to incorporate parental input measures. The ability to combine administrative data with household panel data would help make significant progress in understanding these important schooling issues.

2.5 Gender Differences in Skill Portfolios

A large body of previous research has documented male-female differences in major choices at college and in occupations throughout the working life. Recent research has shown some convergence in major choices and occupation distributions by sex. Goldin (2006) notes that "Not only did women increase their attendance and graduation from college more than men, they also began to close the gap with men with regard to college majors. Whereas in 1970 a standard dissimilarity index for college majors between men and women exceeded 0.5, it fell to about 0.3 in 1985 (Goldin, 2005). Both men and women increased their majors in business administration, but women did to a greater extent and reduced their concentrations in the more traditional female fields of education, literature, languages, and home economics. Womens majors shifted from those that were "consumption" related to those that were "investment" related." (P.10) Many more females are moving into occupations previously almost exclusively male. As Goldin (2006) shows in Figure 8, occupations "shifted, not surprisingly, from those that had been considered traditional ones for women, such as teacher, nurse, librarian, and social worker, to a varied group of professions including lawyer, physician, professor, and manager." (p. 13)

One aspect of this that remains controversial and not well understood is how males and females differ in "endowments" of different types of skills or traits or how easily different kinds of skills can be augmented or produced. Accumulation of skills in a multi-dimensional skill portfolio can be

influenced by choices at the secondary, and post-secondary levels of education, especially in major choice. In addition, the evolution of the portfolio will be influenced by, and reflected in occupation choices. Previous research has emphasized male-female differences in responsibilities for child-rearing in influencing these choices, but research that exploits the more detailed job skills data that is now widely used in the skills and tasks literature to explain broad wage patterns has only just begun. The evidence in Yamaguchi (2013) suggests that this is a promising area of future research.

2.6 Immigrants and Entrepreneurs

A recent literature has emerged on the link between immigrants, entrepreneurship and innovation, providing a new aspect of potential benefits to a host country of immigration. Kerr and Lincoln (2010), for example, document the large role immigrants play as inventors using data on patenting. More generally, despite a large literature trying to explain the incidence of self-employment, or the choice between wage employment and self-employment, much more needs to be learned about what exactly makes an entrepreneur, especially with respect to skills. Credit constraints have been widely studied, but knowledge of what kinds of aptitudes or skill sets are required and how they are acquired remains very incomplete.[12] However, there is an emerging literature that may lead to a better understanding of entrepreneurs through an incorporation of the skills and tasks literature and the cognitive/noncognitive distinction. A recent example is Levine and Rubinstein (2013) who show that incorporated self-employed ("entrepreneurs") have a distinct combination of cognitive, noncognitive, and family traits. Since entrepreneurship is crucial for job creation and growth, improving understanding of these issues will be of great value to policy makers.

The literature on the effects of immigration on the wages of the native born considers the possibility that immigrants, even for the same levels of many observable characteristics such as education and experience, may have different types of human capital compared to native born in the sense of being imperfect substitutes for the native born with the same characteristics. Recent examples of this literature are Ottaviano and Peri (2012) and Piyapromdee (2014). If immigrant type human capital is different, then negative wage effects of immigration are disproportionately born by recent

[12] See for example, Hurst and Lusardi (2004), Lazear (2004)

immigrants, affecting their ability to assimilate well in terms of labor market and income outcomes.

The difference between immigrants and native born in terms of underlying skills is not well understood. Thus far there has been little work linking immigration to the skills and tasks literature. A recent paper that does make the link in the context of immigrant assimilation is Imai, Stacey and Warman (2014). In this paper the authors use O*Net based skill measures to compare skill sets in the source and host countries and how well matched immigrants are when they enter and in the years following entry. Using O*Net style measures to try and understand more about immigrants human capital is a promising area of future research that could help the design of immigration policy.

3 Need for a New Household Panel to Address the Issues?

Large scale nationally representative household panel surveys have become the primary instrument for social science academic and policy research in most developed countries. To assess the need for a new national household survey for the United States it is necessary to review the rationale for having nationally representative household panel surveys for social science research and policy analysis, and to assess whether, by international standards, the currently available panel data sets in the United States provide a suitable basis for leading edge, innovative social science research.

3.1 The Rationale for Nationally Representative Household Panel Surveys

Social science research and policy analysis in most countries use a variety of data sources. A large amount of extremely valuable data is available from cross section data sources such as the relatively infrequent, but very large national census data sets, and various smaller surveys dealing with particular topics such as labor force surveys, health surveys, etc. The current population surveys (CPS), including the annual March current population survey (MCPS) are good examples. Cross section data are particularly useful for providing a snapshot at a point in time of things like the unemployment rate, the amount of poverty, the degree of income inequality, etc. From the point of view of social science research and policy analysis, however, the really important questions are not the "what questions", e.g what is the unemployment rate, or what is the average wage rate or distribution of wages, but the "why" questions. Why is the unemployment rate what it is? Why do some people

have a higher wage rate than others? An understanding of the answers to the "why" questions is crucial information for policy makers in designing policy aimed at influencing the outcomes that are provided in the picture given by the cross section data sources.

Previous research on the "why" questions has increasingly recognized the value of a more integrated approach to understanding behavior that leads to the observed outcomes of interest. This more integrated approach increasingly emphasized the links between outcomes in different topic areas - health, labor market, fertility, crime, education - and the broader context in which these outcomes for particular individuals were determined in terms of household structure and peer influences. More importantly, it showed the strong links between outcomes over time and the value of taking a life course approach to answering the "why" questions. First, the outcomes for an individual observed at a particular point in time are strongly influenced by decisions taken in earlier periods, in a particular context. Second, the decisions taken in the earlier periods are influenced by expectations about future periods. Nationally representative household panel surveys provide the data necessary to implement this life course approach.

3.2 The Current United States Panel Surveys

The United States currently has four main active panel surveys that have played a major role in previous research in the area of human capital, education, achievement and learning. The oldest of these, and the only one set up as a nationally representative household sample, is the Panel Study of Income Dynamics (PSID). The PSID has been, and remains, an incredibly valuable resource for research on human capital issues. Its great advantage for researchers is that it represents a household panel of all ages and has been going long enough to include different birth cohorts, and full lifetime work histories for some cohorts. The other three surveys are the National Longitudinal Survey of Youth, 1979 (NLSY79), the National Longitudinal Survey of Youth, 1997 (NLSY97), and the National Longitudinal Survey of Youth, 1979 Children and Young Adults (NLSY79-children). By historical standards the NLSY79 has a good retention rate, but by the late 1990s the retention rate was approaching 80%. A new panel, the NLSY97, was then created, starting again with a representative survey of a new cohort, providing the benefits of having some cohort variation, as well

as a representative sample. Recognizing the importance of the influence of the life course of parents on a wide variety of outcomes for children, the NLSY79-children survey was created to provide data on the biological children of the women in the NLSY79.

The PSID was launched in 1968. The motivation to create what became the PSID was to assess the "War on Poverty" which was a pressing concern at that time. The PSID became the cornerstone of social science research in the United States (McGonagle *et al.*, (2012)). The PSID was the first and longest running large scale household panel and became the model for panels in other countries. Starting in the late 1990s, the PSID broadened the areas covered, shifting to a more comprehensive life course development approach. It is hard to over-estimate the importance of the PSID as a social science resource. It has lead to more than 3200 peer reviewed publications and is widely used by United States federal agencies. (McGonagle *et al.*, (2012)).

3.3 Recent Developments in Nationally Representative Household Panel Surveys in Other Countries

The research based on the more inclusive topic data availability in the PSID starting in the late 1990s, and other previous panels and data sets, has increasingly emphasized links between a wide variety of topic domains, and this has been reflected in developments in nationally representative household panel surveys in other countries. Two recent examples are the revisions and extensions to the British Household Panel Survey (BHPS), and the creation of a new nationally representative household panel survey for Canada, the Longitudinal International Survey of Adults (LISA). As described above, there is a great advantage not only in studying domains like "human capital", "family" and "health" together because of these links, but also in studying them within a comprehensive framework for the whole life course. The new LISA panel provided the opportunity to create by design a representative household panel to incorporate these links across topical domains identified by previous research in an interdisciplinary design setting. This has substantial advantages over a more modular framework by topic area approach. When the design takes place with topic expert groups together rather than in separate modules there is potential for a more efficient design around substantive scientific and policy questions.

In creating new panels there is also the opportunity to provide innovative new measures as cen-

tral, core design features of the panel, rather than as more ad hoc add ons to an existing structure. This was a guiding principle in the creation of the pilot Canadian Household Panel Survey (CHPS) that eventually became LISA. LISA is designed as a longitudinal household survey, collecting social and economic data every two years. The documentation is currently in draft form but from the draft introduction, LISA may be summarized as follows. The core content provides information on the interaction of labor market, education and family experiences, positions these events in the context of peoples lives by recognizing the dynamics between yesterdays decisions and todays achievements and links these transitions to outcomes in other areas of life. LISA has two unique features. First, the initial data collection of LISA was a coordinated effort with the 2011-2012 Program for International Assessment of Adult Competencies (PIAAC). Initiated by the Organization of Cooperation and Development (OECD), PIAAC is designed to assess the skills and competencies of working aged adults across 26 countries, including most countries in the European Union, Canada, Australia and the United States. These assessments were designed to evaluate competencies in reading, mathematics, literacy, numeracy, and problem solving in a technology rich environment (OECD, 2011). In this coordinated collection, the sample was shared between PIAAC and LISA so that the PIAAC assessment would be available for some (but not all) LISA sample members. Second, LISA includes a data replacement strategy using several administrative data sources, including tax record sources for historical and contemporary data of earnings and employers for all paid employees. Pension plan information from the Pension Plan in Canada (PPIC) file is also obtainable commencing in 2000. Additional years of administrative data will be matched to LISA on an on-going basis.

The first wave of LISA, which includes the PIAAC sample, is completed and is currently being made available to researchers through the Research Data Centres of Statistics Canada. Due to the inclusion of the full PIAAC component, the first wave (2012) contained only a limited set of questions for the human capital module developed during the preparatory work on CHPS. However, the second wave (2014), introduces the most important features of the skills module, including the individual worker level measurement of O*Net style job skills and self evaluation of skill changes since the first wave, including the process by which the skills changed. An additional important feature of LISA is a relatively large sample size of over 30,000 permanent members.

The move to a large sample size is also apparent in the United Kingdom household panel surveys. The BHPS started in 1991 with a sample size of 5500 households (10,300 individuals) but by 2001, with the addition of samples from Scotland, Wales and Northern Ireland, this was almost doubled. The BHPS underwent various revisions over the first 18 waves covering 1991-2009 and from 2010 became part of the much larger *Understanding Society* study which consists of approximately 40,000 households. This move to larger sample sizes was motivated by the need to understand the large differences across different groups in society. Heterogeneity is a key feature of modern economies like the United Kingdom, Canada and the United States. Large sample sizes are necessary for studying many aspects of heterogeneity, including regional differences and differences across various minorities and immigrant groups. An additional feature of the *Understanding Society* study is the *Innovation Panel* of 1500 households that can be used as a test bed for studying innovative data collection methods and new potential research areas.

3.4 The Need for a New Nationally Representative Household Panel Survey for the United States

Many aspects of the US economy and household structure have changed dramatically since the PSID was launched in 1968. The question of what constitutes a "household", or how useful any more traditional definition of a household might be for social science research is a matter of much debate as the concept of a "household" is evolving. Living arrangements and interactions are increasingly taking place in a more dynamic environment. There remains a major policy concern with poverty, especially because of the marked increase in inequality in recent decades, but the changed nature of the economy and household structure calls for a carefully considered restructuring of the design of a nationally representative panel capable of performing the same pivotal role for future research as the PSID did in the last half century.[13]

Not all research needs can be foreseen at the time a panel is originally designed. In the past it has been possible to make amendments and additions to panel data sets to respond to changing

[13]LISA tries to deal with this problem by distinguishing between permanent (PSMs)and temporary (TSMs) sample members where the PSMs are all household members in wave 1 and TSMs are any household members that are cohabitants of PSMs. As households change TSMs become associated with a PSM and are interviewed in any wave in which they remain cohabitants of a PSM.

needs, extending the useful life of these panels. This has certainly been true of the PSID. However, the pace of change seems to be increasing over time. A new nationally representative panel would provide the opportunity to design the panel in the form of a flexible longitudinal platform that could be readily adapted to respond to future needs. For the area of "human capital, education, achievement and learning", all the work done on initiatives, such as the PDII, to fill data gaps or amend or augment existing data sets, could be incorporated in a more systematic and efficient way. In addition, the PSID sample is very small relative to the nationally representative samples in other developed economies. As in Canada and the United Kingdom, heterogeneity is an important feature in the United States. There are many important differences, for example, across minorities and immigrant groups as well as across geographic regions. A larger sample size is needed to make progress in understanding these differences and the implications for inequality.[14]

In summary, in creating a new panel there is the advantage of starting again in this new environment with a large nationally representative sample and having the opportunity of providing innovative new measures as central, core design features of the panel, as in LISA, rather than as more ad hoc add ons to an existing structure.[15] More generally, it provides an opportunity for a new United States panel to both incorporate the latest lessons learned from innovations in other panels internationally, but also to push the frontier forward, making the United States panel a world leader in this regard. This will help to ensure the continuation of cutting edge social science research in the United States, providing the best possible foundation for effective, evidence based social and economic policy.

4 What information needs to be collected and for whom?

In the construction of large nationally representative household panel surveys, the designers face a variety of trade offs. There is a primary objective of satisfying the needs of researchers in addressing the most important current and anticipated future social science issues, but this often leads to severe

[14] A further possibility is the incorporation of NLS or PSID sample members into a new larger household panel survey as occurred with the BHPS in Understanding Society, providing some immediate panel aspect for the new larger survey. While there would be some issues of representativeness due to attrition from the older panels, the benefits may outweigh this cost.

[15] LISA's design, for example, makes all members of a household also members of the LISA sample, including the children, but does not interview children until they turn 15. All adult members of the sample are interviewed.

competition for "questionnaire space". There is a limit on the length of the survey in terms of the burden on the respondents for an effective survey. One way to handle this problem is to ensure that the design takes place with topic expert groups together rather than in separate modules as there is then potential for a more efficient design around substantive policy areas.

A common feature of more recent panels, such as LISA, is the extensive use of administrative data wherever possible. Obtaining income information from tax records is an obvious example, even allowing for the possibility of retrospective information. The use of administrative data has many benefits, including in many cases a higher level of accuracy and a lower burden on respondent time. An additional common feature has been to avoid, as far as possible, proxy respondents, targeting specific questions to specific household members.

The specific information that needs to be collected can be divided into three basic categories: best practice standard information measures, current and future administrative linkage measures and substantive topic based innovative measures focussed on key areas related to gaps in the research relevant for the most important current scientific and policy issues.

4.1 Best Practice Standard Information Measures

There are a number of standard information measures in the area of human capital, education, achievement and learning that must be included in a new panel. An obvious example is education. Over several decades there have been changes in the way education has been measured in major data sets, including both panels and cross sections such as the census. There have been major breaks in education measures, as in the early 1990s for the CPS, as ideas on the best way to capture education have changed. For these standard measures a new panel should incorporate lessons from previous experience in choosing the questions for the standard measures. However, the information from previous data sets has been, and will continue to be very useful, so some weight should be given, especially for the more standard or basic variables, to maximize comparability as far as possible.

4.2 Administrative Linkage Measures

Linkages to administrative data has become increasingly common for large survey data sets. The new Canadian household panel, LISA, has taken a very systematic approach to linking adminis-

trative data, based on some past experience, and based on an environment where this is becoming increasingly possible. There are several areas where administrative linkage is potentially very useful. The most important linkage used in Canada is to certain tax files. This was first done in 1995 for the Survey of Labour and Income Dynamics (SLID) which is a recurring, short, household panel. Abraham *et al.* (2001) described the advantages in the context of SLID as follows. "Household surveys generally experience data quality problems when attempting to collect information on income. As many respondents consider this to be a sensitive issue, response rates for income questions are typically lower than for other topics. By going the tax route, respondents may avoid discussing this delicate matter with interviewers. One expects collecting data directly through tax files should thus increase the number of respondents from whom income data is obtained." In addition, "Underreporting or non-reporting of income sources is also problematic with data collected interview. Typically respondents forget income they may have received from smaller income sources, including income from interest and dividends, selfemployment earnings, social assistance, and unemployment benefits.... As all taxable income sources must be declared when filing a tax return, using administrative records instead of survey data should greatly reduce problems associated with underreporting." (p.9)

The experience with SLID suggested that the administrative linkages worked well in that a very large fraction of respondents opted to give permission for their tax files to be used which provided accurate data on reported income and reduced, to a certain degree, the burden for the respondent in answering questions for the survey. However, there is a balance to be struck on the extent of the reliance on tax records. Based on the experience with SLID, LISA uses the tax file linkages extensively in a "mixed mode" approach, where the linkage provides not only current income, but also past income for many years, and some employer information. LISA will also obtain pension information from administrative files. Given the novelty of using administrative in SLID, and uncertainties about how well it might work, the first introduction in 1995 was preceded by pilots to provide more information on advantages and disadvantages. A detailed review of experience in other panels and preparatory pilots or pre-testing should be undertaken for a new panel with

administrative linkages in for the United States.[16]

While administrative files for income and pensions may largely substitute for information that would otherwise be provided by the respondent, other administrative linkages may be useful in providing information that could not be obtained from the respondents, but that are relevant to the respondent's decisions. An important current research and policy issue discussed earlier is the effect of changing organization and incentives within schools on student outcomes. Much of this research has been carried out on school based data sets. A panel can bring more home and environment detail that could push forward this research, but it is difficult for a household panel to obtain this school information from the respondents. At a minimum, however, an administrative linkage measure could be incorporated into a panel by collecting school identifiers (name, address, year) that could be used to incorporate future results from the school based research.

4.3 Innovative Measures

For a number of the topic areas it will be possible to identify certain information gaps that need to be filled if substantial progress is to be made. A new panel should give careful consideration to innovative measures that can help fill these gaps. Examples of these in the area of human capital, education, achievement and learning are measures of post-school informal skill acquisition, multi-dimensional skill or ability type measures, and expectations and information set measures. The inclusion of "ability" measures like the Armed Forces Qualify Test (AFQT) in the NLYS79 generated a very large new literature making explicit use of ability measures that for the most part were treated as endowments, though increasingly recognized as being produced themselves. A new panel can go one step further by including similar measures at more than one point in the life-cycle. The first wave of LISA gives an internationally comparable measure of adult abilities across all age ranges in the sample. Future plans include possible testing at more than one point in the life-cycle for the same individual.

Direct testing of skills at various points in the life-cycle provides one measure for analyzing the

[16]The tax linkage in LISA requires respondents to be informed that their interview information will be supplemented with information Statistics Canada has from other administrative data sources. This practice is referred to as "informed replacement". It results in a high availability of administrative data for respondents. Some values are imputed for respondents for whom administrative data could not be found, with imputation flags provided in the data set.

otherwise directly unobserved, and often informally acquired skill evolution over the life-cycle, but it is expensive to collect an infeasible to do very frequently in a panel. Two other approaches can help complement the testing and fill the data gap for research in understanding the evolution of skills in the post-schooling phase. The first and second waves of LISA have begun this approach. First is the use of self evaluation questions that first ask whether the individual's skills increased over the period since the last interview, and then probe for the specific way in which the skill increase occurred, ranging from traditional employer sponsored formal classroom training through a variety of formal and informal alternatives. The questions proposed for the *Canadian Household Panel Survey* (CHPS) and incorporated in the first wave of LISA are given in the Appendix. Second is the collection at the individual worker level of O*Net style self-evaluated skills used on the job as part of the worker's description of their job used for standard occupational coding. These are asked for all jobs in all years of the panel and therefore provide much better frequency that direct testing. Examples of these questions, used in the second wave of LISA are reported in the Appendix. Analysis of the CHPS pilot suggests that these are likely to be very useful measures.[17]

A third, and related approach, not yet tested, is to augment the the collection at the individual worker level of O*Net style self-evaluated skills used on the job with the same set of questions and scales, but referring to the worker's own capabilities rather than just on the skills used on the job. These measures have the potential to help address both the mismatch issue, and the acquisition of possibly different skills than those used on the current job that lead to promotion in future jobs that will be picked up in future job-based skill measures. Pilot testing of the self-evaluated skills used on the job was successful in showing that respondents appeared to understand the questions well and the time required to complete this section was little more than needed for the conventional job description response used for standard occupation coding.

It is increasingly recognized that more panel based information is need on expectations and information sets in order to understand life-cycle decision making. The research on how to capture expectations and information set measures is still relatively new. The main goals are to try and

[17]While some of these questions may appear complicated, the LISA "preferred mode" of "personal interview", used about 80% of the time, works well. For the skill questions, for example, during the personal interview the respondent looks at a show card and picks their response.

elicit information on two things: (1) What information do people use in forming their expectations relevant for human capital investments? (2) How is the information used in forming the expectations? Example questions are given in the Appendix. These questions were used in preliminary work on CHPS but were not in the pilot.

4.4 Outline of Information to be Collected

The basic information that needs to be collected is as follows:

1. **Standard measures of total schooling:**
    - Years attended/completed
    - Degrees received
2. **College-related questions:**
    - Currently enrolled, part-time/full-time
    - Type of institution (name/location)
    - Tuition (or perhaps just institution)
    - Financial aid (grants & loans, link to administrative data if possible)
    - Course of study/major
    - Grades
    - Re-payment of loans/default (link to administrative data measures if possible)
    - Adults under 30 but out of school can be asked a limited set of questions once:
        - Type of institution attended last or graduated from (name/location)
        - Final GPA
        - Final Course of study/major
        - Financial loans (amounts borrowed, owed, default; link to administrative data)
3. **Primary/Secondary schooling questions:**

- Class grades
- School and peer quality measures link (name/location of school)

4. **Early childhood investments and outcomes:**
   - Parental time and goods input
   - Pre-school, daycare, etc.
   - Simple test score measures if possible
5. **Beliefs/perceptions/information sets:**
   - Adolescents:
     - Wages for high school dropout, high school graduate, college graduate at age 30?
     - Wages for someone like respondent under different education scenarios
   - Adults:
     - Wages for someone like respondent (same skills, same type of current job) 10 years in the future
6. **Post-school training and skill development:**
   - Standard formal firm training measures, type/amount
   - Government-provided training, type/amount
   - Innovative measurement of types of skills acquired/used on job related to DOT/O*Net style information
7. **Literacy and numeracy measures:**
   - two or three times in childhood: age 4-6, 10-11, 15-16
   - periodically for adults, perhaps twice

4.5 Information from other topical domains to be included in the survey

As discussed above, a new panel should create a flexible longitudinal platform that would provide a comprehensive framework for the life course, incorporating links across topical domains identified by previous research. There are clear links between the topical domain of "Human capital, education, achievement, and learning" and other domains. In the preliminary work for CHPS these included responses in behavior mainly recorded in the human capital domain from changes in factors in the health domain and in the family domain. The health domain includes "health shocks", and health information or health information changes, e.g. new research shows 'x' is bad for you. How do individuals or households respond to these in the human capital or other domains? Similarly, changes in the family domain, such as divorce or a change in the peers or other significant individuals a child interacts with, or could potentially interact with have implications for behavior in the human capital domain.

5 Conclusions and Priorities

The creation of a new nationally representative household panel for the United States would provide the opportunity to both incorporate the latest lessons learned from innovations in other panels internationally, and to push the frontier forward, making the United States panel a world leader in this regard. This will help to ensure the continuation of cutting edge social science research in the United States, providing the best possible foundation for effective, evidence based social and economic policy. There is a limit, however, regarding how much information can be collected for any one topical domain, making efficient survey design and the establishment of priorities an important issue. In terms of survey design, three areas have seen a number of innovations in recent years for survey design. One is to break very rigid compartmentalization by topic domain, using interdisciplinary teams to try and economize on data collection by agreeing on common measurement of variables and concepts used across disciplines. For example, in family modules concerned with parent-child interaction from a sociological point of view, it may be possible to agree on measures that economists consider particularly relevant for inputs in early childhood production functions.

Other innovations include experimenting with efficient ways to collect longitudinal data for vari-

ables where significant changes are typically triggered by specific events. In this way, some questions do not have to be asked in every panel wave. Similarly, it is useful to have discussion, including interdisciplinary discussion to cover a variety of modeling techniques and requirements, on how often a particular question needs to be asked - what would be lost if it was asked every other wave instead of in every wave? More generally, there is the issue of structuring the panel with core and rotating content to save questionnaire space, as well as an option to have "occasional" modules for more specialized topics. In addition, evaluation should be made of all the "traditional" questions. For example, the revisions to the BHPS removed a large number of what had been the traditional training questions after a review of their value to researchers in the years they had been available. This influenced the reduced emphasis on these questions for CHPS and LISA, making room for more innovative post-schooling skill acquisition modules. Closely related is the issue of leveraging content from more specialized existing data sets. Specialized data sets, for example on health, or retirement, or children, often have large batteries of questions to provide very detailed information for the specific field. Examination of results from the information acquired in this way can show how whether a large fraction of the content may be obtained from a significantly reduced subset which is more suitable for a broader panel that has to cover many specific fields. Careful construction of the reduced content can make it linkable with the full content in the specialized sources in a way that leverages results from the specialized data sets.

A final important innovation is the increasing use of administrative linkages. In part this provides additional new information that might be difficult to access via survey questions, but in part it has also been used to economize on respondents' time. The extensive use of administrative linkage is relatively new. The Canadian experience is that a very high fraction of respondents give permission for administrative linkage and that it can save some respondents' time. However, the experience might not be the same for a United States panel.

For the topical domain of human capital, education, achievement and learning, there are two important priorities. The first is to collect the data necessary to try and fill in the main gaps in measures of inputs and outputs in human capital production, especially in the more informal settings such as home and pre-schooling and in the post formal schooling period. For the outputs this includes

test measures for children, youth and adults and job skill and task measures for adults. For the inputs it includes parental and other inputs for children and for adults it includes measures of the process by which skills accumulate during a career beyond traditional training measures. The second is to collect data necessary to try and get a better understanding of how people make decisions regarding human capital investments. These includes questions on expectations and information sets relevant for these decisions. More generally, setting priorities also benefits from an interdisciplinary setting where the value of particular questions that are useful for more than one topical domain can be fully assessed. This is complementary with the process of trying to achieve common measurement.

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A Appendix

This appendix describes some of the innovative question modules developed for CHPS, most of which have already been included in the first to waves of LISA, except for the expectations measures.

A.1 Pre-tested Self-reported Skill Accumulation Questions in the CHPS/LISA

- Preamble: *Many people experience change in their skills over their adult life. There are many ways skills can change. For example, some skill improvement happens through additional formal training after schooling in some kind of classroom setting; some of it happens by watching more skilled workers or by self-practice. I would like you to think about the change in your own skills since [last interview or other reference point] and how this change came about*
  - **Initial question:** *Would you say your skills have changed in this period?*
- **Follow up questions if the answer is YES:** *Please rate the change in your skills on the following scale:*
  - A. *Decreased*

    (For example, memory is worse so tasks take longer; manual dexterity is not as good as before; I generally find it harder to achieve as much as I did before.)
  - B. *Increased somewhat*

    (For example,I can do things a little more quickly; I can do things at a little higher level than I could before; I can do new things.)
  - C. *Increased a lot*

    (For example, I am much better at my job; I have learned a lot more; I can do many more things, or some new things at a high level.)
- **Follow up questions if the answer is B or C:**

  Please rate how much more you are earning or could expect to earn as a result of this increase in your skill (percentage scale)

- *Please indicate, in order of importance, the means by which the improvement in your skills happened* (scale):
  - A. *Formal classroom training at work*
  - B. *Other formal training*
  - C. *Self-study, practice, or other informal training or learning*

A.2 Pre-tested and Piloted Job Based Skill Module in the CHPS; Second Wave of LISA

- READING COMPREHENSION
  - *How important is reading comprehension to the performance of your current job?* Answered on a 5 point scale: "not important" to "extremely important".
  - *What level of reading comprehension is needed to perform your current job? Please select a number from 1 to 7.*
  - Examples of the reference points on the seven point scale are:
    - 2 is read step-by-step instructions for completing a form
    - 4 is read a memo from management describing new personnel policies
    - 6 is read a scientific journal article describing surgical procedures
- MANUAL DEXTERITY
  - *How important is manual dexterity to the performance of your current job?* Answered on a 5 point scale: "not important" to "extremely important".
  - *What level of manual dexterity is needed to perform your current job? Please select a number from 1 to 7.*
  - Examples of the reference points on the seven point scale are:
    - 1 screw a light bulb into a light socket
    - 4 is pack oranges in crates as quickly as possible
    - 7 is perform open heart surgery with surgical instruments

- MATHEMATICS
  - *How important is mathematics to the performance of your current job?* Answered on a 5 point scale: "not important" to "extremely important".
  - *What level of mathematics is needed to perform your current job? Please select a number from 1 to 7.*
  - Examples of the reference points on the seven point scale are:
    * 2 count the amount of change to be given to a customer
    * 4 is calculate the square footage of a new home under construction
    * 6 is develop a mathematical model to simulate and resolve an engineering problem

A.3 Pre-tested Expectations/Information Set Questions in the CHPS

- First set of questions to assess the information individuals have on earnings differences by education
- Following a pre-amble with some income definitions, example questions are:
  - Consider all 30 year old [men/women] who quit high school and, therefore, did not receive a high school diploma. Among these [men/women], what do you think is the median income earned? By median income I mean ...
  - Now consider all 30 year old [men/women] who completed high school and received their diploma but did not attend any further schooling. Among these [men/women], what do you think is the median income earned?
- Assess the payoffs individuals use in making education choices
- An example of these hypothetical questions, following a pre-amble, is: *Suppose you were to quit school during the last year of high school. In this scenario you would not receive your high school diploma.*
  - A. At age 30, what is the median amount of money (explanation) you would expect to earn?

  - B. If there is a 50 percent chance you would earn more than [response to A], how likely is it that you would earn more than [response to A x 0.9 rounded to nearest 100 dollars]?
  - C. How likely is it that you would earn more than [response to A x 1.1 rounded to nearest 100 dollars]?

- Information (on earnings and financial aid) re post-secondary choice, based on scenario questions following a pre-amble: "I'd like you to consider two hypothetical scenarios. In one case, you would begin working immediately after finishing high school. In the other case, you would attend university full-time for four years and receive your bachelor's degree, at which time ..."

- Question: "Taking into account ...would you choose to go to university if you knew you would earn the same amount each year after finishing with a bachelor's degree as if you had not attended university?"

- Question: Again, taking into account...would you choose to go to university if you knew ... [alternative earnings scenario]"