THE COMPARATIVE EFFECTS OF EDUCATION AND THE COMPLEXITY OF WORK ON ADULT INTELLECTUAL ABILITY

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ABSTRACT

Using a combined longitudinal cohort sample known as the Berkeley Growth Studies, I examined the effects of educational achievement and the complexity of work on adult intellectual ability from ages 18 to 61. The Soft Modeling statistical technique (Falk and Miller 1992) was used to model the relationship among: parents' education, number of siblings, father's occupation, intellectual ability, educational achievement, and the complexity of work with data, people, and things. Data were collected at four points in time at approximately ten year intervals. Intellectual ability was measured using the Stanford-Binet, Weschler-Bellevue, Weschler Adult Intelligence Scale (WAIS) and the WAIS-Revised inventories. The complexity of work was measured using the Dictionary of Occupational Titles.

The goals of this study were threefold: (1) to add a theoretical underpinning to the work of Melvin Kohn (1983) on the effects of job conditions on intellectual functioning, (2) to expand upon Kohn's work on the relationship between the complexity of work and intellectual functioning, and (3) to address methodological weaknesses in his previous work in these areas.

Three theoretical perspectives, human ecology theory, symbolic interactionism, and social cognitive theory, were used to support my general argument that the educational

environment is more influential than the work environment for the outcomes of work complexity and adult intellectual ability.

The results show that while IQ at age 18 is the greatest predictor of both the verbal and performance dimensions of adult intellectual functioning, educational achievement also contributes substantially to verbal intellectual ability over the life-span. Work complexity has only a small effect on the verbal dimension of adult intellectual ability. Educational achievement is also the strongest predictor of work complexity. These findings indicate that given individual differences in ability, education is the key predictor of both career placement and the complexity of work and consequently sets the trajectory for the individual's occupational career over the life-course.

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CHAPTER I

INTRODUCTION

Three social institutions that nearly every person in the modern world will negotiate at one time or another are the family, the educational system, and work. Most individuals spend their early years being socialized by the nuclear or extended family. At about age five children leave the family setting for a good portion of the day to receive a formal education. Most American children spend the next 12 to 20 years in an academic setting in preparation for their entry into the world of paid work. After their schooling is completed, work will consume almost one-half of their waking hours for the next 30 to 50 years (Spenner 1988a). The family, the education system, and work are the three social institutions that have the greatest impact on most Americans.

There is no doubt that participation in all three of these institutions leaves its mark on the individual. Families provide the foundational support for a well-adjusted, healthy child by providing not only an interpersonal environment but also the economic and cultural setting in which the child lives (Brooks-Gunn 1995). The educational system is a strong mechanism for socialization both directly, through the direct instruction of cultural knowledge (Bowles and Gintis 1976) and indirectly through peer socialization (Corsaro and Eder 1995; Hallinan and Williams 1990; Savin-Williams and Brendt 1990). Finally, work will consume the time and energy of the adult and contribute to further socialization and experience (Kohn and

Schooler 1983). The question for this study is not *if* these institutions contribute to the socialization of the individual. The fact that they contribute substantially is empirically supported and accepted in the social sciences. Rather, my goal is to clarify the relative contributions of two of these institutions, education and work, to the personal development of individuals. The broader purpose of this dissertation is to add to the empirical literature which attempts to sort out the effects of education and work on individual cognition. My more focused goal is to compare the effects of education and work on intellectual ability and to offer a theoretical framework for understanding why education is so important for this outcome.

The timeliness of this study is evident in the current political debates on educational funding, charter schools (Hallinan 1996), and the focus on a "global economy" which requires that Americans become life-long learners in order to compete with other developing countries. Education and work are inextricably tied to each other and the outcomes for both have consequences for the quality and longevity of life for the individual. Educational attainment and occupational achievement are two fundamental American goals; every parent wants his or her child to receive a "good education" and go on to be successful in the work world. The problem faced by social scientists is that although we use education extensively as a demographic control variable, we sometimes take for granted its importance as a predictor variable. For this study, both education and work are independent variables used to predict cognitive functioning.

In this paper I argue that while both education and work are independent predictors of the cognitive functioning of individuals, the effects of education are stronger and more

enduring than those of occupational conditions. I offer two arguments to support this claim. First, the educational institution is a primary source of socialization and has as its explicit goal the socialization of children and young adults into the dominant culture. This process is undertaken by the direct instruction and reinforcement of values and behavior. The educational process is structured to limit input from competing sources so as to make the acquisition of cultural knowledge and values as efficient and effective as possible. The values and knowledge instilled in the educational institution are expected to stay with the individual to guide decision-making throughout the life-course (Bourdieu and Passeron 1977).

Second, education determines the placement of the individual in the occupational structure and so is the starting point for the trajectory for occupational achievement (Spenner 1988b). The variance in occupational placement and consequently the opportunities for work that is cognitively demanding begins at this starting point and increases or decreases throughout the career line. The direct effects of education on adult cognition originate from the acquisition of knowledge and skills, interaction with others, and the selective sorting of students for placement in the occupational hierarchy. Tracking and credentialing are two mechanisms within the educational environment that contribute to the process of occupational placement. Tracking directs the student's academic route (Alexander and Entwisle 1996), and academic credentials continue to predict occupational placement throughout the life course (Bills 1988; Ishida, 1997).

The indirect effects of education on adult cognition continue through job conditions and the social networks associated with occupational positions (e.g., professional organizations and peer interaction in the workplace) (Kohn 1977). To test this general

hypothesis, I utilize and expand upon the work of a well-known sociologist and the social structure and personality tradition he follows.

Melvin Kohn has added considerably to the literature in the area of social structure and its effects on cognition. Kohn began his work in this area with a sample of parents and their children in Washington, D.C. In this landmark study he found that parents' values for their children were directly affected by their position in the class structure (1969). In subsequent studies and analyses he changed his focus from social class to social stratification and the more proximate mechanisms which operate within the stratification system in molding the values, beliefs, and intellectual functioning of individuals. Most of his subsequent work has focused on working conditions, in particular the complexity of the demands of work (a sub-component of self-direction), and the outcomes of values, social orientations, and the intellectual functioning of individuals (Kohn 1977; Kohn and Schooler 1983; Kohn and Slomczynksi 1990). In all his published work, Kohn finds that the type of work and its demands upon the worker have weak to moderate, but consistent effects on the beliefs, values, and intellectual functioning of the worker.

Statement of the Problem

The goal of this paper is threefold. First, I attempt to bolster Kohn's work with a theoretical underpinning utilizing three major theoretical perspectives: human ecology theory, symbolic interactionism, and social cognitive theory. My synthesis of these theories is an attempt to shed light on the "black box of education." The fact is that empirically, education is important. The question is *why* is it so important in predicting everything from values to mortality? In this dissertation I present an elaborate theoretic argument to provide the reader

with an understanding of the complex interactions between individuals and environments. My theoretical discussion necessarily extends beyond the data used in this study; my goal is not only to predict statistically but also to provide the reader some insight into those variables that contribute to the outcomes of interest yet are not included in my model because of design limitations. While I test only a small portion of this larger model of education, occupation, and intellectual ability, I argue that the context and processes by which these social institutions influence human cognition are important not only for understanding what we can "predict" statistically, but also for what we cannot.

Second, I expand upon Kohn's longitudinal analysis by using a cohort sample measured on all the variables of interest at four points in time (The Berkeley Growth Studies). Since Kohn's data included measures at only two points in time, this study adds to his analysis in that I will be able to examine the predictive ability of education and complexity of work over a longer period of time. The analysis of change over time for intellectual ability will also be improved by additional measurement points.

Finally, in an extension of his primary longitudinal study, I address two methodological weaknesses with Kohn's analysis of the relationship between the complexity of work and intellectual functioning. The first is his limited measurement model for intellectual functioning. Second, his dropping of the direct path from education to intellectual functioning results in an inadequately specified general model. These two shortcomings may have resulted in biased estimates for the effect sizes of the independent variables upon intellectual functioning.

In this study I utilize standardized measures of intellectual ability with established reliabilities and a modeling technique which will allow me to include both education and occupational conditions in a single analytical model. I conclude this chapter with a brief summary of the three theoretical perspectives, their basic assumptions and propositions, and a general argument for their applicability to my research question.

Theoretic Approaches

Symbolic Interactionism

The general theoretical framework used in this dissertation is the symbolic interactionist (SI) perspective. Situated within the realm of sociological social psychology, symbolic interactionists see the individual as the product of social interaction, situated in a context of time and space and both the creator and reproducer of culture and meaning (Denzin 1992). Three assumptions that are shared by all contemporary SI theorists are that: (a) humans act on objects on the basis of their meanings, (b) meaning is derived in social interaction with others, and (c) meaning is modified through an interpretive process (Blumer 1969).

Significant symbols, which are gestures that represent ideas, play a key role in this process. Language is the primary source of symbols, but other gestures such as body language may also be meaningful (Blumer 1969). Another assumption for symbolic interactionists is that society precedes the individual. Humans are born into a previously existing social environment, therefore, structure and culture exist prior to the individual (Mead 1977). With this assumption comes the implication that established sets of symbols

in the form of language and culture exist, and the individual is socialized into her social environment throughout the life course (Denzin 1992).

The importance for the SI perspective in this dissertation is in the acquisition of intellectual ability and education (as each is defined by the social context). Mead's definition of intelligence includes the acquisition of the attitudes of significant others via interaction (Mead refers to this collection as the "inner-forum"). The development of an "inner-forum" facilitates problem solving by providing the individual with a repertory of perspectives that may be cognitively "tried on" to test their effectiveness in a problematic situation (Mead 1977). The contexts for the interaction and acquisition of these perspectives throughout the life course begin with the family and its immediate environment and move outward to include the educational and work settings. The volume and quality of interaction within these environments direct the cognitive processing and consequently the self-development of the individual. I also believe that SI is the perspective under which the learning-generalization theory cited by Kohn (1977) may be subsumed.

The foundation for the theoretical framework of the development of intellectual ability and educational achievement (and thus occupational achievement) in the SI tradition is the theory of mind and self developed by Mead (1977). For Mead, the self is a set of social attitudes or perspectives acquired through symbolic interaction (the use of language and gestures) with others. The self is the product of the unique ability of humans to make an object of themselves. That is, they can step outside themselves cognitively and observe their own actions, thought processes, and emotions. To be able to do this is to possess a self.

The self is reflexive and processual. It is acquired through interaction with others. For example, the child does not possess a self until she can put herself in the (mental) attitude or position of another person and look back at what she is doing. Mead uses the example of the stages of play and games to illustrate the process of self-development.

Young children often "play" at being someone else. They may dress-up like their parent or a fireman and say what they have heard those individuals say in the past. This is denoted as the "play" stage for Mead. This stage does not necessarily imply the presence of a self, as the child is not actually putting herself in the attitude of the fireman, rather she is simply reenacting the role as she has observed it.

The next stage of development does require a self. Games, particularly complex games such as baseball, require the child to put herself in the mind of the other players while at the same time being in her own position. For example, the catcher must anticipate the pitcher's next pitch while at the same time knowing her own responsibility at home plate, and the runner on first's intentions as to whether he will try to steal second. If he does try to steal, the catcher must anticipate the second baseman's response to the action and act accordingly by throwing the ball to tag the runner out. It is this ability to take the attitude of the other that denotes the possession of a self.

The self, according to Mead, is a social-cognitive structure made up of three parts: the "I," the "me," and the "generalized other." The "I" is the impulsive, unpredictable part of the self (Mead 1977). Mead conceptualizes the "I" as the source of values and the self that we search for in our quest for self-knowledge: "It is there that novelty arises, and it is there that our most important values are located. It is the realization in some sense of this self that

we are continually seeking" (1977:237). Because it is the unsocialized part of the self, the "I" is completely unpredictable and is the component of the self that allows for the freedom and agency of the individual. The "me," on the other hand, is the socialized part of the self.

The "me" is the collection of all the attitudes of others that the individual has selectively acquired during interaction. An illustration of the "me" is to imagine all the people with whom an adolescent has interacted in the past. The individual selects portions of the attitudes (ideas, values, mannerisms, beliefs etc.) of those others and incorporates them into her own collection of attitudes. This collection of selectively acquired perspectives forms the "inner forum," a storehouse of attitudes from which the individual may draw for future interactions. Mead posits that the "I" and the "me" have a dialogue with these attitudes when confronted with a problematic situation. The "I" reacts to a situation, and the "me" selects an attitude from the inner-forum which is most appropriate to address the current problem. It is this ability to mentally try on solutions to problems that Mead calls intelligence.

Finally, the "generalized other" is the part of the self that reflects the morality (values, beliefs, expectations) of the community of reference for the individual. This community may be a particular peer group for an adolescent or a church community for an adult. The individual draws on the norms and values of the "generalized other" for her conduct (behavior that is enacted in the real or imagined presence of others). These three parts of the self work together in a process to define situations. The self process derives meaning in a situational context and directs both the interpretation of the actions of others and the individual's response to those actions (Mead 1977).

What is most important for applying Mead's theory to the substantive areas of intellectual ability, education, and the complexity of work is to recognize that "society" and the "generalized other" are contextual, nested terms which may apply to the social environment in the home, at school, at work, or the society within which these institutions are enveloped. For example, the adult interacts at home with family members and at work with co-workers. She may also attend college part-time where she interacts within an academic group. All these contexts are nested within the community culture of, for example, a small, urban town or a large city. In turn, the community setting is nested within the regional culture (e.g., the Midwest), which is in turn nested within the national culture of the United States. To complicate this further we must take into account the global society which is disseminated through the agents of mass media such as television and the Internet (Denzin 1992). The proximity of the social influence (House 1981) as well as the commitment and involvement of the individual with those in the social group (Burke and Reitzes 1991) will influence the degree to which the social setting will affect self-development.

The learning-generalization theory utilized by Kohn fits into the SI perspective in that the individual learns to adapt to the physical and social environment via a process of problem solving. The most notable difference in the two theories, however, is that the SI perspective assumes a more involved, active participant in the learning process than does the behaviorist theory of learning-generalization (Corsaro and Eder 1995). For Mead, the mind develops in an active, reflexive process with considerable work on the part of the individual to make sense of things and solve problems (1977). Also, for symbolic interactionists, language and the ability to cognitively "try on" solutions to a problem are fundamental components of the

learning process. In his presentation of learning-generalization, Kohn does not elaborate upon the process by which knowledge is acquired. It is taken for granted that learning happens as a result of problem solving in a particular setting (in Kohn's research this setting is work) and is then generalized to problem solving situations in other settings (e.g., the home and leisure pursuits). The use of an interactive theory allows one to examine the highly complex processes involved in learning and behavior.

In summary, Mead's theory of mind, and more generally the symbolic interactionist perspective provides an understanding of the processes involved in the development of the self and intellectual functioning of individuals. Education fits into the perspective as one of the institutionalized environmental contexts in which interaction takes place. Other social environments and their "generalized others" include the family and work. Kohn does not elaborate upon his theory of learning–generalization so we do not know if he is supporting a behaviorist or cognitive learning approach to learning. I take the liberty of expanding on his basic proposition that individuals learn and then generalize that knowledge to other contexts by assuming he refers to learning as an interactive, cognitive process.

Human Ecology Theory

While symbolic interactionism offers insight into the *processes* by which individuals develop intellectual ability, human ecology theory offers the structural framework within which these processes occur. The basic assumptions for this theory are that humans interact and are interdependent with their physical and social environments. The primary motivation for human action is survival, which is achieved through problem solving using objects (both material and social) in the environment. Human ecology theory is unique in that it emphasizes

multiple contexts of interaction in time and space and stresses the importance of individual perceptions in determining decision making and behavior (Bubolz and Sontag 1993).

Bronfenbrenner's (1995) *person–process–context* model for human development offers an extension of this thesis by defining four "system" levels of decreasing proximity within which interaction takes place. These systems may be visualized as nested circles radiating from a center where the biological organism (the individual) is located. The *microsystem* is the environment, both physical and social, which is closest to the developing individual. It consists of:

> a pattern of activities, roles, and interpersonal relations experienced by the developing person in a given face-to-face setting with particular physical and material features, and containing other persons with distinctive characteristics of temperament, personality, and systems of personal belief (Bronfenbrenner 1989:227).

The *mesosytem* is the collection of groups and environments within which the individual interacts. These may include the family, school, and neighborhood. The next most distal environment is the *exosystem*, which includes the settings that have an effect on the individual, but only as a result of indirect participation. An example of an individual's exosystem would be the parent's work environment, which has an effect on the parent who in turns interacts with the child (Bronfenbrenner 1995).

Finally, to incorporate time and space into the interaction between the individual and the environment Bronfenbrenner (1995) adds the *chronosystem,* which situates the interaction between and within these systems into a temporal context of history and individual development.

Employing these four systems and the propositions that are derived from them, human ecology theory allows for the complexity of multiple influences at various social levels for individual development, while postulating the reciprocity of effects between the individual and her various environments. These capabilities are particularly important for the substantive issues of this dissertation. The activities and adaptation of the individual within the family, educational, and work environments are determined by a complex set of variables which operate at various proximities ranging from the biological characteristics of the individual to the social political environment of the country in which she lives. When looking at only two of these variables (i.e., education and the complexity of work) to predict an outcome like intellectual ability, we must be careful to situate theoretically those variables within the extended context of other contributing factors.

The symbolic interactionist perspective and human ecology theory are overlapping and complementary. Both see human development in terms of a process of adaptation to the environment via problem solving. Both see interaction with objects in the environment as key in this process. Both place the individual within a physical and social environmental context that direct perceptions and consequently decisions to act in a particular way. Both view language and symbols as the tools for this process.

The most notable difference between the two, and the reason for my utilization of both, is the difference in focus. The focus for SI is on the process of deriving meaning, and thus perceptions, in interactions with others. The development of the self is central to this focus. With the development of the self comes the development of the cognitive ability to solve problems. The self also houses the values and experiences which direct the actions of

the individual. Thus, SI, and in particular Mead's theory of mind and self, offers understanding as to how the social interactions and experiences of the individual direct her thinking and behavior.

The focus for human ecology theory is the interaction between the individual and larger social and physical structures. SI directs us to look at face-to-face interactions in social and physical context while human ecology theory directs us to see these interactions within increasingly larger contexts.

The last theory presented here completes the triad by directing our attention to the self processes which influence how the individual perceives and acts upon the environment. I follow with a summary of Bandura's social cognitive theory (1986).

Social Cognitive Theory

Bandura's basic assumption is that humans are not directed by drives or simply conditioned to repeat actions by reinforcements. "Rather, human functioning is explained in terms of a model of triadic reciprocality in which behavior, cognitive and other personal factors, and environmental events all operate as interacting determinants of each other" (Bandura 1986:18). He defines the unique nature of human individuals in terms of capabilities which include the ability to use symbols and forethought, learn vicariously, self-regulate, and be self-reflective.

The use of symbols, claims Bandura (1986), allows the individual to be a powerful agent in adapting to the environment. The ability to use forethought allows for planned, rational behavior, a capability only possible through the use of symbols. Forethought facilitates behaviors which are future/goal oriented. The ability to learn vicariously discounts

the behaviorist contention that learning results only from sensory experience. Humans may learn from the actions of others, and by doing so save time and eliminate unnecessary risks to their own safety and well-being. Again, this capability is facilitated through the use of symbols (e.g., vicarious learning through literature and art forms).

The last two capabilities are expressed in terms of self-processes. The self-regulating capability posits that individuals do not act solely in response to outside stimuli (social or physical). Individuals possess a self that is the source of the motivation and internal values which affect behaviors. The self possesses a reflective capability that allows for the examination and evaluation of thoughts and beliefs produced by the individual. Bandura identifies self-efficacy, which is the individual's assessment of her own ability to perform in certain situations, as a key type of self-reflective thought (Bandura 1986). The individual evaluates the environment and her own thoughts and feelings about the situation and then acts in a goal-oriented way. Importantly, Bandura includes both cognition and emotions in his theory of self-motivation. He acknowledges the fact that an individual may appear to act irrationally on the basis of emotional experience because her beliefs or values override her "rational" cognitive assessment of the situation (1986).

The triadic reciprocality posited by Bandura allows for interaction among three factors: personal experience and characteristics, the environment, and previous behaviors. Each factor will be weighted differently depending upon the context. For example, he claims that an environment with few restrictions on the individual will allow for the greater influence of personal cognition and decision making. "Because of the multiplicity of interacting influences, the same factor can be a part of different blends of conditions that have different

effects" (Bandura 1986:24). This model allows for the probabilistic prediction of outcomes. We cannot, however, predict outcomes with certainty because each individual brings to the situation her own personal characteristics, life history, and experiences, which have been cognitively processed to produce unique perceptions.

Bandura's theory is helpful in providing insight into the complexity of the contributors to educational attainment, occupational placement, and intellectual ability that may be left unmeasured in our model. Like SI and human ecology theorists, he maintains that the objective experiences of individuals are mediated by self-processes and perceptions. He does not, however, underestimate the power of the objective environment and its ability to facilitate or constrain action on the part of the individual. Humans act with forethought and purpose within their environment, choosing between available options and reflecting and acting again upon the outcomes of those choices.

Not only does the environment influence the person, but the person also influences the environment. An example of the person influencing the environment is the different responses evoked by individuals as a result of their appearance (Bandura 1986). A female elicits a different response in certain situations than does a male (e.g., a female entering a men's restroom or attending a singles bar). The same is true for individuals of differing race and physical appearance.

An assumption of social cognition theory is that individuals wish to exert some type of control over their environment. The product of the successful manipulation of the environment is self-efficacy. The processes of the development of self (as posited by Mead) and self-efficacy begin at birth and continue throughout the life-course.

> The initial experiences that contribute to development of a sense of personal agency are tied to infants' ability to control the sensory stimulation from manipulable objects and the attentive behavior of those around them. Infants behave in certain ways, and certain things happen. Shaking a rattle produces predictable sounds, energetic kicks shake their cribs, and screams bring adults (Bandura 1986:414).

Even a seemingly helpless infant has some control over her environment, and most parents have experienced their own child's attempt at the manipulation of it.

The environment, in turn, can enable or constrain the infant's ability to develop cognitively and physically. An infant born into a single family household with few material resources and little interaction with adults will develop differently than an infant in a rich material and social environment. Cognitive processes and the development of self-efficacy are key concepts in Bandura's theory. The addition of cognitive learning theory allows greater insight into the cognitive and affective processes that contribute to learning, perceptions, and behaviors.

What I wish to stress in this summary of Bandura's theory is that each individual life-course is unique, but still predictable in a probabilistic sense. Most importantly for this dissertation is the idea that children begin their journey in this world and interact with their environment first, as biological organisms with temperaments and traits (Bandura 1986). Some children will be socialized within a very restrictive environment, while others will experience very little restraint on personal development. Most will fall somewhere in the middle of this continuum. During the critical years of childhood and adolescent socialization, individuals will, through a process of selection and alteration of objects in the environment, develop into thinking, perceiving, acting adults. This environment includes not only material

objects, but significant others who both influence and are influenced by the child. By examining the environments in which the child develops and observing their choices within those environmental constraints, researchers can offer a probabilistic prediction of outcomes for such variables as educational and occupational attainment and the ways of thinking which are associated with different experiences of both. In this dissertation my methods agree with Bandura's position of the prediction on the basis of probability rather than the attempt to determine ultimate "causes" of outcomes.

It follows that for this study I conceptualize intellectual ability as a variable that may be predicted with a certain probability given the knowledge of key experiences within particularly influential environments (namely educational and occupational organizations). Other key experiences that contribute to the variance in this outcome include those involving the family of origin and the home environment.

In the next chapter I use empirical literature to substantiate my theoretical argument and application. I organize the literature review by environmental proximity (using Bronfenbrenner's systems) to identify some of these key contributors to educational achievement, occupational placement, and intellectual ability. Within that environmental framework, I provide an overview of educational and occupational attainment (or hindrance) and link it to my outcome of primary interest--intellectual ability.

In addition to literature utilizing other samples, I have the fortunate ability to talk about previous studies that use subjects in the Berkeley Growth Studies (the sample for this study). I use these findings within the literature review to support my theoretical argument.

My objective for the next chapter is to offer a coherent, plausible predictive model of the contributions of education and occupational conditions to adult intellectual ability.

CHAPTER II

EXPLICATION OF THEORY AND REVIEW OF LITERATURE

In the previous chapter, I presented a theoretical argument which highlighted the complexity of the issues discussed in this dissertation. Intellectual ability is determined by multiple influences both genetic and environmental. While my theoretical explication is elaborate, as is often the case, my data offer the ability to test only a few of the relationships described. Again, the intent of my extensive theoretic elaboration is to shed light on those variables which are not measured or modeled in this study; I hope that this theoretical explication will shed some light on the unexplained variance in the model of education, complexity of work and intellectual ability presented in this study.

Following the precedent set by Melvin Kohn, the outcome of major interest for this study is conceptualized as intellectual ability. While Kohn constructed his own empirical measures for "intellectual functioning" which was his construct for intellectual ability, I chose to utilize measures that have been employed by educators and psychologists as diagnostic tools in the evaluation of intellectual ability for nearly a century. While standardized IQ tests have been criticized for their perceived weaknesses, they are to date the most widely used and researched measures available for measuring the behavioral aspects of intellectual ability.[1]

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[1]See Thorndike and Lohman (1990) for a history of ability testing and Collier (1994), Gould (1996), Samuda et al. (1998), and Seligman (1992) for recent discussions

Moreover, several longitudinal studies that have followed individuals over the life course have included these measures in their instruments, allowing researchers to analyze a set of comparable measures over extended periods of time.

While there is considerable debate about how to define and measure intelligence, for the purposes of this study I take the position that defines intelligence most broadly and use measures which are most widely accepted as representative of the construct. I use a general definition agreed upon by most professionals who study intelligence: "intelligence comes down to first the ability to learn from experience, and second to the ability to adapt to the environment" (Mugny and Carugati 1989:1). Both general ideas fit into the Meadian definition of intelligence which posits intelligence to be the ability to solve problems (1977). It also aligns with Kohn's conceptualization of intellectual flexibility:

> As appropriate measures of intellectual flexibility we rely on scores based on a single factor comprising several indices of how well men dealt with problems they encountered in the interview. These indices are disparate in form and apparent content-some are based on problems that are abstractly intellectual in content...some are perceptual... and some are motoric (Kohn 1969:186).

Since problems arise out of the individual's interaction with the physical and social environment, the ability to adapt to the environment is inherent in problem-solving. In this way, my definition for intelligence also reflects the ability to achieve the primary goal of human existence identified by both Mead and Bronfenbrenner, which is adaptation to the physical and social environment. Conceptualizing intelligence in this way is also in agreement with the definition that is the foundation for the standardized intelligence tests used in this

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of intelligence tests and alternatives.

study. In his development of intelligence tests, Weschler defined intelligence as, "the aggregated or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment" (Thorndike 1997: vii). Weschler went on to develop intelligent tests for both children and adults using this definition as a reference point for measurement.[2]

Review of the Literature

Any attempt to review the relevant literature on the predictors of intellectual ability must go beyond the major independent variables of interest to a discussion of those variables which have been shown to have both direct and indirect effects upon intelligence. Intelligence is the result of an interaction between genetic and environmental factors (Scarr 1981) requiring that we follow a trail of indicators beginning at birth and continuing throughout the adult years. Since the focus of this study is on adult intellectual functioning, and I am utilizing longitudinal data with a baseline measure of adult IQ (at age 18), it will not be necessary to delve too deeply into the background predictors of IQ. However, the relationship between IQ, education, and occupation in the early years of development must be discussed to understand the complexities involved in unraveling the relationships among the three. The interactions between the active, reflexive human organism and significant others in various environments set the individual on an increasingly (or decreasingly, depending upon previous outcomes) selective path. This path directs the intellectual, educational, and occupational

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[2]The standardized IQ score was introduced by Binet as a means to compare functioning between children of different ages. The intelligence quotient (IQ) of a child was a function of her chronological age and her performance score on a mental test (mental age). These scores are multiplied by 100 to remove the decimal point, the result being a mean score of 100 and a standard deviation of 15 points for comparison across ages (Thorndike 1997).

attainment of the individual long before she reaches her eighteenth birthday (and our baseline measure of IQ).

In keeping with the theoretical framework constructed in the previous chapter, I discuss these contributing factors in the context of the proximity of systems within which the individual develops. Using Bronfenbrenner's *person--process--context* model of human ecology, I organize my review of the literature beginning with the most proximate systems (micro and meso-systems) and build outward to the most distal (the exo and chronosystems). I discuss the individual traits, experiences, and environments that have been shown to influence the individual and contribute to outcomes for IQ scores, educational achievement and occupational placement. Keep in mind that I begin with experiences before the baseline measure because experiences and decisions during the formative years will have an effect on the opportunities available later in life. Some may have cumulative effects, propelling the individual ever more strongly in a given direction (e.g., a delinquent act which causes the individual to be labeled as deviant) while others continue to direct the choices available by expanding or limiting future options (as in the elimination of college as an option for high school drop-outs or the expansion of educational options for the class valedictorian).

The Microsystem

The microsystem constitutes the most proximal processes for the developing individual. It encompasses "processes of progressively more complex reciprocal interaction between an active, evolving biopsychological human organism and the persons, objects, and symbols in its immediate environment" (Bronfenbrenner 1995: 620). In applying these processes to the substantive area of intelligence and education, proximal processes would

include the interaction of individual biopsychological traits such as inherited intellectual ability, personality traits, and physical appearance (e.g., race, gender, and physical disabilities) with significant others. Significant others in the microsystem include those who interact habitually with the individual over an extended period of time including parents, siblings, teachers, and peers. One product of these micro-processes that is important to this is the self-concept. Included in the self-concept are self-efficacy and self-esteem, both motivating forces which influence and direct perceptions and behavior.

Interaction as a Dynamic Process of Self-Development

Mead (1977) posits, and SI theorists agree that the self is acquired via interaction with others. How does interaction with others result in a self? Mead proposes that the individual uses a cognitive process to select and store attitudes for the purpose of utilizing them in future interactions and problem-solving situations. Bandura (1986) gives greater insight into this process by proposing that modeling is the process by which these attitudes are acquired. Both SI and social cognition theorists believe that interaction is the mechanism for learning. Bandura goes beyond SI theorists to explicate the process of information acquisition and its behavioral outcomes.

Learning through Modeling

According to Bandura (1986), human behavior is learned through a process of modeling. Humans observe both the actions of others and the consequences of those actions. Observed behaviors are not limited to the physical performance of tasks; they include attitudinal and cognitive indicators such as the expression of values and the enactment of problem-solving strategies. Nor are the models of behavior limited to persons in the

immediate face-to-face environment; television, literature, and other forms of vicarious representations of models can provide individuals with exposure to new behaviors. Because the unique, human ability to represent behaviors in symbolic form, modeling is a powerful mechanism for learning. The use of symbols allows humans to cognitively store and manipulate experiences in memory and anticipate future behavior and consequences. Individuals can learn vicariously by observing others and cognitively processing those behaviors and their outcomes. In doing so, they can avoid harmful or painful outcomes by avoiding behaviors that have been observed to produce negative outcomes (Bandura 1986).

Bandura's conception of modeling is the active acquisition of rules for thinking and behavior rather than the physical mimicry of observed behavior. The infant comes into the world with a limited ability to model observed behavior. With practice, she becomes adept at mirroring facial expressions and sounds. Through exposure to modeled behaviors and practice, the infant gains more skill as her base repertoire for behaviors increases. Building upon these acquired skills, she becomes increasingly adept at imitating the behaviors of significant others. Learned skills are cognitively stored as rules and concepts and exposure to new experiences and behaviors are modeled, processed, and cognitively classified and "attached" to established, related concepts in memory. Because new knowledge is attached to old, learning capabilities increase as her base store of learned rules and concepts increases (Bandura 1986).

The selection of objects to model is directed by attentional factors such as the salience, exposure time, discriminatability, and complexity of the object or behavior modeled (Bandura 1986). For example, objects presented by significant others such as the mother or father are

more salient than those presented by strangers. Background noise or objects which compete visually with the object to be modeled may distract the infant's attention. Simple objects are more easily modeled than more complex ones.

Learning by modeling is dependent upon four processes: (a) attentional (discussed above), (b) retentional, (c) production, and (d) motivational (Bandura 1986). The degree of retention for rules and behaviors determines the ability to reproduce them. The infant can only imitate an observed facial expression to the extent that she can remember it. If retention is adequate enough for the production of the facial expression by the infant, she can go on to practice the behavior until mastery is achieved. Finally, the infant must have some motivation to model behavior or learning will not occur.

The Source of Motivation

Motivation is a key concept for any theory of human behavior and particularly for the topic of this dissertation. Campbell and Pritchard define motivation as: "a set of independent/ dependent variable relationships that explain the direction, amplitude, and persistence of an individual's behavior, holding constant the effects of aptitude, skill, and understanding of the task, and the constraints operating in the environment" (1976:65). It is interesting to note that this definition does not point to a single source of motivation. Rather, the authors claim that there are multiple indicators of motivation which can be evaluated only in the context of their combined effects on performance outcomes. The set of theoretic predictors identified as important in predicting the outcomes of interest for this study include bio-genetic and personality traits, interactions with significant others, and life experiences directed by the biological, physical, and social environment. The outcome of interest is performance on adult

intelligence tests. Thus, the sources of motivation for any individual are directed by environmental influences and are subject to changes in the physical maturity and social development of the individual over the life-course.

Bandura posits that the source of motivation in infants is the need for social interaction and attention. Underlying this proposition is the assumption held by most sociologists that humans are inherently social and crave the attention and approval of other humans. A second assumption, explicit in Bandura's theory, is that behavior that is rewarded is more likely to be repeated, while behavior that is punished or goes unrewarded will not. I believe that Bandura's principle of reward as a motivation for action is interactionist for three reasons: (a) he recognizes that the reward does not necessarily need to follow the behavior, it need only be anticipated, thus including cognitive planning in the process; (b) he posits that behaviors may be learned by experience in any form, including vicarious and symbolic modeling; and (c) rewards may take many form, including self-evaluations (Bandura 1986).

Motivation may initially be driven by the innate need for attention and interaction, but later, Bandura argues, the infant learns to derive some sense of self-satisfaction for her own accomplishments, and these feelings are in and of themselves a reward (Bandura 1986). Gradually, the infant's primary source of rewards expands and moves from external attention to internal evaluation. As she matures, and her learning increases, she also develops the ability to move from modeling only behaviors that are physically observed and experienced to acquiring the ability to model objects that are in symbolic form. For example, the toddler sees a picture of a dog in a book and recognizes that it fits in the same category "dog" as the

family pet. Later, the child can predict the end to a new story because she has symbolically modeled and learned the rules for that type of plot from other bedtime stories. The ability to learn symbolically greatly increases the efficiency and capacity for information storage and retrieval through the ability to classify and regroup objects cognitively. These skills facilitate the synthesis of acquired information and thus provide the individual with creative ability. The child now has the ability to select smaller chunks of learned information and reconstruct them to fit new situations that may be similar to those experienced at an earlier time, but different enough to warrant a unique approach for action.

Inherited Ability vs. the Environment

The individual meets her social world as a biological organism with inherited physical and psychological characteristics. Of primary interest in this study is the intellectual ability that the individual brings to her environment. Intellectual ability is widely believed to have both an inherited and environmental component (Neisser et al. 1996; Scarr 1981) with the contributing proportion of each the subject of an ongoing debate.[3]

In their review of current issues on IQ scores, Neisser and colleagues (1995) point out that the heritability portion of IQ (designated as h^2) increases with age, while the environmental portion (c^2) decreases.

> We now know that the heritability of IQ changes with age: h^2 goes up and c^2 goes down from infancy to adulthood (McCartney, Harris, & Bernieri, 1990; McGue, Bouchard, Iacono, & Lykken, 1993). In childhood h^2 and c^2 for IQ are of the order of .45 and .35; by late adolescence h^2 is around .75 and c^2 is quite low (zero in some studies).

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[3]See Aby (1990) for a guide to the literature on the IQ debate.

> Substantial environmental variance remains, but it primarily reflects within-family rather than between-family differences (1995: 16).

While one might focus on the strong heritability portion of IQ, I instead focus on the "substantial environmental variance" which remains. I do so because both the theoretical foundation of this dissertation and the empirical literature support the position of a complex interplay between the biological organism and the environment in which it develops. Supporting this position are several studies which demonstrate the malleability of IQ scores by the manipulation of the environment.

Ability and SES

Dumaret (1984) used a longitudinal, matched case-control study design to examine the effects of environment on siblings who were raised in adoptive and biological families. The author followed 28 mothers (and their children) who had abandoned an infant but kept other offspring or had other children in foster or institutional care. The infant must have been adopted before seven months into a high SES family. Each child in the study was matched to another non-related child of the same age in the same school. Social class was measured using occupational status, with the biological families mostly low or lower-middle class. The hypothesis was that the environment would play a significant part in the development of IQ (i. e., higher SES would lead to higher IQ). This hypothesis was supported.

Data from the Dumaret (1984) study produced significant differences in group means for IQ in children raised in three different family environments. The mean IQ for children raised in high-status professional homes was 105.7. The mean for those raised by their biological families was 85.5, and the mean for the siblings raised in institutional settings or

foster homes was 81.8. The difference for the first and second group is significant ($p = .001$). The difference between those raised in high status occupation homes and those raised in low-status occupation homes is 23.9 points, more than one and one-half standard deviations for IQ scores.

There are several things to note about this particular study. The experimental design of the study is strong and contributes to its predictive ability. The differences in occupation are pronounced and the findings appear to show a dose/response effect in this regard. That is, the differences between groups increase with the differences in environmental exposure.

Another piece of evidence supporting the contributions of the environment to IQ is the clinical intervention trial conducted by Scarr-Salapatek and Williams (1973). They tested the proposition that low-birth-weight infants born into low SES families are in double jeopardy for lower IQ scores in childhood. Both these factors are associated with lower scores and result in an additive effect on IQ outcomes. The authors conducted their trial to determine if early stimulation on these babies improved IQ scores at one year of age (n=30). The mothers and infants were randomly assigned to one of three groups and given three separate treatments of educational intervention. IQ was measured using the Cattel Infant Intelligence Scale. All the mothers were classified as Black and low SES (SES is not defined). Their hypothesis was that more stimulation would result in higher developmental outcomes for low-birth-weight infants from low SES families.

The results showed significant differences between the three groups: the greater the amount of stimulation the infants received, the higher the mean IQ scores for infants. Babies of mothers who were trained in interaction and play techniques scored significantly higher at

one year of age than at four weeks and obtained near normal scores (mean of 95.3) as compared to the control group which had no intervention (mean of 85.7). While the small n-size for this study does warrant close scrutinization of the results, the differences in the outcomes for IQ scores (nearly one standard deviation for the mean group scores) is quite large and probably not due to idiosyncracies in the sample selection. Also, clinical trials are a powerful tool for testing hypotheses, and the controls in this study were sufficient to assure reliable and valid results. The built-in controls for SES and race also add weight to these findings.

Ability and Minority Status

One remarkable example of the documented contributions of environmental factors to IQ is a study by Duncan, Brooks-Gunn, and Klebanov (1994). They tested the results of previous studies that found minority groups produce consistently lower IQ scores than their majority counterparts. A topic of ongoing debate is whether these differences are due to genetic inheritance or environmental factors. The Duncan et al. (1994) study is a convincing demonstration that the environment is the primary source of these differences.

Duncan et al. (1994) analyzed the effects of poverty and low income on the development and IQ of children. They proposed several theories which might explain the effects of poverty on child development. Neighborhood resources, contagion theories, collective socialization, competition theories, and relative deprivation theories all offer some explanation for the effects of poverty or lower social class to lower scores on IQ tests. They test these theories by examining the correlations between income (measured using an income-to-needs ratio), neighborhood conditions (the concentration of poor and affluent families in

an area), and family characteristics (mother's education and mother as head of household). Intervening variables were coping strategies, depression and anxiety, and social support.

Two samples were used: the first, the Panel Study of Income Dynamics (PSID) (n=1364) and the second, the Infant Health and Development (IHD) study, a clinical trial for educational efficacy for preventing low birth weight in infants (n=895). The PSID sample included 568 Black and 796 White children. The IHD group also had high minority representation with a sample composition of 54.7% Black, 11.3% Hispanic and 34% White children. The authors found that while the educational attainment of the mother contributed positively to the child's IQ (WPPS) scores at age five, poverty, especially chronic poverty, was the strongest predictor of low IQ scores. Race and the number of affluent households in the neighborhood also predicted IQ scores. Black children scored significantly lower than did White children, and a larger proportion of affluent households had higher IQ scores (Duncan et al. 1994). The status of Blacks in the United States offers some explanation for these findings.

As Neisser et al. (1996) point out, Blacks in the United States are sometimes seen as a caste-like minority in that they were not voluntary immigrants to this country and do not expect their situation to improve. Also, their self-comparisons are more favorable for those in their country of origin than to those in this country. This is not true for many voluntary immigrants who think more highly of themselves and their achievements in comparison to those they have left behind, and they identify with those who live in their adopted country. Caste-like minorities, in general, believe that regardless of their own aspirations, their social position "will be restricted to a small and poorly-rewarded set of social roles" (1996: 94).

Caste-like minorities as a rule, regardless of the country in which they live, perform below those with higher social status on tests of academic achievement and intelligence (Neisser et al. 1996). If we look at Blacks in the United States as a caste-like minority, we can examine the causes for the lower mean IQ scores for Blacks as a group.

In short, minority status is an important factor in predicting intelligence scores because minorities are disproportionately represented in the lower classes and thus have greater exposure to the environmental risk factors that contribute to low scores on IQ tests. They have less income to provide nutrition, toys, and experiences which enrich learning. Parents most likely have lower levels of education and so less "human capital" (Coleman 1988; Coleman 1968) with which to help their children achieve in school. Overall, these families have fewer resources by which to enrich their children's experiences and consequently their cognitive development.

The Cumulative Effects of Environmental Factors on Ability

Having less of everything makes a difference in cognitive development, and the effects of negative environmental factors are cumulative (Sameroff et al. 1993). The less one has (money, parental interaction, education, affluent neighbors, access to objects valued by the dominant culture) the lower her expected performance on tests of intelligence. Since 41.5% of Black children in 1995 were living in poverty (U. S. Census Data 1997), it would be reasonable to expect that they would also be disproportionately exposed to all the risks for lower IQ scores associated with lower social class status.

The most convincing evidence for the contributions of environmental factors in IQ outcomes in the Duncan et al. (1994) research is the difference in the effect size for IQ

regressed on race when other variables are controlled. In the process of controlling for environmental factors, the effect for race on IQ was reduced in the following manner: the mean IQ score for Black children (5 year-olds) is 10.7 points below those of the reference group after controlling for gender, birth-weight, treatment, and site. The difference reduces to 7.8 points when they added mother's education and presence of father in the home to the equation. It is even lower when the income-to-needs ratio is added (4.8 points). Finally, after controlling for measures of the home learning environment, the gap in mean IQ is reduced to only 2.9 points. The discrepancy between mean group scores falls from over two-thirds of a standard deviation for IQ scores to less than one fifth of a standard deviation (Duncan et al. 1994). This study illustrates how environmental factors can be used to explain most of the discrepancy between minority and majority groups on IQ scores. After controlling for the other risk factors associated with social class, the differences in IQ scores between Blacks and the (White) reference group is reduced to only one fifth of a standard deviation, or 2.9 IQ points.

The Interaction of Individual Differences and the Environment

While I believe and have presented support for the position that the environment contributes significantly to the intellectual development of individuals, I do not wish to discount the contributions of the individual to this process. Ceci and Hembrooke (1995) posit a "bioecological" view of intellectual development which models (theoretically) the complex interaction of biological and contextual factors in the development of intelligence. Their model is subsumed under the Bronfenbrenner microsystem and includes such biological factors as cognitive processing speed, temperament, and facial features. These factors

interact with environmental variables such as exposure time and the cultural value of the target objects in the environment in directing the course of processing. It is important to note that Ceci and Hembrooke (1995) propose an *interactive* association between these variables rather than an *additive* one. Their proposition allows the individual to both act and react toward her environment within the context of her own inherited qualities and the environmental setting. For example, the infant with faster cognitive processing speed, who is more attentive to environmental stimuli, and has greater exposure time to varied objects in the environment, holds an advantage for developing intellectual abilities. Temperamental predispositions and personality traits also influence the process and may facilitate or inhibit intellectual growth.

Neisser et al. (1995) cite experimental studies that tested cognitive skills of reaction time and inspection time toward various objects and found that both are correlated to IQ scores. Faster reaction time (the speed at which one responded to a visual display) was positively correlated with intelligence (Neubauer and Bucik 1996), and the amount of time taken to inspect an object before drawing a conclusion about it was negatively correlated to IQ scores (Bates and Eysenck 1993; Deary 1993; Kranzler and Jensen 1989).

Personality characteristics also appear to act as mediators between intellectual ability and the behavioral outcomes of IQ scores, educational achievement, and occupational attainment. Psychologists have identified a group of personality factors (referred to as the Big Five) which appear to have a strong heritability component. These factors, and some of their empirical indicators are: (a) extroversion (talkative, outgoing); (b) agreeableness (helpful, pleasant); (c) conscientiousness (responsible, efficient); (d) neuroticism (worrying, tense); and

(e) openness (original, imaginative) (Loehlin, McCrae and Costa 1998). Interestingly, supporting the theoretical framework presented here, Loehlin et al. analyzed these factors using factor analysis and concluded that while "51% to 58% of the variance is genetic in origin, 42% to 49% is due to experience unique to the individual, to temporary situational factors, and to gene-environment interaction" (1998:447). Thus, it appears that like intellectual ability, personality traits reflect an interaction between inherited and environmental influences. These traits contribute to personal development in that they direct attention to and interaction with objects in the environment.

This position is supported by research findings using members of the same sample used in this study (the Berkeley Growth Studies). Utilizing factor analysis to analyze personal characteristics derived from Q-sort procedures, Eichorn, Hunt, and Honzik (1981) produced four characteristics that were significantly correlated to IQ scores in men and women in the Growth Studies sample. Being cognitively invested (valuing intellectual matters, holding high aspirations and being verbally fluent) had the strongest correlation with IQ scores throughout the life course. Adolescents who were judged to be calm, dependable, and distant from their peers had higher IQ scores as adolescents and adults. Men who were insightful, introspective, comfortable with uncertainty, and who were not repressive or self-defensive in adolescence had higher IQ scores in later years. Also, perhaps inferring the reciprocal influence of IQ on personality factors, individuals whose IQ scores decreased with age also tended to have less self-confidence at middle age.

It is the interplay of personal characteristics and environmental characteristics over time that produce the outcomes of interest for this study. While the infant comes into the

world with a limited ability to manipulate the environment, her efficacy increases as she learns to model behaviors and cognitively process information. This increased efficacy may in fact contribute to the observed increase in the inherited portion of ability. Personal preferences and reactions mediate the actions of the individual toward environmental stimuli and at the same time influence how others react toward the individual. The fact that the heritability component of IQ increases over time indicates a person-environment interaction. Neisser et al. (1995) posit that this may be the result of the increasing ability of the individual to select her own environmental conditions as she grows older.

> Why should individual differences in intelligence (as measured by test scores) reflect genetic differences more strongly in adults than they do in children? One possibility is that as individuals grow older their transactions with their environments are increasingly influenced by the characteristics that they bring to those environments themselves, decreasingly by the conditions imposed by family life and social origins. Older persons are in a better position to select their own effective environments, a form of geno-type-environment correlation (Neisser et al. 1995:17).

It is important to point out that the intellectual ability of the individual is an important influence on achievement in both academic and occupational settings. Students scoring higher on standardized test of intelligence generally achieve more years of schooling (Neisser et al. 1996) and tend to learn more while in school (Cronbach and Snow 1977). IQ scores are also positively correlated with job performance (Ree, Earles, and Teachout 1992). Thus, IQ is both a predictor and outcome variable for this study.

The Interaction of Self-Processes with Objects in the Environment

While innate ability contributes to adult intellectual ability and educational and occupational achievement, motivation to achieve also enhances these outcomes. Motivation

to act has its roots in self-processes such as self-efficacy. Students who believe in their ability to perform well in school are more likely to earn higher grades in school (Zimmerman, Bandura, and Martinez-Pons 1992). Students with high self-efficacy also have higher levels of persistence and put forth more effort on tasks. Students with higher levels of persistence will stay on task longer and recover more quickly from failures. People who posses self-efficacy also have higher expectations that they will succeed (Brown 1998).

Self-Process Contributing to Motivation

For both SI and social cognitive theory, the sources of individual motivation are found in the need to maintain self-consistency and self-esteem (Bandura 1986; Turner 1987). Self-consistency concerns the maintenance of a relatively stable self-concept. The self-concept may be defined as what one *thinks* about herself. Self-esteem, on the other hand, concerns the *feelings* one has about herself (Brown 1998).

Tesser (1988) presents a model of self-concept maintenance which proposes that the processes of self-reflection and comparison, mediated by the variables of closeness, relevance and performance, influence the outcome of self-esteem. To gauge her own success or failure, the individual compares her performance[4] to the performance of others. The closeness of the other in terms of liking, friendship, etc. has an influence on the self-evaluation for performance. If the other used for comparison is very close to the individual (e.g., her best friend), rather than losing self-esteem when her friend is more successful, she may salvage her

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[4]Performances are activity and context specific. Lack of ability or adequate performance in one area will likely be compensated for by directing efforts to an area of greater competence (Bandura 1986).

own self-esteem by "basking in the reflected glory" of her friend's success (Cianaldi et al. 1976). A greater blow to the individual's self-esteem would be the failure to perform as well as a competitor to whom she feels no personal closeness. Finally, the relevance of the other's performance to the individual's self-concept will mediate the effects of performance on self-esteem. If an older sister is a brilliant scholar, and achieves higher grades in school, the effects on the individual's self-esteem may vary. If the individual also considers herself to be a scholar, the effects will likely be negative. If, however, the individual sees herself primarily as an athlete, her self-esteem may be unchallenged.

Interestingly enough, research shows that most people maintain a positive self-concept and high level of self-esteem even if their self-evaluations are objectively inaccurate (Greenwald 1980). Most people will go to great lengths to avoid or minimize negative feedback and evaluations of the self (Baumgardner and Arkin 1987). One strategy, for example, is the use of self-defeating behaviors such as handicapping or compensation. Self-handicapping refers to the production of a priori excuses in anticipation of failure (Arkin and Baumgardner 1985). The child who is afraid of striking out in baseball may tell the coach on the way to the plate that her arm is sore, and she needs a new prescription for her glasses. Repeated failure in one area may be compensated for by a shift of focus to another. A child who has little success in the classroom, for instance, may put little effort into her studies, focusing instead on improving her athletic ability.

The motivation to maintain a sense of continuity of self-concept and positive self-evaluations even in the face of failure are powerful forces directing perceptions and behavior. In keeping with the theories presented here, the individual is motivated to act toward the

environment and in the process performs an ongoing self-evaluation. The real or imagined reactions of significant others are perceived by the individual, cognitively and affectively processed, and acted upon. Previous behaviors have an influence on future perceptions and behaviors as the individual negotiates and acts upon other persons and objects in the environment. For the purposes of the theoretical explication of unmeasured variables in this study, these self-processes may be conceived as contributing to the development of intellectual and academic ability throughout the life course. If experiences which contribute to the development of these skills are rewarding and contribute to a positive self-image the individual will likely increase her efforts and continue to set and work to achieve more challenging personal goals. If, on the other hand, the individual experiences failure and is not rewarded in these areas she will probably reduce efforts or shift them to some other area in which success is more likely. This process begins with the individual's first exposure to interactions and reflected appraisals in the home environment.

Interaction with Significant Others in the Home Environment

Parents have a great deal of influence in helping to shape the self-concept of the child. Early parent-child interactions are important for developing intellectual ability (Moore and Snyder 1991), self-efficacy (Felson 1990), self-esteem (Baumeister and Leary 1995; Bowlby 1969), and values (Glass, Bengtson and Dunham 1986). Both actors--the child and the parent--bring interpersonal and material resources to interactions. The child brings personal characteristics and temperaments and her physical self[5] to the interaction. The parent

[5]Brown (1998) identifies three components of the empirical self. The material self consists of all the material objects that the person refers to as "mine." The social self is how the individual is thought of by others (her identities) and is as complex as the number of

provides not only her physical self, to provide the infant with nutritional, hygienic, and attentional needs, but also material objects such as money, toys, educational resources, play space, and objects of cultural value (e. g., status symbols such as clothing and living accommodations). In addition, the parent provides intellectual resources (i.e., her own intellectual ability and knowledge) acquired through formal or informal education and socialization. The exposure of the infant to these various environmental objects contributes to her ability to model and acquire skills and concepts. Verbal interaction, in both quantity and quality, appears to be a key contributor to this process (Bernstein 1971; Thorlindsson 1987). Verbal interaction is one of the primary mediums through which parents model rules, expectations, and values. In the following sections I discuss the influence of the home environment on the outcomes of IQ, academic achievement and occupational attainment.

Differences in family characteristics are associated with differences in IQ scores in children of all ages. Three aspects which seem to have a significant impact on intelligence are the economic resources of the family, the educational resources of the parents (especially the mother), and the number of siblings in the family (Blake 1989; Dumaret 1984; Duncan, Brooks-Gunn, and Kelbanov 1994; Sameroff et al. 1993; Scarr-Salapatek and Williams 1973). All three of these factors may contribute to IQ by either facilitating or inhibiting the quantity and quality of parent/child interaction.

Using a sample from the National Longitudinal Study of Youth, Guo (1998) examined the effects of poverty on children and found that the effects varied depending upon the length

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others with whom she interacts. The spiritual self is the inner, psychological self, composed of all intangible objects referred to by the individual as "mine."

of time in poverty and when in the life course poverty occurs. While long term poverty and poverty experienced for a short time only during adolescence had a depressing effect on adolescent IQ scores, short term poverty experienced in the early childhood years did not. Referring to my earlier argument, children in families with few material resources are disadvantageds with regard to exposure to environmental stimuli and cultural objects. Parents in these households are required to spend a greater proportion of their time and energy on activities that are focused on survival, as opposed to providing enriching experiences for their children. Just the stress and fatigue of the chronic struggle for economic survival may reduce the quality of interaction that does occur between parents and children. Compounding the problem, having few material resources and limited time and energy may contribute to larger deficits in intellectual ability if those scares resources must be distributed between a large number of children. In addition, since lower levels of education are associated with poverty, parents may be less able to model symbolic objects such as vocabulary and literacy for their children.

Blake (1989) provides an extensive review of the literature on the effects of family size on achievement. She utilizes data sets (including the Occupational Changes in a Generation, 1962 and 1973; the General Social Survey 1972-1986; the 1955 Growth of American Families study; the 1970 National Fertility study; Cycles I and II of the Health Examination Survey; and the High School and Beyond Survey) which altogether include over 150,00 subjects studied over a period of 30 years, to explicate the effects of family size on outcomes such as intelligence and educational and occupational achievement.

Blake's (1989) results confirm previous findings that larger numbers of siblings predict lower IQ scores.[6] However, the effect appears to be the greatest (in size and consistency) for the verbal portion of intelligence tests. This finding is important however, because as Blake notes, the verbal portion of intelligence tests are "the principle cognitive predictor of educational success" (1989:117). Blake (1989) attributes the relationship between sibling size and IQ scores to the dilution of adult resources in homes with more children. Of particular importance for IQ outcomes is the dilution of adult interaction with the children in the household. The larger the ratio of children to adults in a family, the smaller will be the proportion of adult interaction for children.

Blake's findings and her interpretation of those findings fits with the theoretical framework presented here. Intelligence is developed through a process of interaction and in particular through the manipulation of symbols to create shared meanings. Adults have more experience in the use of language and as such should have larger repertoires of symbols. Children, on the other hand, must build a symbolic repertoire (words, metaphors, etc.) over a period of time through interaction with knowledgeable others. It makes sense that if children, who posses limited language ability, spend more time with other children than they do with adults (who have large stores of symbolic tools), their symbolic acquisition will be slower than their counterparts who spend more time interacting with adults.

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[6]Recent findings by Guao and VanWey (1999) elaborate upon the relationship between family size and intellectual development. While they claim that the relationship is spurious, their methods call for replications to confirm their findings (see Downey et al. 1999; Phillips 1999). Ironically, their argument and findings support my position that the environment contributes to children's intelligence via a complex, interactive process.

Parents also influence the academic achievement of their children. They do so in a variety of ways including modeling positive values toward education and knowledge acquisition, providing material and social support for educational activities (Teachman 1987), and modeling skills and attitudes that contribute to success in the formal educational setting (Bandura 1986). If parents cannot provide these resources, their children's achievement in the educational arena suffers.

The dilution of resources is supported again by Blake's (1989) findings for educational achievement. She reported that not only is the number of siblings negatively related to IQ scores, but also appears to inhibit academic achievement. Having more siblings predicted higher high-school drop-out rates and decreased the likelihood of attending college.

Dilution also appears to operate when the number of parents is reduced. Using data from the High School and Beyond study, Astone and McLanahan (1991) looked at the effects of single vs. two-parent households on children's educational attitudes, aspirations, and achievement and found that living in a single-parent home has a negative effect on all three outcomes. In addition, and perhaps contributing to these negative outcomes, children from single-parent homes reported that their parents spent less time monitoring their schoolwork and had lower educational expectations for them. Interestingly, children from single-parent homes reported talking to their parents more often than children from intact families. This may not, however, run contrary to the interactionist theory presented here, as the parent may be using the child for support rather than modeling behaviors that contribute to academic achievement. Mulkey, Crain, and Harrington (1992) report similar findings, with single-parent status contributing to lower grades. They also find, however, that the outcomes

appear to be mediated to a large extent by parental behaviors such as supervising and having contact with their children.

Two important resources parents bring to parent/child interactions are income and their own formal education. Other family resources which contribute to academic achievement are values which contribute to school achievement and parental involvement in the child's education (Rumberger et al. 1990; Sui-Chu and Willms 1996).

I discussed previously the contributions income makes to family and parental resources, or more importantly the negative consequences of having too little income and material resources. SES (income, parents' education, and father's occupation) has consistently been shown to have a large effect on academic achievement (Alexander, Entwisle, and Horsey 1997; Mulkey, Crain, and Harrington 1992). Income mediates the effects of living in a single-parent home (Mulkey, Crain, and Harrington 1992) and also the number of siblings present (Blake 1986).

Living in the United States is difficult for families with low income. Family income allows parents to provide physical health, security, a less stressful family environment, material resources for cognitive stimulation, and social status for their young children. It is also the means by which parents may improve the quality of their children's formal education by enrolling them in selective private schools, hiring tutors to improve weak areas of achievement, and providing enriching activities such as summer camp, music lessons and enrichment courses. Supporting these claims, Entwisle and Alexander (1992) found that poor children fell behind their higher SES counterparts in the summer months when school was not

in session. They gained ground again during the months school was in session. The authors attribute the decline while out of school to the lack of resources at home for poor children.

Economic resources may also contribute to human resources in the home. Middle class families who can live comfortably on one income increase parent/child interaction by providing a full-time parent able to devote large amounts of time to the children. Families in which both parents work long hours simply have fewer hours in the day to do so. Parents with higher income can also afford to pay for higher education. While students of families differing in SES may have similar aspirations for attending college in the early years of school, the reality of funding a college education appears to cause differences in later expectations of attending (Hearn 1991; McClelland 1990). Students from lower SES families generally develop lower expectations of going to college than their higher SES counterparts (Brinkerhoff, Merlin, and Corry 1976; Hanson 1994).

Another valuable resource parents offer their children is their own store of knowledge and experiences in the formal educational setting. Parents' educational achievement is frequently the strongest predictor of their children's educational achievement (Brinkerhoff and Corry 1976; Davis 1994). SI and social cognitive theorists would see no contradiction in these findings. As I argued earlier in this paper, experiences are modeled behaviors stored as rules and concepts. Parents' experiences in the formal education system are learned and modeled for their children. Higher levels of education for parents point to two important resources they have to offer their children (1) they have been successful in the academic setting and know the rules and expectations for successful performance, and (2) higher education generally provides the parent with higher social status and income.

Parents who have attended college have a store of knowledge obtained in the formal educational setting. Much of the knowledge acquisition that takes place in the classroom is vocabulary development. Parents with larger vocabularies are more able to model symbolic objects for their children. The same is true for math skills taught in the classroom; parents have the ability to model problem solving and math algorithms for their children, offering them an advantage over children whose parents have achieved fewer years of schooling. Parents who have spent more years in the educational system also know the rules for success in that institutional setting: getting to school on time, maintaining high attendance, paying attention to the teacher, memorization techniques, getting involved in extra-curricular activities, and appropriate interaction with authority figures. Parents may model these rules for their children both verbally and by their actions.

Parents with higher educational achievement may also have greater knowledge of the effects of tracking and work to insure a higher placement for their own child. In fact, Useem (1992) finds this to be true in her study of 86 mothers in two suburban communities. She found that parents with higher levels of education were more knowledgeable about tracking and were more likely to intervene in their children's math placement in junior high school. Similarly, better-educated parents are also more likely to provide educational resources in the home which support their children's academic performance (Teachman 1987).

Values also influence school performance and children acquire many of their attitudes and values toward achievement and education from their parents. Values appear to mediate the effects of parents' income on educational achievement. Fejgin (1995) looked at differences in American Jewish and Asian students on standardized math scores. She found

that Jewish tradition, which places a high value on scholarship and education, canceled out much of the effect of SES on math scores. Jewish students obtained higher math scores than Asian, Black, and White students. The Jewish students also held higher academic aspirations, spent less time watching TV, and were more likely to attend private school than Asian, Black or White students in the sample.

Parents also instill expectations and beliefs in their children as to whether they will attend college. Stevenson, Chen and Uttal (1990) compared Hispanic, Black and White parents' expectations for their children's academic achievement and find that while White children liked school less than Black or Hispanic children, their expectations for attending college were higher than either group. This is remarkable since the Black and Hispanic parents were more likely than White parents to assign a high rating to their own child's performance and competency in math and reading. The children's ratings for the reflected appraisals of their parents revealed that Black children rated their parents' appraisals more highly than did White or Hispanic children. It appears that White parents had higher expectations for their children than did the other two groups and instilled those expectations in their children.

Parents may also have different expectations for the role of formal education. Schneider et al. (1998) proposed that different types of parental attitudes toward education contributes to the stratification of educational institutions in the United States. Because our system of education is locally governed, parents have a great deal of influence in selecting the type of education their child receives. Parental choice in the selection of schools is a contributing factor to the segregation of schools by SES, values, and ethnicity. To test their propositions, the authors compared Black, Asian, Hispanic, and White parents on the school

attributes they think are important in considering a school for their child. They found that Black parents and parents with no college are more likely to rank high scores on academic tests as important. White parents and those with higher levels of education are more likely to think that instilling values is very important, and parents with lower levels of education are more likely to rank discipline as important. Also, White parents and parents with higher levels of education were more likely to rank (ethnic) diversity as an important school attribute. Since parents can influence the curriculum and structure of the school through their participation in local elections, school boards, and parents' associations, differences in parents' values and beliefs about the role of formal education can contribute to the type of education their child receives.

Interaction with Significant Others in the School Environment

The school experience itself is key in the academic success or failure of the individual. Teachers and peers are added to the individual's group of significant others and have an influence on decision-making, academic achievement (Bank, Slavings, and Biddle 1990; Hallinan and Williams 1990; Natriello and McDill 1986), and career decisions (Hallinan and Williams 1990; Felsman and Blustein 1999).

Interaction with peers facilitates the acquisition of social and cognitive skills (Corsaro 1985; Doise and Mugny 1984), and the reflected appraisals from peers and teachers influence the individual's self-evaluations and consequently her self-efficacy and esteem (Bandura 1986). Peer influence is pervasive throughout high school and college and has even been indicated in the decision to stay or leave before graduation from college (Bank, Slavings and Biddle 1990).

The influence of peers is not unidirectional. Beginning in the first grade, individuals are selective of whom they associate with and model. This selection process is particularly salient with regard to sex and race. Students prefer to spend time with peers of the same sex in elementary school, and this selective homophily intensifies until it peaks in the middle-school years, when it begins a downward trend. The same pattern appears for the selection of same race friends, although the decline in racial homophily is smaller and comes later than that for sex (Shrum, Cheek, and Hunter 1988). These findings reflect Bronfenbrenner's second proposition stating that proximal processes "vary as a joint function of the biopsychological characteristics of the developing person; of the environment, both immediate and more remote..." (1995:620) in that sex and race are both biological characteristics and larger social constructs that influence the interactions of individuals within the more proximal context of the microsystem. Gender and race are more appropriately classified as components of the meso or exo systems, but as Bronfenbrenner recognizes, there is interaction both within and among systems levels, and the homophily of peer groups reflects this interaction. Homophily of peer preferences also carries over into the selection of friends by interests and status characteristics (MacLeod 1995; Willis 1977). In a classic ethnographic study, Willis (1977) exposed the subculture of peer groups in English working class public high schools. The "Lads" were children of working class families who formed a tightly knit peer group complete with its own subculture of norms, symbols, and values. They rejected middle class values, language, and norms in favor of the values, dialect, and norms of the working class. The rejection of middle class values included the rejection of the value of a formal education, and the result was purposeful academic school failure and dropping-out.

In another ethnographic study, this one of two different racial groups living in the same low-income housing projects, MacLeod (1995) described the differences in two peer groups, one predominantly White, the other Black, in their attitudes toward education. The predominantly White "Hallway Hangers" rejected the middle-class value of educational achievement, preferring instead to skip school, hustle, or work at menial jobs for money. The predominantly Black "Brothers," on the other hand, generally accepted middle-class values and strove to maintain acceptable school performance. For both these groups, the peer group was the strongest social force[7] for deriving a sense of identity, self-esteem, and social support. The influence of parents was secondary during the adolescent and early adult years.

Teachers also influence the intellectual and educational achievement of individuals. The self-fulfilling prophecy[8] has been documented in the classroom setting, with the outcomes affecting academic achievement. In an often cited study of this phenomenon (Rosenthal and Jacobson 1968) teachers were told that after evaluating all the students, researchers found selected students who were late bloomers and would, with the proper guidance, catch up during the coming school year. In fact, there were no differences between the late bloomers and the control group of students. At the end of the year, however, those students identified as late bloomers did in fact have greater gains in IQ scores than the control group. It

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[7]The outcome for both groups, however, revealed that economic forces were more powerful in determining educational and occupational achievement.

[8]The self-fulfilling prophecy occurs when one individual makes inaccurate or false assumptions about another, and these assumptions in turn evoke behavior in the target individual which confirms or makes the false assumption true (Miller and Turnbull 1986).

appeared that the identification of these students raised teachers expectations and resulted in a teacher-student interaction which had a positive effect on students' intellectual ability.

Teacher expectations may also differ for students based on other types of information. Clifton et al. (1986) found that teachers' expectations are influenced by the ethnicity, sex, ability, and academic performance of the student. Expectations for academic performance were lower for non-White students, males, lower-ability students, and students who had lower school performance records. Alexander and Entwisle (1987) also found that teacher characteristics have an effect on their evaluation of students. Their most important finding is that high SES and White teachers evaluated minority students more negatively on their expectations and maturity level than they did White students. In another study, Farkas et al. (1990) found that the best predictors of grade assignments were the teacher's rating of the students' work habits, cognitive performance, and mastery of schoolwork. The subjectiveness of these criteria suggest that teachers have a significant impact on defining the individual's academic performance, and consequently their future placement and achievement.

The Mesosystem

The processes and activities within the mesosystem take place in environmental contexts which direct their "form, power, content, and direction" (Brofenbrenner 1995:621). These more immediate contexts include the physical and social environments of the neighborhood community (e.g., ethnic, rural or urban), educational institutions, and the region of the country. It is also worth noting that the global environment is increasingly impinging on the meso and microsystems via the mass media and television in particular (Denzin 1992; Bandura 1986), again revealing the interaction between systems levels. Children today spend

more time than ever before watching television, and the content and graphic reproduction of events are amazingly true to life. Today significant others may include someone (or some cartoon character) from a favorite television show, with whom the individual has never had face-to-face interaction.

The Neighborhood Community

Brooks-Gunn et al. (1993) find that the composition of the neighborhood of residence has an influence on the IQ of children and adolescents. It appears that the immediate community contributes to cognitive development via its contribution to the material and social resources to the families within it. The larger the ratio of affluent homes in a neighborhood, the higher were childrens' IQ scores. There may be several explanations for these findings. More affluent neighborhoods are composed of families of higher SES, who would be expected to possess higher levels of education and income and a lower probability of being headed by a single-parent. Supervision for the children in the neighborhood is likely to be higher because of the increased probability of families that have one full-time stay-at-home parent. Also, the higher levels of income and education in these neighborhoods would likely be correlated with lower crime and higher status cultural objects such as museums and libraries.

The previously cited studies by Willis (1977) and MacLeod (1995) are also useful in pointing out the contributions of the neighborhood setting in the outcomes for education. Individuals who do not possess social status or the economic means by which to achieve that status may form their own subcultures and reject the values and norms of the dominant culture--including those values which contribute to educational and occupational

achievement. Because they resided in a cluster of low-income housing projects, the young men in both samples had very little exposure to experiences shared by middle-class adolescents, nor did they possess the economic means to obtain those experiences. The result was a feeling of "otherness" and isolation which led to the rejection of the dominant culture in favor of their own culture which fit their material resources.

The Educational Community

Because our system of education was originally organized geographically by neighborhoods, the two communities are overlapping. Neighborhood schools are generally fairly homogeneous with regard to the SES and racial composition of students who attend. Most systems also use some type of placement or tracking mechanisms to match ability and performance with an appropriate curriculum. Individual academic ability is regularly measured and predicted beginning in the primary grades using standardized tests of intelligence (e.g., the Weschler inventory) or correlates which measure achievement (such as the Iowa Basic Skills Inventory, and the PSAT, SAT or ACT college placement tests). Achievement in the earliest years of schooling is important to avoid being selected out of the "normal" academic track for placement in remedial or lower academic tracks (Alexander and Entwisle 1996). The academic achievement of children in grade school usually carries over into junior high and high school achievement as well (Husen 1969). Finally, college entrance is heavily influenced by high school grades, curriculum, and test performance (Persell, Catsambis and Cookson 1992). Since education is the best predictor of occupational status and income (Sewell, Hauser, and Alwin 1975), it is conceivable that the early school achievers

coming from higher SES homes would be more likely to obtain higher level occupations in later years.

The Exosystem

Less tangible contexts that influence the direction of individual experience include the institutionalized aspects of the family, educational system, occupational structure, and political and economic environments. Individuals acting within these institutions may have an effect on the individual through policy decisions that restrict or encourage certain types of action. For example, politicians who legislate funding for day-care and Head Start services have an effect on parental options for work. School administrators who implement a strong tracking program within the school system have an indirect effect on the individuals who are selected into the various vocational tracts. In the political and economic realm, politicians who support business and encourage a market-driven job structure have an indirect effect on the occupational opportunities available to the individual and her associated income and occupational status. The most relevant research which examines the interactions among individuals and the environments of the exo, meso, and microsystems is that done by Melvin Kohn. His research on the structural effects of social class and the work environment on the values and cognition of individuals and their families is an example of social research in the Bronfenbrenner tradition.

Kohn's work follows that of Bronfenbrenner by beginning with the most distal environmental conditions and working toward the most proximal to account for differences in outcomes for individual cognition. Kohn began with an examination of the concept of social class, which could be classified as part of the exosystem. However, he disassembled

this larger construct to examine components of the mesosystem such as social stratification by education, occupation, and income. Finally, Kohn looked within the mesosystem to identify those interactions in the microsystem which contribute to individual cognition. This pulling apart of the nested systems levels to identify the mechanisms which operate at various proximities to the individual is at the heart of Bronfenbrenner's ecological theory. Kohn's work illustrates the analytical approach encouraged by Bronfenbrenner and utilized in this study. I follow with a summary of his research process and important findings.

Occupational Conditions and Self-Direction

Kohn's early work utilizes three samples (and one follow-up) for nearly all his analyses. His focus is on social class (and later stratification) and its effects on parents' values, social orientation, self-concept, and intellectual functioning. Using the data from these three samples, he launched his analyses by looking at larger social constructs such as social class and proceeded to narrow his focus to those more proximate constructs that had the greatest effect on values, orientation, and intellectual functioning. Kohn moved his focus on independent variables from social class (in his earlier work) to stratification (education, income, occupation), to education and occupational conditions, and finally to self-direction at work. In this section I describe the samples and major findings and discuss their relevance to the proposed study.

Kohn's first study (1959) utilized a two-step sampling from the Washington D.C. area. This involved first, the selection of census tracts eliminating those with 20% or more blacks and the highest quartile for median income. From these selected tracts were drawn three distinct types of residential areas--four tracts of predominantly working class, four

middle-class, and three having large proportions of each. Selection was made by occupational distribution and median income, education, rent, and value of owner-occupied homes. The second selection was of families by records from public and parochial school systems; families were selected who had fifth-grade children. The sample consisted of 200 randomly selected subjects from white collar homes (by father's occupation) and 200 from manual occupation homes.

Personal interviews were conducted with two interviewers (mother and father were interviewed in separate rooms). Social Class was measured using the Hollingshead Index of Social Position (Class I, II and III= middle class; Class IV and V = working class).

The findings for this study (Kohn 1959) showed agreement for both middle and working class mothers on several items. Both groups wanted their children to display happiness, honesty, consideration, obedience, dependability, manners, and self-control. Also of importance were popularity, being a good student, neatness, cleanliness, and curiosity. There were, however, some differences between working and middle class mothers. Fewer working class mothers regarded happiness as desirable for boys. Working class mothers valued obedience, neatness, and cleanliness, but distinguish between the sexes (boys should be dependable, good students, and ambitious, while girls should be happy, have good manners, and be clean). Middle class mothers valued consideration, self-control, and curiosity and do not differentiate between what is desirable for boys and girls.

Fathers in the study (Kohn 1959) agree with mothers in general except that they do not value happiness for daughters. Middle class fathers also add dependability to the list of values, and working class fathers want children to be able to defend themselves. Middle class

parents (fathers and mothers) are also more likely to ascribe predominant importance to the child's acting on the basis of internal standards of conduct, while working class parents stress the child's compliance with parental authority.

Kohn (1959) interpreted these findings as a reflection of the different circumstances and problems that are faced by middle and working-class parents Middle and working-class parents do share some values but differ significantly on several. Kohn claimed that the values of the respective classes are a result of the life circumstances of each. Values appear to fit the situation of the social class member. In either situation the values that seem important but problematic (because they are necessary for success, but difficult to develop) are the ones most likely to be accorded high priority. These situations create different problems for the middle than the working-class members. Those in the middle-class see the internal standards of conduct as more problematic, and therefore desire these traits in their children. Working-class parents, on the other hand, find the qualities that insure respectability more problematic, and thus these desired qualities become the focus of their concerns (Kohn 1959).

A second sample was selected from Turin, Italy, as a cross-national comparison to the Washington sample. Conducted in 1962-63, it was also deliberately composed of middle and working-class families. Limited to families having children of the equivalent of fifth grade, children were not interviewed in Turin, rather some fathers and all mothers were interviewed (fathers = 341; mothers = 520). In addition to questions covered in the Washington, D.C. study, fathers were asked about their occupational circumstances.

Kohn (1977) also selected a third, national sample in 1964 composed of 3,101 men, chosen to represent all men employed in civilian occupations in the United States. No women

or children were studied. Also not represented were the lowest SES--the unemployed. Interviews for this study dealt with parental values, general orientation, intellectual flexibility, and occupational experiences. Orientations included the degree to which the respondent is authoritarian or open minded, their criteria of morality (on a continuum from opportunistic to responsible), trustfulness, and stance toward change (is receptive or resistant to change). Since this sample was intended for use in the replication and expansion of the earlier Washington D.C. study, the questionnaire included the same variables along with additional measures of personality characteristics.

Again, the findings from the first (1959) study were confirmed. Kohn (1977) elaborated upon his earlier explanation, identifying self-direction and conformity as general values held by the middle and working classes respectively. Middle-class parents are more likely to emphasize children's self-direction (focusing on internal standards for behavior), while working-class parents are more likely to emphasize conformity to external authority (focusing on externally imposed rules). The findings reveal that social class is significantly associated with father's values for their children even when controlling for age and sex of the child, race, religion, national background, region of the country, size of the community, family size, and birth order of children. As fathers' social class ascends, so does the importance of self-direction and internally located morality in their children.

Of particular importance in the replication studies are four principal findings for both the national sample and the Turin study. First, Kohn (1977) finds that the relationship between values and social class is linear, and social class may be conceptualized as being a continuum. Second, he identifies two components of class--education and occupational

position--as independently related to values and orientation. Income and subjective class identification do not contribute substantially to values and orientation once these two variables are controlled. Kohn (1969) also finds that the present class location has a greater impact on values and orientation than does the class of origin.

> The Turin study and the National study lead to the same conclusion: The relationship of social class to parents' valuation of self-direction or conformity for children is largely attributable to class-correlated variations in men's exercise of self-direction in work. Because the relationship between exercising self-direction on the job and valuing self-direction for children is so direct, one might conclude that parents are simply preparing children for occupational life to come. We believe, rather, that parents come to value self-direction or conformity as virtues in their own right, not simply as means to occupational goals (Kohn 1969:162).

The most important finding in the replication studies is that the conditions of work having the strongest association with values and orientation are those conditions that constitute the degree of self-direction one has at work. The closeness of supervision; the substantive complexity of work with data, things, and people; and the complexity of the organization of the work are significantly related to virtually all aspects of values, orientation, and intellectual flexibility, independent of their relationship with social class. Other occupational conditions (e.g., ownership, competition, serious job insecurity, bureaucracy, position in the supervisory hierarchy, time-pressure, and the amount of overtime) are also related independently of class to values and orientation. However, the "structural imperatives of the job" (Kohn 1977:197) have the greatest effect on values and orientation. The reason is because they are the "essential job conditions that impinge on the worker most directly, insistently, and demandingly" (Kohn 1977:197). Kohn concludes that education and the

degree of self-direction experienced on the job are the two greatest contributors to values, orientation, and intellectual flexibility.

> Occupational position seems to matter for values and orientation because it determines the conditions of self-direction that jobs provide or preclude; the critical facet of occupational position is that it is determinative of occupational self-direction. Education, on the other hand, seems to matter for values and orientation chiefly because it can be so very important for intellectual flexibility and breadth of perspective (Kohn 1969:189).

Kohn claims that the level of self-direction and complexity and challenge of tasks are environmental realities for men during their work hours. The values and orientations necessary for success in a particular work environment are learned and then carried over to the home environment. In particular, Kohn posits that the intellectual flexibility of the individual (see Kohn's definition in the introduction of this paper) is increased with greater self-direction at work, and in particular with greater complexity of working with data, people and things. These cognitive qualities are then carried over into activities outside the work environment, such as those undertaken during leisure time.

While Kohn is a pioneer in the systematic deconstruction of social class by its levels of proximity to the individuals functioning within it, other researchers have examined the effects of selected components of social class. Research by Featherman and Houser (1994) and Sewell, Hauser, and Alwin (1975) support Kohn's findings that education is the strongest predictor of occupational achievement--it is widely believed that the educational system is a training and credentialling ground for the occupational structure (Bills 1988; Bourdieu and Passeron 1977). The evidence in support of the educational contributions to IQ are also well-documented (Neisser et al. 1995). What is intriguing and new about Kohn's analysis

is that he finds evidence that work also contributes to intellectual ability, and he identifies the facilitating mechanism as the level of self-direction one has in his/her job.

Building on Kohn's findings, and keeping in mind the temporal ordering of events, the order of prediction for adult IQ should be that innate ability has a positive influence on the level of education one achieves, which in turn predicts occupational achievement. Complicating this model are the reciprocal effects of educational achievement on IQ and the direct effects of IQ in adolescence on educational and occupational achievement and IQ later in life. Finally, occupational achievement is important because of its strong, positive correlation with the self-direction one has on the job, and for the purposes of this study, the complexity of work with people, data and things.

The Chronosystem

Again, keep in mind that the previously discussed processes are also nested within a temporal context of historical time which has a bearing upon the structural, cultural, and perceptual understanding of events. These temporal contexts include the timing of life-course events such as educational completion, childbearing, and first "real" job after obtaining credentials. The current cultural context also has a bearing on career decision-making. For example, women in the 1950's were more likely to choose a domestic career over one in the paid work-force, as demonstrated in previous studies utilizing the Berkeley samples (Clausen 1993; Elder 1977). This is not necessarily true in the cultural climate of the 1990's. Also important in the temporal context of events are shifts in the political and economic structure and climate. The funding boom for secondary education in the 1960's and 1970's allowed individuals who would not have attended college in an earlier period to obtain degrees and

improve their occupational choices. This is also true of the GI bill after World War II, which did in fact contribute to the higher average level of education of the Berkeley sample (Clausen 1993; Elder 1977).

Another example of these shifts is the decrease in availability of manufacturing jobs that require only a high school education. High school graduates today still have more occupational options than their high-school drop-out peers, but far fewer opportunities than young adults in the 1950's entering the workforce with only a high school diploma. Finally, the globalization of the economy has resulted in an occupational structure that is different today than it was 50 years ago, including a decline in manufacturing jobs and an increase in the demand for highly-skilled service workers (DiTomaso and Freidman 1995).

The utilization of three sociological/psychological theories in this dissertation is necessary to demonstrate the complex processes that are involved in the development of intellectual ability. Not only is there variance in individual ability at birth, but interactions in an assortment of environments influence and direct development and the acquisition of new skills. These environments are influenced by processes and structure originating at various systems-levels, from the biopsychological level of the individual organism to the largest exosystem level of the social and physical environment. Kohn's work is the starting point for identifying and studying the mechanisms operating at each system level for the purpose of predicting and improving individual outcomes.

Replicating and Extending the Kohn Model

The primary goal of this study is to expand on previous work done by Kohn and his associates in modeling the effects of education and work on intellectual functioning. While

his work is groundbreaking in the area of social structure and cognition, there are several areas in the Kohn model on which this study improves.

Measures of Intellectual Functioning

Kohn's (1969) measures of intellectual functioning would be improved by the use of standardized measures with established validity and reliability. In his earlier work, Kohn equates his concept of intellectual flexibility with intelligence. In fact, one empirical indicator of intellectual flexibility used in his analysis is the "interviewer's appraisal of the respondent's intelligence" (Kohn and Schooler 1983:30). His measures, however, have several shortcomings. Kohn's conceptualization of intellectual functioning includes two aspects. The first is intellectual flexibility, defined as:

> evidenced by performance in handling cognitive problems that require weighing both sides of an economic or a social issue, in differentiating figure from ground in complex color designs, and in drawing a recognizably human figure whose parts fit together in a meaningful whole. We also include the interviewers' evaluations of the respondents' "intelligence" and a simple count of their propensity to agree with agree-disagree questions (Kohn 1973: 101).

The second aspect of intellectual functioning is "the demands men put upon their intellectual resources" (1973:101) which are indicated by the reported time spent engaged in leisure-time activities such as watching television, reading magazines, going to museums, and plays, reading, or working on hobbies.

These measures may not be valid or reliable measures of intellectual functioning. In fact, some of these indicators may be biased toward individuals who have had business experience, higher education, and higher incomes. Although Kohn recognizes the latter two biases and adjusts for them in the analysis, he does not acknowledge the bias in questions such

as, "Suppose you wanted to open a hamburger stand and there were two locations available. What questions would you consider in deciding which of the two locations offers a better business opportunity?" (1973:101). Clearly, someone with little business experience would score much lower on this than an individual with extensive business experience. For example, a street vender with several years experience would probably score higher on this question than a farmer or housewife, while not necessarily being a better problem solver in an equally demanding, but different scenario. To address this measurement problem, I use standardized measures of intelligence which have been tested extensively for validity and have established reliabilities.

The Use of Cross-Sectional Data in Causal Relationships

An earlier weakness of Kohn's analysis of the relationship between the complexity of work and intellectual flexibility was that most of his studies used cross-sectional data (data collected from a sample at one point in time) to model causal relationships. This is a violation of one of the three prerequisites for a causal sequence--that there is temporal ordering of the cause and effect. While causal inferences are commonly made in the analysis of cross-sectional data using a theoretical basis for the direction of effects, only data collected at two or more points in time should be used to analyze causal sequences (Gollob and Reichardt 1987).

The problem of temporal ordering of the variables in a causal sequence are particularly important in the analysis of the complexity of work and intellectual functioning because of the possibility of spuriousness of the association by a third variable--education. Education has been shown to be one of the strongest predictors not only of cognitive functioning (as

measured by standardized test of intelligence) but also of one's placement in the occupational structure. Education appears to have a direct, positive effect on both intelligence and occupation. The relationship is made even more complex by the fact that education is also predicted by intelligence.

Individuals with higher intellectual functioning tend to achieve higher levels of education, and individuals with higher levels of education show higher levels of intellectual functioning (Neisser et al. 1996). Temporal ordering for these effects is crucial in examining the relationship between education, intellectual functioning, and complexity of work. Gollob and Reichardt point out that "causes take time to exert their effects, and therefore values of a variable can be caused only by values of prior variables" (1987:81). Following this reasoning, measures of intellectual functioning, education, and complexity of work must be established at two or more points in time to determine the effects of one on the other.

Kohn (1977) recognized the need for longitudinal data to assess these effects and in 1974 collected data from a subset of his 1964 national sample in an attempt to confirm his findings using cross-sectional data. In this study, I improve upon Kohn's (1977) longitudinal model by utilizing a cohort sample with measures of IQ at three points in time and complexity of work at two.

Assumptions and Restrictions of Causal Models

While Kohn (1977) does use longitudinal data to model the effects of education and the complexity of work on intellectual functioning, his model violates an assumption of causal modeling in that he does not include all the pertinent causes of the dependent variable. Kohn's (1983) longitudinal model includes measurements at two time periods: 1964 and

1974. However, in modeling the effects of education and complexity of work on intellectual flexibility, he does not allow education to have a direct effect on intellectual functioning measured at time two. Rather, education is only allowed to affect intellectual flexibility via indirect paths through ideational flexibility at time one and occupational self-direction at times one and two. Considering that the reported unstandardized regression coefficients for the direct effects of education on intellectual functioning are .54 and .48 at time one and time two respectively, the model has been misspecified. Education is an important predictor of intellectual functioning at time two, and it should be allowed to have a direct effect on that variable in the model.

Kohn's (1977) rationale for dropping the direct path is that when entered into a full model (where all paths are included) the effect of education on intellectual functioning becomes negative, so the path may be set at zero for the trimmed model. The problem with this reasoning is that the coefficient changed its sign, indicating a suppressor effect from one or more of the other variables in the model. Rather than addressing the suppressor effect on education, Kohn (1977) dropped the path and the result is a misspecified model. The misspecification of a causal model may result in serious under- or overestimation of other effects in the model (Gollob and Reichardt 1987). I suggest that this is the case for Kohn's (1977) model and the result has been a bias in the estimate of the effects of complexity of work and education on intellectual functioning.

Summary and Hypotheses

I have presented a theoretical perspective which posits that interaction in various environments over the life course contribute to the intellectual ability of the individual.

Additionally, I argue that the outcomes of interest--education, occupation, and intellectual ability--are the results of the complex interactions between the biological organism and objects in the environment. The environments of the exo, meso, and microsystem are nested one within the other, and their influences may be overlapping and reciprocal. The individual both influences, and is influenced by the environment, and the result is the selective acquisition of self-processes. These self-processes direct the behaviors of the individual in the educational and occupational realms, which in turn enhance or inhibit intellectual development.

While I test only a small number of the theoretical constructs presented in this dissertation, my measures and research design are strong. I use longitudinal data with intellectual ability measured at three points in time using inventories with established reliabilities. In addition, I use often-used and accepted measures of the complexity of work with data, people and things (the DOT) taken at two measurement points. My theoretical explication of other unmeasured variables is included to provide the reader with a more detailed picture of these processes. The three environments discussed in my theoretical section (the family, education, and work environments) each have some representational measurement in my model (parents' education and father's occupation, educational achievement, and the complexity of work). In the following section I propose a set of testable hypotheses derived from the theory and literature presented in chapters 1 and 2. (see Figure 1 for a model of these proposed relationships):

1. The family is the primary environment for interaction and socialization in the formative years. Parents offer the developing individual both intellectual and

material resources which facilitate successful skill acquisition and cognitive development through modeling. Because family resources influence achievement in the academic environment which in turn contribute to occupational achievement and intellectual ability:

1a. Parents' education will have a direct, positive effect on IQ at age 18, adult IQ at time three, and adult IQ at time four. However, the effects are expected to decrease over time as the individual becomes more removed from the influence of the family environment.

1b. Parents' education will have a direct, positive effect on educational achievement.

1c. Father's occupation will have a direct, positive effect on IQ at age eighteen and educational achievement.

1d. The dilution hypothesis predicts that the number of siblings in the family of origin will have a negative effect on IQ, particularly the verbal component of IQ. Therefore, I predict that the number of siblings will have a direct, negative effect on IQ at age 18, adult IQ at time three, and adult IQ at time four. I also expect the effect to be stronger for the verbal components of IQ at time 3 and time 4.

1e. The dilution hypothesis also predicts that the number of siblings will have a negative effect on educational achievement.

2. Because ability is a strong predictor of achievement in both the educational and occupational realms:

2a. IQ at age 18 will have a direct, positive effect on educational achievement.

2b. IQ at age 18 will have a direct, positive effect on adult IQ at time three and time four.

2c. IQ at age 18 will have a direct, positive effect on the complexity of work at time two and time three.

2d. IQ at age 18 will have an indirect effect through education on the complexity of work at time two and time three.

2e. The lagged, direct effects of IQ at age 18 on adult IQ at time three and time four will be larger than the lagged, direct effects of the complexity of work at time two and time three on adult IQ at time three and time four respectively.

3. The educational institution is another primary source of interaction and socialization. Within the educational environment, individuals have direct instruction in symbolic objects (vocabulary, mathematics etc.) and the rules for using those objects. Because educational achievement contributes to both IQ and occupational achievement:

3a. Education will have a direct, positive effect on adult IQ at time three and time four.

3b. The lagged, direct effects of education on adult IQ at time three and time four will be larger than the lagged, direct effects of the complexity of work at time two and time three on adult IQ at time three and time four respectively.

3c. Education will have a direct, positive effect on the complexity of work at time two and time three.

3d. While the lagged effects of education on adult IQ at time three and time four will be larger than the effects of education or the complexity of work at time two and time three, the effect of education on adult IQ at time four will be weaker than the effect on adult IQ at time three, the result of reduced exposure to the educational environment.

3e. Conversely, the effects of the complexity of work on adult IQ will be larger at time three than at time two, the result of spending relatively more time in the work environment.

4. The third major environmental influence on most adults is the work setting. After leaving the educational environment, the work environment becomes most salient. For this reason, we can expect (and Kohn's findings conclude) that the complexity of work one performs on a daily basis will contribute to intellectual ability.

4a. The complexity of work with data, people, and things will be positively correlated with adult intellectual functioning. These effects are expected to be lagged, so the complexity of work at time two will contribute positively to adult IQ at time three. Similarly, the complexity of work at time three will contribute positively to IQ at time four.

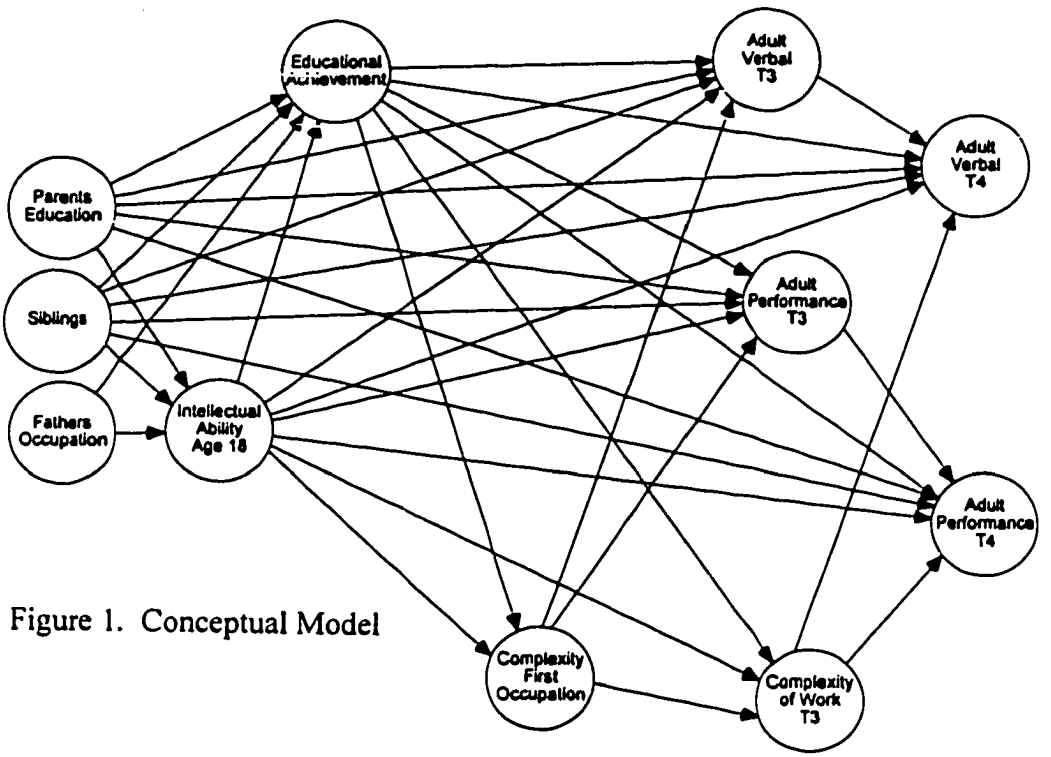

Figure 1. Conceptual Model

CHAPTER III

METHODS

To test my hypotheses I utilize the soft modeling technique to model longitudinal data taken from a combined cohort sample. Data from the Guidance Study (GS), the Berkeley Growth Study (BGS), and the Oakland Growth Study (OGS) are used to estimate the parameters for the model of education, complexity of work, and intellectual ability. I follow with a description of the sample, measures, and statistical methods.

Sample

The subjects in this sample are selected from participants in the Intergenerational Growth Studies (IGS) from the Institute of Human Development in Berkeley, California. The IGS is composed of three samples selected from infants and adolescents in the Northern California area between 1920 and 1932. These subjects were followed on a regular basis through adulthood, and data were collected on personality characteristics, IQ, education, occupation, income, family status, and physical and mental health status (Eichorn 1981). The modeling technique utilized here requires that I have complete data on each individual, and 88 subjects met this criterion. Scores for IQ at age 18 for an additional 22 cases were replaced using the mean of the group based upon data from adult time three WAIS scores bringing the sample total to 109 subjects.

As a result of the period effect of gender differences in occupations, data analyses in this study include only males from the studies. The Dictionary of Occupational Titles is used to measure the complexity of work, and therefore, only subjects who were employed in occupations that are included in the DOT have measures for these variables. This cohort grew up in a period when women were not well-represented in these occupations and so most did not have measures of work complexity. For this reason, they were excluded from the sample. These data are also homogeneous with regard to race; this is an all-White, male sample. In the next section, I describe the three subsamples which comprise the Intergenerational Studies sample from which the study sample was selected.

The Guidance Study

The Berkeley Guidance Study (n=248) is a sample of infants drawn from every third birth in Berkeley, California, between January 1, 1928, and June 30, 1929. The original sample was designed as a six-year prospective study of preschool children and was extended to follow the cohort into adulthood. The original goal was to assess the prevalence and severity of behavior problems both with and without intervention. After initial assessments, infants were assessed annually until age 18, and again at ages 30 and 40 on physical health, personality dimensions, and intelligence (also included were family background and demographic measures) (Eichorn et. al. 1981).

Berkeley, California, is a university town, and the Guidance study sample reflected this in that the parents of these infants had lower income but higher levels of education than the general population of the United States. A complete assessment including physical health and development was completed for the subjects at 21 months, and follow-up assessments were

done every six months until the subjects were four years old. Annual assessments were performed from years five through 18. Intelligence tests were given periodically throughout childhood, and the Wechsler-Bellevue Intelligence Scale (WBIS) Form I was administered at age 18 (Eichorn et. al. 1981). Subjects were again located, interviewed and tested at ages 30 and 40.

Berkeley Growth Study

The Berkeley Growth Study originated with 61 infants born between September 15, 1928, and May 15, 1929, and was designed to track physical and mental development during the first year of life. The Berkeley sample, which reflects the same cohort as the Growth Study, was taken from healthy, full-term infants born to white, English-speaking parents (mostly middle-class Protestants) in the Berkeley area. In the next three years, 13 more infants were added to the sample bringing the number to 74 (Eichorn 1981).

Assessments for this sample were done monthly until the subjects were 15 months old, then every three months through 36 months. From ages four through seven the assessments were done annually, and from ages eight through 18 they were performed every two years. Adult assessments were undertaken at ages 21, 26, 36, and 50 years (approximately). These assessments were very in-depth and included IQ measures throughout childhood, and the Wechsler-Bellevue, Form I at ages 18, 21, and 26 years. The Weschler Adult Intelligence Scale (WAIS) was administered at age 36 (Eichorn 1981). Both the Growth Study and Guidance groups completed their most recent follow-ups at age 53.

Oakland Growth Study

The Oakland Growth Study was originally designed to look at development (physical and social) in normal adolescents. Sampled were fifth and sixth graders (ages 10-12 years) from five elementary schools in Oakland, California in 1932 (n=212). Thus, the Oakland cohort is an average of seven and one-half years older than both the Berkeley samples. Comparable measurements were taken for this sample for physical and intellectual development, along with other background and personality measures. Assessments were performed in small groups semi-annually through junior and senior high school (six years). The final adolescent assessment was taken at age 17 years, at which time the Stanford-Binet test was administered. Adult assessments were done at ages 33, 38, and 48 years (Eichorn 1981). The most recent follow-up was completed when the group was about 61 years old. The sample-sizes for each sub-sample are: GS = 40; BGS = 31; and OGS = 38.

Measures

Measures for this study were taken at four points in time. Also included in the model are family characteristics reported from various earlier interviews, but I do not conceptualize this as a collection point because the baseline for the major variable of interest (IQ) is taken at age 18. Mother's education, father's occupation, and the number of siblings occur before my baseline measure, so they are depicted as exogenous variables in the model (see Figure 1). Given this, the baseline measure (T1) was taken at approximately age 18 for all subjects in the sample.

Measured at the second data point (T2) is the subject's first occupation, established using the following criteria: the completion of all formal education and military service (if

applicable) or reaching the age of 35. Because education was completed before this point, it comes between the first and second data collection points in the model (i.e., after T1, but before T2).

The third data collection point (T3) reflects assessments completed when the Berkeley group was about 39 and the Oakland group 48 years of age. The fourth data point (T4) includes assessments taken when the Berkeley group was about 53, and the Oakland group 61 years of age. The ages are approximate because of the variance in locating the subjects for these follow-ups. Also, subjects in the Guidance study had their second adult follow-up at age 40, while the Growth Study was assessed at age 36, therefore, the mean for the two is reported. In the section which follows, I describe the measures moving from left to right (i.e., in chronological order) in the model depicted in Figure 1 (see chapter 2).

Parents' Education

Mother's education is a continuous measure indicating the number of years of schooling completed. Values ranged from one to 17 years ($\bar{x} = 5.6$; $s = 3.8$).

Father's education is an ordinal measure utilizing the Eichorn scale. The scale scores range from one to ten with one indicating the father did not complete elementary school, and ten indicating some type of advanced professional degree (e.g., PhD or MD) ($\bar{x} = 5$; $s = 2.5$).

Siblings

The number of siblings is measured as a continuous variable. The value indicates the total number of siblings in the household, not including the subject ($\bar{x} = 1.7$; $s = 1.4$).

Father's Occupation

Father's occupation is measured using the Hollingshead Scale. Values for the original scale range from one to seven with seven as the low. Occupations coded as one include higher executives and major professionals. Middle range values (3 or 4) include administrative personnel, small businessmen and technicians, and high values (6 or 7) include semi-skilled and unskilled employees. For this study, coding was reversed so that high numbers reflect higher status occupational classifications ($\bar{x} = 3$; $s = 1.7$).

Intellectual Ability at age 18

The baseline measure of intellectual ability is measured as a composite IQ score. Both Berkeley groups (GS and BGS) were administered the Weschler-Bellevue (WB) test at their final adolescent follow-up interview. The Oakland group was given the Stanford-Binet test, the scores of which were converted to equivalent Wechsler-Bellevue scores for analysis ($\bar{x} = 122$; $s = 8.6$).

Educational Achievement

The subject's educational achievement is a continuous measure. The value reflects the total years of schooling completed ($\bar{x} = 16$; $s = 2.8$).

Adult Intellectual Ability

The Weschler Adult Intelligence Scale (WAIS) was used at the adult time three collection point. The WAIS-Revised (WAIS-R) version was administered at the fourth adult data collection point.

The WAIS and WAIS-R tests are designed to measure two structural components of intelligence--verbal and performance ability. Each of these components is measured by

tests that reflect ability in particular areas shown to load on either the verbal or performance portion of intelligence tests. Each factor represents "a unique ability needed to do well in a certain class of tasks or tests" (Nunnally 1967:449). The WAIS tests used in this study include 8 sub-scales which reflect the verbal and performance areas of ability. The tests for verbal ability include sub-tests for information (IN), comprehension (CO), similarities (SI), and vocabulary (VO). The sub-tests for performance are object assembly (OA), picture arrangement (PA), block design (BD), and picture completion (PC).

Substantive Complexity of Work

Measures for the complexity of work with people, data and things are extracted from the Dictionary of Occupational Titles (see Robinson 1979). Scores for the substantive complexity of work in these three areas are imbedded in the occupational codes and range in value from one to nine with one representing the lowest level of complexity.[1] Scores for this study were coded from zero to nine with zero meaning the individual's work does not include working with items in the category of reference (i.e., data, people, or things).

Statistical Methodology

To model the relationship between education, the complexity of work, and intellectual flexibility, I utilized the Soft- Modeling technique (Latent Variable Path Analysis with Partial Least Squares Estimation or LVPLS) as presented by Falk and Miller (1992). LVPLS allows the use of multiple item indicators to estimate scores for latent

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[1]See Kohn (1977: Appendix B) for the definition and scales for complexity of work with data, things, and people.

variable constructs in a predictive model. There are several strengths which make this technique useful for estimating the effects of the relationship between social constructs. These include the relaxation of assumptions as compared to hard modeling techniques, the use of partial least squares estimates, and the assumption of a predictive, rather than causal relationship between the concepts. Also, the use of multiple manifest variables reduces measurement error and increases construct validity. LVPLS allows the researcher to determine the total, direct, and indirect effects of independent variables on outcome variables. Finally, the model is assessed through the traditional use of the multiple correlation coefficient and the root mean square estimate of model fit.

The use of LVPLS is not restricted to interval level data; it may be used with measures of any level, including categorical. Additionally, LVPLS may be used with data having non-normal or unknown distributions. LVPLS also allows for small samples to be used, requiring only that there be more cases than variables in a block (a block includes a latent variable and its manifest indicators) and more cases than latent constructs in the model. Unlike hard modeling techniques, LVPLS can handle a large numbers of variables in the model, and it is not vulnerable to errors of identification because all the constructs in the model have estimated values (Falk and Miller 1992).

The measurement model shown in Figure 2 shows the latent constructs (in circles), and the manifest variables from which they are estimated (squares). An arrow from one latent variable to another indicates the prediction of the variance for the variable to which it is pointing (arrows are shown in Figure 1, but not the measurement model). An arrow pointing from the latent construct to the manifest variable depicts a factor loading.

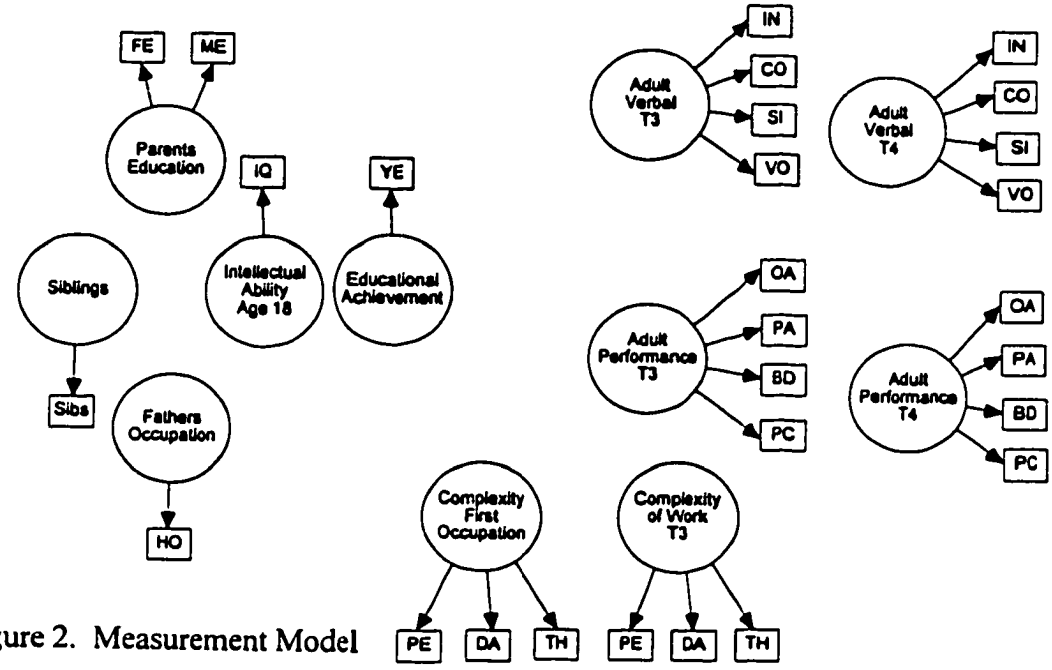

Figure 2. Measurement Model

The DOS program used to estimate the model utilizes a correlation matrix in an iterative estimation process, the goal of which is to minimize the residuals on both the manifest and latent variables (the manifest variables have preference in this process as one assumption of soft modeling is that the empirical observations are more precise than the theory). The result of this process is an estimated model which is the best fit of the data to the designated relationships between constructs (Falk and Miller 1992).

Limitations of the Sample and Design

Sample Limitations

While the characteristics of this sample might be seen as a limitation for generalization to the larger population, I prefer to see it as a strength in that we have built-in controls for two variables (gender and race) which would be expected to confound our

findings. The goal of this study is not necessarily to generalize to the population as a whole, rather it is to test the theoretical relationship between constructs. This sample offers multiple measures of intellectual ability and complexity over 40 years, making it a uniquely rich source of longitudinal data. Its strengths, therefore, far outweigh its weaknesses.

The age differences between the cohorts may also appear to present a confounding effect, as I do not control for age. However, because we are looking at change over a long period of time, the seven years difference between cohorts should not have a significant effect on the outcomes of interest. In addition, the model is constructed so that the baseline measure is taken at a uniform age (18 years) and follow-ups for IQ measures are taken after completion of education and placement in the first "real" adult occupation. By constructing the measures in this way, we are assured that major milestones normally associated with age are fixed for both cohorts, thus decreasing the confounding effects of age.

Design Limitations

Soft modeling is useful for researchers who wish to test the theoretical relationship between variables. Its use is limited to prediction of outcomes, rather than causal analysis. This limitation is a philosophical one, however, if one considers whether or not scientists can really propose causal relationships between variables. The degree of prediction or causation is heavily dependent upon previous empirical findings and the theoretical basis upon which the model is constructed. Strong theory and previous findings make for a strong predictive model. This is the case for the model presented here.

While soft modeling does not provide tests of significance for the estimated parameters, we can compute the amount of variance "explained" by the independent variables (R-square). We can also evaluate the fit of the model using a root mean square estimate for the correlation between manifest and construct residuals. Soft modeling provides the social scientist with an intermediate statistical technique that is useful to go beyond description, without positing causation.

CHAPTER IV

DATA ANALYSIS

In this chapter, I provide a summary of the data analyses utilized to test the stated hypotheses. I begin with a statistical description of the variables in the model, including the zero-order correlations between measured variables. I then present the factor loadings of the manifest variables on their respective constructs and their residuals, and the correlations between those constructs. Finally, I display the path coefficients, estimates of error, and R-square values for three models: the full model, presented earlier in chapter 3 as the conceptual model and two reduced models, trimmed to produced the most parsimonious illustration of the relationship between the constructs of interest.

Descriptive Statistics

IQ scores at age 18 for 22 subjects were missing in the (n=109) sample. Rather than drop these cases, I estimated the scores using the results of a WAIS test taken by the subjects some time between age 18 and the first adult WAIS test used in this study. The mean (118) for the (n=22) group was used to replace missing values. Missing data on mother's education for two other subjects were also replaced with the mean.

The mean, standard deviation, standard error of the mean and median are displayed in Table 1 for each of the measured variables in the model. I abbreviate the terms "time three" and "time four" (T3 and T4) for ease in reading. Generally, the distributions

approached normality. There were, however, some extreme outliers in the distributions for picture completion T3 (N=2), complexity of work with data T2 (n=4), similarities T2 (n=1),

Table 1. Descriptive Statistics for Manifest Variables

	Mean	SD.	Std. Error	Median
Father's Education	5.1	2.5	.24	5
Mother's Education	5.6	3.7	.36	4
Siblings	1.6	1.4	.13	1
Father's Occupation	3	1.6	.16	3
IQ at Age 18	122	11.7	1.1	121
Years of Schooling	16.1	2.8	.27	16
Complexity First Occ. People	3.8	2.6	.25	3
Complexity First Occ. Data	5.8	1.7	.16	6
Complexity First Occ. Things	3.6	2.8	.26	2
Complexity T3 People	5	2.2	.21	5
Complexity T3 Data	7	1.3	.12	7
Complexity T3 Things	3.2	2.8	.27	1
Information T3	10.3	2.7	.26	11
Comprehension T3	15.3	2.9	.28	16
Similarities T3	13.8	2.8	.27	14
Vocabulary T3	35.2	8.4	.80	36
Object Assembly T3	36	6.2	.60	37
Picture Arrangement T3	19.6	5.1	.49	20
Block Design T3	30.5	6.3	.60	33
Picture Completion T3	12.2	1.9	.18	12
Information T4	10.4	2.7	.26	11
Comprehension T4	15.7	2.9	.28	16
Similarities T4	13.8	2.7	.26	14
Vocabulary T4	36.5	8.1	.77	38
Object Assembly T4	34.8	6.2	.59	36
Picture Arrangement T4	18.8	4.9	.47	20
Block Design T4	27.9	6.6	.63	29
Picture Completion T4	11.8	1.7	.17	12

and object assembly at T2 (n=1) and T3 (n=2). These outliers are all located on the low ends of their respective distributions. The deletion of these cases would mean a loss of eight cases

and so I estimated the full model with and without those cases to determine if their extreme scores carried significant weight. The models had no significant differences in the estimated path coefficients or R-squares, and so the cases were included in the analysis.

All the zero-order (Pearson's product moment) relationships were expected to be positive except for the relationships between siblings and the other variables. Most of the relationships are confirmed by the zero-order correlations (see Appendix A). The exceptions are found in variables paired with the complexity of work with things for the first occupation and object assembly at both T3 and T4, and a single pairing between mother's education and work with data at T3 (none of these correlations are statistically significant).

The complexity of work with things for first occupation produces a statistically significant correlation with only two variables--the complexity of work with things at T3 and the complexity of work with data at first occupation. Interestingly, the complexity of work with things at T3 produced a small positive correlation with object assembly at both T3 and T4 (.22 and .24; $p<.05$), and block design at T4 (.20; $p<.05$).

The number of siblings was expected to correlate negatively with all the intelligence variables, however, comprehension and object assembly at T3 produced insignificant correlations. Siblings also produced insignificant correlations with the complexity of work with both data and things at T3.

Father's Education

Father's education produced significant, positive correlations with all but six variables. Father's education correlates moderately with educational achievement (.44), information at T3 (.41), and information (.40), comprehension(.47), similarities (.47), and vocabulary (.42)

at T4. Small, significant correlations are produced between father's education and mothers education (.39), IQ at age 18 (.33), the complexity of work with people (.19) and data (.21) at first occupation, comprehension (.38), similarities (.34), vocabulary (.36), object assembly (.29), picture arrangement (.30), and block design (.36) at T3, and object assembly (.36), picture arrangement (.27), block design (.28), and picture completion (.24) at T4.

Mother's Education

The correlations between mother's education and the other variables mirrored those for father's education with a few exceptions. The correlations between mother's education and the complexity of work with people for the first occupation (.17) does not reach significance. Conversely, mother's education produces a small yet significant correlation when paired with picture completion at T3 (.23).

Siblings

As noted previously, the number of siblings produced negative associations with all but four variables: the complexity of work with data and things, comprehension, and object assembly, all at T3. However, the only significant correlations for the pairings with siblings are for picture completion T3 (-.26, $p<.01$) and similarities T4 (-.20, $p<.05$).

Father's Occupation

The correlations for father's occupation mirrored those for father's education very closely, both in their direction and strength. The greatest differences are in the correlations for picture assembly and block design at T4. Both correlations are smaller than those for father's education, and are not significant.

IQ at age 18

The correlations between IQ at age 18 and all the other variables were expected to be strong and positive (again with the exception of the number of siblings). Most of the correlations produced from this sample are indeed positive and significant, however, the values range from weak (.27) to strong (.72). Rather than list all the correlations for IQ at age 18, I refer the reader to Appendix A. In fact, only two variables, the complexity of work with things at first occupation (.05) and at T3 (-.01) did not reach significance (because the values are so small, the change in sign in the bivariate correlation at T3 may simply reflect variation about the value of zero).

Education

Respondents' level of education was also expected to show strong, positive correlations with all variables other than the number of siblings. The correlation matrix produced by this sample does show strong positive correlations with all but four of the measured variables. The correlations for complexity of work with things at first occupation (.01), object assembly at T3 (.08) and T4 (.10), and the complexity of work with things at T3 (-14) are not significant. Again, I refer the reader to Appendix A.

Complexity of Work

The complexity of work variables produced an interesting set of correlations. The complexity of work with people at first occupation shows weak but positive correlations with father's education (.19) and occupation (.20), and moderate correlations with IQ at age 18 (.37) and educational achievement (.56). Not surprisingly, it is also positively correlated with the complexity of work with data (.67) at first occupation, the complexity of work with

people (.62) and data (.36) at T3, and the four WAIS verbal scores at both T3 and T4, information (.46; .42), comprehension (.40; .29), similarities (.38; .37) and vocabulary (.48; .43). All these correlations were significant at the .01 level.

The complexity of work with data at first occupation shows the same pattern of correlations as those for the complexity of work with people. One exception stands out: the correlation between work with data at first occupation has a significant positive correlation (.24; $p<.01$) with the complexity of work with things at first occupation. The correlation for the complexity of work with people at first occupation and the complexity of work with things at T3, however, is not significant.

The complexity of work with things at first occupation produces a correlation pattern almost the opposite of those for work with data and people. Significant positive correlations are produced for the complexity of work with data at first occupation (.24) and things at T3 (.46).

The correlations for the complexity of work with people and data at T3 are in the same direction as those for people and data at first occupation, although the r-values are not identical. The complexity of work with people at T3 produced significant correlations with the complexity of work with data (.65) and things (-.24) at T3, and information (.32; .28), comprehension (.34; .27), similarities (.30; .31) and vocabulary (.34; .33) at both T3 and T4.

WAIS Scores

The scores for the WAIS sub-tests are all positively correlated with each other. By far, the majority of these correlations are significant at alpha = .01. The only exception is the correlation between picture assembly at T3 and Similarities at T3 (.14), which is not

significant. Most of the sub-scores produced significant correlations with father's education, mother's education, father's education, IQ at age 18, and educational achievement. Three performance sub-tests, picture completion, object assembly and block design, are the exceptions with correlations that do not reach significance. The number of siblings is negatively correlated with all but three of the WAIS sub-tests but reach significance for only two: picture completion at T3 (-.26) and similarities T4 (-.20). Generally, the verbal sub-tests of comprehension, similarities and vocabulary have significant positive correlations with the complexity of work with people and data, but no correlation with the complexity of work with things.

The Measurement Model

Background and Baseline Measures

The factor loadings and residuals for the manifest (measured) variables are listed in Table 2. The latent construct parents' education has two measured components: father's and mother's education. Both have strong loadings on the construct (.86 and .81 respectively),with residuals of .25 and .34. The number of siblings, father's occupation, intellectual ability at age 18, and educational achievement each have only a single manifest variable and thus all have loadings of 1.0.

Complexity of Work

The complexity of work constructs are derived from three measured variables: the complexity of work with people, data and things. The loadings for two of these components, complexity of work with people and data, for the first occupation are quite high (.92 and .90 respectively), and the residuals are small (.15 and .20). The complexity of work with things,

Table 2. Component Loadings for Full Measurement Model

Components and Manifest Variables	Loadings	Residuals
Parents Education		
Fathers Education	.86	.25
Mothers Education	.81	.34
Siblings		
Number of Siblings	1.0	0
Fathers Occupation		
Hollingshead	1.0	0
Intellectual Ability Age 18		
IQ score at age 18	1.0	0
Educational Achievement		
Years of Education Completed	1.0	0
Complexity of First Occupation		
People	.92	.15
Data	.90	.20
Things	.10	.99
Complexity of Work T3		
People	.94	.11
Data	.86	.26
Things	-.26	.93
Adult Verbal T3		
Information	.86	.25
Comprehension	.80	.36
Similarities	.81	.35
Vocabulary	.90	.19
Adult Performance T3		
Object Assembly	.80	.36
Picture Arrangement	.73	.46
Block Design	.85	.28
Picture Completion	.61	.62
Adult Verbal T4		
Information	.86	.26
Comprehension	.82	.33
Similarities	.84	.30
Vocabulary	.92	.16
Adult Performance T4		
Object Assembly	.82	.33
Picture Arrangement	.75	.44
Block Design	.79	.37
Picture Completion	.66	.57

however, has a very weak loading on this construct (.10) with a very large residual (.99). The results are similar for the complexity of work at T3, with loadings for people and data quite high (.94 and .86) but very low for the complexity of work with things (-.26). The residuals for the three respectively are .11, .26, .93.

Intellectual Ability

The WAIS is an established measurement instrument and so the loadings on the latent constructs are expected to be adequate or high (above .55) on all the manifest variables. The data do produce good loadings on all these variables, ranging from the lowest value of .61 for picture completion at T3 to a high of .92 for vocabulary at T4. The lowest loadings are found on those variables contributing to the performance construct, while the verbal construct loadings are all above .80.

Correlations Between Latent Constructs

The PLS program estimates a value for each of the latent constructs, allowing the construction of a correlation matrix for those constructs. This matrix is displayed in Table 3. The latent construct correlation matrix again confirms the expected directions of associations. All constructs are expected to have a positive association with those constructs that occur later in the model with the exception of the number of siblings. The number of siblings does produce negative correlation values with all other constructs, however, these correlation are all essentially zero. All other associations are positive with the exception of the correlation between the complexity of work at T3 and adult (intellectual) performance ability at T4 which is zero. Parents' education is moderately correlated with father's occupation, educational achievement, and all four intellectual ability constructs. Father's

occupation shows moderate correlations with educational achievement, and both verbal constructs.

Intellectual ability at age 18, the baseline score for this study, has a strong, positive correlation with both verbal constructs (.81 and .77 respectively) and moderate correlations with educational achievement (.55) and the performance scores at T3 and T4 (.58 and .53 respectively). Weaker correlations are produced between intellectual ability at age 18 and the complexity of work constructs (.38 and .30 respectively).

Table 3. Latent Construct Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11
1	1.00										
2	-.11	100									
3	.69	-.05	100								
4	.39	-.14	.32	100							
5	.46	-.15	.44	.55	100						
6	.21	-.13	.22	.38	.55	100					
7	.14	-.03	.19	.30	.53	.57	100				
8	.48	-.14	.49	.81	.63	.49	.35	100			
9	.44	-.09	.30	.58	.30	.15	.06	.48	100		
10	.53	-.20	.50	.77	.67	.46	.32	.88	.56	100	
11	.41	-.11	.25	.53	.27	.07	-.01	.47	.83	.53	100

1. Parents Education
2. Siblings
3. Father's Occupation
4. Intellectual Ability at Age 18
5. Educational Achievement
6. Complexity of First Occupation
7. Complexity of Work T3
8. Adult Verbal T3
9. Adult Performance T3
10. Adult Verbal T4
11. Adult Performance T4

Educational achievement has moderate correlations with the complexity of work constructs (.55 and .53) and the verbal intelligence constructs (63 and .67). The complexity of work for first occupation has only moderate correlations with the complexity of work at T3 (.57) and the verbal constructs (.49 and .46). The correlations between complexity of first occupation and the performance constructs are quite weak (.15 and .07).

Not surprisingly, the correlations between the intellectual ability measures at T3 and T4 are large with values of .88 between the verbal constructs and .83 for performance. Also as expected (because these are two different dimensions of intelligence), the correlation between performance and verbal at T3 is smaller (.48). The correlation between the two at T4 is .53. The correlation between performance at T3 and verbal at T4 is .56, and between performance at T3 and verbal at T4 is .47.

Estimates for the Conceptual Model

Path Coefficients

The first model I estimated was the conceptual model presented in chapter 3. In this model (see Table 4), I allowed parent's education to predict educational achievement and all four of the adult intellectual ability constructs. The number of siblings is allowed to predict educational achievement, and intellectual achievement at all time points. The paths from parents' education and father's occupation are allowed to predict educational achievement and intellectual ability at age 18. Educational achievement and intellectual ability at age 18 are each allowed to predict all constructs occurring later in time. Parents' education has the largest direct effects on intellectual ability at age 18 (.31) and the performance dimension of adult intellectual ability at T3 (.28). The direct effects for verbal component of adult

Table 4. Path Coefficients for Model #1

Predictor Constructs	Predicted Constructs	Path	% of variance
Parents Education	Intellectual Ability Age 18	.31	12.1
	Educational Achievement	.17	7.8
	Adult Verbal T3	.13	6.2
	Adult Performance T3	.28	12.3
	Adult Verbal T4	.10	5.3
	Adult Performance T4	.05	2.1
Siblings	Intellectual Ability Age 18	-.10	1.4
	Educational Achievement	-.06	0.9
	Adult Verbal T3	.01	0.1
	Adult Performance T3	-.01	0.1
	Adult Verbal T4	-.06	1.2
	Adult Performance T4	-.02	0.2
Fathers Occupation	Intellectual Ability Age 18	.11	3.5
	Educational Achievement	.18	7.9
Intellectual Ability Age 18	Educational Achievement	.41	22.6
	Complexity of First Occ.	.12	4.6
	Complexity of Work T3	-.02	0.6
	Adult Verbal T3	.61	49.4
	Adult Performance T3	.54	31.3
	Adult Verbal T4	.15	11.6
	Adult Performance T4	.11	5.8
Educational Achievement	Complexity of First Occ.	.49	27.0
	Complexity of Work T3	.32	17.0
	Adult Verbal T3	.16	10.1
	Adult Performance T3	-.09	2.7
	Adult Verbal T4	.16	10.7
	Adult Performance T4	.01	0.3
Complexity of First Occ.	Complexity of Work T3	.40	23 0
	Adult Verbal T3	.14	6.9
	Adult Performance T3	-.06	0.9
Complexity of Work T3	Adult Verbal T4	-.04	1.3
	Adult Performance T4	-.10	0.1
Adult Verbal T3	Adult Verbal T4	.61	53.7
Adult Performance T3	Adult Performance T4	.75	62.3
R^2 Intellectual Ability	.17		
R^2 Educational Achievement	.39		
R^2 Complexity of First Occ.	.31		
R^2 Complexity of Work T3	.39		
R^2 Adult Verbal T3	.73		
R^2 Adult Performance T3	.40		
R^2 Adult Verbal T4	.81		
R^2 Adult Performance T4	.70		
RMS Cov (E, U)	.04		

intellectual ability at T3 (.13) and T4 (.10) are smaller, as is the direct effect on educational achievement (.17). The effect of parents' education on adult performance at T4 is smaller than that at T3 (.05). The effects of parents' education on the adult intellectual ability constructs decreases from T3 to T4.

To estimate the amount of variance in the dependent construct that is explained or predicted by the independent construct, Falk and Miller (1992) recommend multiplying the value of the correlation between the constructs and the path coefficient. If the estimated shared variance is less than one and one-half percent, the path does not predict a substantial amount of the variance in the dependent construct and so may be dropped from the model. The exception may be constructs which are theoretically important, but do not produce substantial statistical results. To illustrate, the correlation between parents' education and adult performance at T4 is .41 and the value of the path coefficient is .05. The product of the two is .0205 or 2.1%. Parents' education predicts 2.1% of the variance in adult performance at T4. If this criterion is applied to the predictive paths for parents' education all the paths are substantial enough to leave in the model.

The number of siblings appears to have predictive value only for intellectual ability at age 18, with a path coefficient of -.10. The other path coefficients are close to zero, although they are in the expected direction (negative). Again, applying the criterion for estimating predictive value, all the paths from the number of siblings account for less than 1.5% of the variance in the predicted constructs, and so may be dropped from the model. In reducing the model for reasons of parsimony, siblings may be dropped as a latent construct, as it offers very little predictive value for adult intellectual ability.

Father's occupation has some predictive value for intellectual ability at age 18 and educational achievement. The path coefficient from father's occupation predicting intellectual ability at age 18 is .11. The coefficient from father's occupation to educational achievement is .18. Both these values are small, but when multiplied by the correlations between the constructs, they account for 3.5% and 7.9% of the variance in intellectual ability at age 18 and educational achievement respectively, and so should remain in the model.

Intellectual ability at age 18 holds substantial predictive value for educational achievement, accounting for 23% of its variance. It also accounts for nearly half (49.4%) of the variance in the adult verbal T3 construct, and almost a third of the variance in the performance construct (31.3) at T3. These values decrease at T4 (to 12% for verbal and 6% for performance), but are still large enough to warrant keeping the paths in the model.

Intellectual ability at age 18 is not a strong predictor of the complexity of work. The path coefficient between IQ at age 18 and the complexity of work for the first occupation is only .12, accounting for 4.6% of the variance in that construct, and the path from IQ at age 18 to complexity of work at T3 is even smaller (-.02) and the amount of variance accounted for is less than one percent. The negative path value for intellectual ability predicting the complexity of work at T3 is worth noting. The correlation between these two latent constructs is positive (.35), and so the change of sign in the path coefficient indicates some type of suppressor effect (which I will address later in this chapter).

Educational Achievement is a strong predictor of the complexity of the first occupation, accounting for 27% of its variance. It also has some predictive ability for the complexity of work at T3 (accounting for 17% of its variance) and adult verbal ability at T3

and T4, accounting for 10% and 11% of the variance in each (respectiveiy). Contrary to expectations, educational achievement accounts for only 2.7% of the variance in adult performance at T3 and only 0.3% at T4. There is a marked decrease from T3 to T4 for the performance constructs, but interestingly, the verbal constructs are essentially unchanged from T3 to T4.

The most notable result for the paths coefficients originating from educational achievement is the negative path produced between educational achievement and adult performance T3 (-.09). The correlation between these two latent constructs is positive (.26), and the sign change may be indicative of a suppressor effect in the model.

The complexity of the first occupation has predictive value for only the complexity of work at T3 and adult verbal intellectual ability at T3. The path coefficient between the two measures of complexity of work is a moderate .40; the complexity of work for the first occupation accounts for 23% of the variance in the complexity of work at T3. The complexity of the first occupation accounts for 6.9% of the variance in adult verbal ability at T3. The path from the complexity of work at first occupation and adult performance at T3 reflects a change in sign between the correlation for the latent constructs (.16) and the path value (-.06), another indication of a suppressor effect in the model.

The path from the complexity of work at T3 adult verbal ability at T4 also produces a sign change between the correlation between the latent constructs and the path coefficient. While the complexity of work at T3 has little substantive predictive value for either verbal or performance ability at T4, (it accounts for 1.3% and 0.1% of their variance respectively) the change in sign cannot be ignored.

Adult intellectual ability at T3 is a strong predictor of intellectual ability at T4. Adult verbal ability at T3 accounts for 54% of the variance in verbal ability at T4. Adult performance ability at T3 accounts for 62% of the variance in performance at T4. The strong predictive ability of these two constructs is not surprising, given the established reliability and results of the WAIS inventories.

Explained Variance in the Latent Constructs

The R-squares for each of the latent constructs in the full model are displayed in Table 4. Parents' education, Number of siblings, and father's occupation are exogenous variables and so the R-square for each of these constructs is zero. Overall, the model produces good estimates for the amount of variance accounted for by the predictor constructs. Parents' education, the number of siblings, and father's occupation together account for 17% of the variance in intellectual ability at age 18. These three constructs, and intellectual ability at age 18 account for 39% of the variance in educational achievement. Two constructs-intellectual ability at age 18 and educational achievement-account for 31% of the variance in the complexity of work for first occupation. Parents' education, number of siblings, intellectual ability at age 18, educational achievement, and the complexity of work at first occupation account for 73% of the variance in adult verbal intellectual ability at T3, and 40% of adult performance ability at T3. Intellectual ability at age 18, educational achievement and the complexity of work at first occupation together account for 39% of the variance in the complexity of work at T3. Finally, the outcomes of major interest in this model--adult verbal and performance intellectual ability at T4--have 81% and 70% (respectively) of their variance accounted for by the independent variables in the model.

Model Fit

The fit of the model is evaluated using the root mean square statistic (RMS). This statistic is a summary of the average correlation between the residuals from the latent constructs and the manifest variables. If the residuals are small, the model is a good fit to the data. Falk and Miller (1992) offer as a guideline these values: a RMS of .20 is an inadequate model, while a RMS value of .02 indicates a superior model. The RMS for the full model presented here is .04, indicating a very good fit to the data. While this first model is a very good representation of the relationship between the constructs, there remains to be addressed the issue of some type of suppressor effects as indicated by the sign changes in several of the path coefficients.

Suppressor Effect in the Model

A suppressor effect occurs when one or more variables in a regression equation obscures or changes the relationship between another independent variable and the dependent variable. The reason for the suppression is that the independent variables are related in such a way that when they are both entered into the equation, one of the variables suppresses some of the variance that the other variable would share with the dependent variable (McClendon 1994). In the model of intellectual ability, education and complexity of work, the suspect variables are education, IQ, and complexity of work because of their high correlations with one another.

To try to "fix" the suppressor effect and find the best statistical illustration of the relationship between the constructs in the model, I use two lines of reasoning: the time ordering of events and the empirical findings for the theoretical model (the first model

estimated in this analysis). It appears that the effects of one or more of the three identified constructs are masking the effects of one or more of the others in predicting the adult intellectual ability constructs. Because the predictor constructs are correlated with each other as well as the predicted constructs, one technique that may be used to identify the problem is to drop paths that could be redundant and evaluate the change in R-square for the dependent variable. If there is no significant decrease in the R-square value when a path is dropped, then the path is not adding to the predictive value of the model, and may be distorting the relationship between constructs. Therefore, the path is not contributing significantly and may be left out of the model. This technique also contributes to the parsimony of the model; the goal being to maintain a balance between the complexity of the model and the predictive value of the constructs included in the model (Falk and Miller 1992). It makes sense to begin by dropping those paths that occur later in time, since the variance they add may be a repetition of the variance from variables measured at an earlier time.

Model Number Two (Reduced Model)

Using these criteria, I constructed a reduced model, dropping those paths which explained less than 1.5% of the variance in the outcome variables. I began at the far right (latest in chronological order) of the model and dropped the paths from the complexity of work at T3 to the adult verbal and performance constructs at T4. I selected these paths to drop because the complexity of work had little predictive value for these constructs, and the path from complexity of work at T3 and adult verbal ability at T4 showed a sign change from the bivariate correlation. I also dropped the path from the complexity of work at the first occupation to adult performance T3 because of the lack of predictive value and the sign

change. The path from educational achievement to adult performance T4 was dropped because it accounted for only 0.3% of the variance in performance at T4. Although the coefficient from intellectual ability at age 18 to the complexity of work at T3 was small (-.02) and showed a change in sign, and the variance accounted for was less than 1.5%, I left the construct in the second model because I wanted to see if dropping the later constructs would change the estimates for some of the earlier occurring constructs. However, I dropped the entire construct for the number of siblings as it did not account for more than 1.5% of the variance in any of the other latent variables. Since it was one of the earliest occurring variables in time (before the baseline measure of IQ at age 18), I felt that its elimination would reduce the complexity of the model while not significantly reducing its predictive ability. The results for the second, reduced model are shown in Table 5.

An F-test for the change in the R-squares from model one to model two revealed no significant changes after dropping the questionable paths. The RMS for the model also showed no change (.04). There were some notable changes in the path coefficients in the reduced model. The path from parents' education to intellectual ability at age 18 dropped from .31 to .27. The path from parents' education to educational achievement increased from .17 to .22. The path coefficients from parents' education to adult performance ability at T3 increased from .28 to .32. These small changes are most likely the result of dropping the sibling variable from the model, or rounding error. The paths from father's occupation to intellectual ability at age 18 and educational achievement are still very small, but the variance accounted for in intellectual ability by father's occupation increases from 3.5% to 5.8%. Other differences in the paths for the two models probably reflect rounding variance.

Table 5. Path Coefficients for Model #2

Predictor Constructs	Predicted Constructs	Path	% of variance
Parents Education	Intellectual Ability Age 18	.27	10.5
	Educational Achievement	.22	10.8
	Adult Verbal T3	.13	6.2
	Adult Performance T3	.32	14.4
	Adult Verbal T4	.11	5.9
	Adult Performance T4	.02	0.8
Fathers Occupation	Intellectual Ability Age 18	.16	5.8
	Educational Achievement	.17	8.0
Intellectual Ability Age 18	Educational Achievement	.39	21.1
	Complexity of First Occupation	.15	6.0
	Complexity of Work T3	.02	0.7
	Adult Verbal T3	.61	49.4
	Adult Performance T3	.52	29.1
	Adult Verbal T4	.16	12.3
	Adult Performance T4	.08	4.2
Educational Achievement	Complexity of First Occupation	.48	26.9
	Complexity of Work T3	.33	18.2
	Adult Verbal T3	.17	10.9
	Adult Performance T3	-.16	4.6
	Adult Verbal T4	.15	10.2
Complexity of First Occ.	Complexity of Work T3	.39	22.6
	Adult Verbal T3	.14	7.1
Adult Verbal T3	Adult Verbal T4	.60	52.8
Adult Performance T3	Adult Performance T4	.78	64.7

	R^2	Change from Full Model
R^2 Intellectual Ability	.16	-.01
R^2 Educational Achievement	.40	+.01
R^2 Complexity of First Occ.	.32	+.01
R^2 Complexity of Work T3	.41	+.02
R^2 Adult Verbal T3	.74	+.01
R^2 Adult Performance T3	.38	-.02
R^2 Adult Verbal T4	.81	.00
R^2 Adult Performance T4	.70	.00
RMS Cov (E, U)	.04	

The elimination of those paths which did not appear to contribute to the model did reduce the number of sign changes in the model. The complexity of work at T3 changed to a positive value (.02) in model two, and the paths from complexity of first occupation to adult

performance at T3 and from complexity of work at T3 to each adult intellectual ability constructs at T4 were dropped without any significant change in the R-square values.

One path still had a negative path coefficient contradicting its positive bivariate correlation. The path from educational achievement to adult performance at T3 (-.16) is still negative, while the correlation between the two constructs is positive (.26). In the final reduced model (displayed in Figure 3), I dropped this path along with other paths with little predictive ability. The path coefficients, R-square values and RMS statistic are for the final model (model three) are displayed in Table 6.

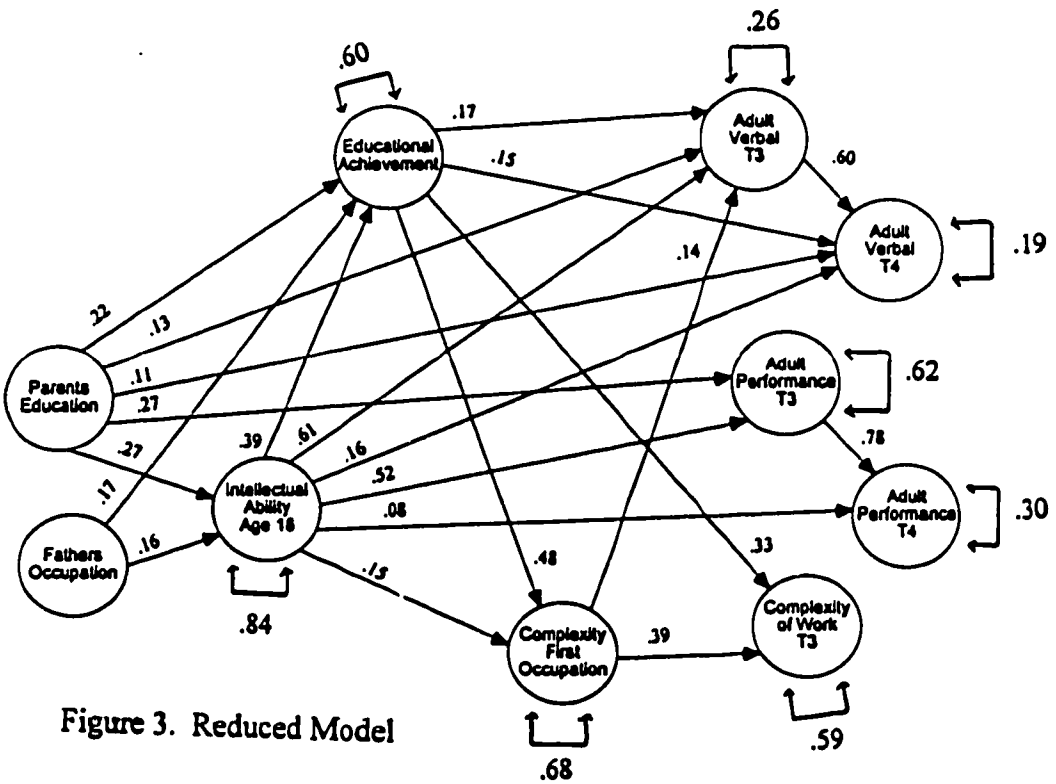

Figure 3. Reduced Model

Table 6. Path Coefficients for Model #3

Predictor Constructs	Predicted Constructs	Path	% of variance
Parents Education	Intellectual Ability Age 18	.27	10.5
	Educational Achievement	.22	10.8
	Adult Verbal T3	.13	6.2
	Adult Performance T3	.27	14.4
	Adult Verbal T4	.11	5.9
Fathers Occupation	Intellectual Ability Age 18	.16	5.8
	Educational Achievement	.17	8.0
Intellectual Ability Age 18	Educational Achievement	.39	21.1
	Complexity of First Occupation	.15	6.0
	Adult Verbal T3	.61	49.4
	Adult Performance T3	.52	29.1
	Adult Verbal T4	.16	12.3
	Adult Performance T4	.08	4.2
Educational Achievement	Complexity of First Occupation	.48	26.9
	Complexity of Work T3	.33	18.2
	Adult Verbal T3	.17	10.9
	Adult Verbal T4	.15	10.2
Complexity of First Occ.	Complexity of Work T3	.39	22.6
	Adult Verbal T3	.14	7.1
Adult Verbal T3	Adult Verbal T4	.60	52.8
Adult Performance T3	Adult Performance T4	.78	64.7

	R^2	Change from Full Model
R^2 Intellectual Ability	.16	- .01
R^2 Educational Achievement	.40	+.01
R^2 Complexity of First Occ.	.32	+.01
R^2 Complexity of Work T3	.41	+.02
R^2 Adult Verbal T3	.74	+.01
R^2 Adult Performance T3	.38	- .02
R^2 Adult Verbal T4	.81	.00
R^2 Adult Performance T4	.70	.00

RMS Cov (E, U)	.04

Model Number Three (Final Reduced Model)

The elimination of three paths in the third model produced no change at all from the second model in the R-square values for the latent constructs. I concluded, therefore, that the paths were redundant and were not contributing substantially to the predictive ability of the

model. Similarly, the loadings on the manifest variables for the final model had no changes greater than .03. This model, shown in Figure 3, is less complex than the full model, but still has the same predictive ability for the outcome of adult intellectual ability. The elimination of the siblings construct and several of the paths between constructs had no effect on the amount of variance accounted for by the constructs in the model. The RMS also remained unchanged (.04) and indicates a very good fit of the data to the model.

CHAPTER V

RESULTS AND CONCLUSIONS

In this final chapter I discuss the results of the data analysis for this study and the implications of these findings for future research. I begin by addressing each of the proposed hypotheses and the general propositions for the study. I follow with my general conclusions with regard to the relationship between the constructs of interest. Finally, I end the chapter with my thoughts on the need for future research in the areas of work and education as they pertain to education and intellectual ability.

Results

In chapter three I presented 16 hypotheses in four domains: (1) the relationship between the home environment, intellectual ability, and educational achievement, (2) the relationship between intellectual ability, educational achievement and occupational achievement, (3) the relationship between the school environment, intellectual ability, educational achievement and occupational achievement, and (4) the relationship between the complexity of the demands of the workplace and intellectual ability. In the following section, I present my conclusions for each formal hypothesis and my more general hypotheses. I end the chapter with recommendations for future research based on the theoretical position and empirical findings presented in this dissertation.

Tests of Formal Hypotheses

Hypothesis 1a.

Parents' education does have a positive effect on intellectual ability over the life course. The effect of parents' education on intellectual ability at age 18 is small (.27) but does account for nearly 11% of its variance. The effect decreases for the measures at T3 , accounting for only 6% of the variance in adult verbal ability and 14% of the variance in adult performance. What is interesting is that at T4, the path to adult performance drops out of the model, while the path to verbal ability remains, although parents' education accounts for only 6% of its variance. Hypothesis 1a is supported in that the path coefficients from parents' education predicting intellectual ability at age 18 and the four adult intellectual ability constructs are positive and decrease over time. The effect sizes are small, but parents' education is only one dimension of the background factors discussed in this paper. Other unmeasured factors include neighborhood influences and economic measures; the fact that parents' education alone accounts for 10.5% of the variance in IQ at age 18 supports the contention that the home environment contributes substantially to the development of intellectual ability before adulthood.

Hypothesis 1b.

The hypothesis that parents' education will have a direct, positive effect on educational achievement is also supported. Again, the effect size is small (.22) but this single background factor explains 11% of the variance in educational achievement, restating the importance of the home environment for intellectual ability and educational achievement.

Hypothesis 1c.

The effects of father's occupation on both intellectual ability at age 18 and educational achievement are small, but positive (.16 and .17 respectively) supporting the third hypothesis. However, the variance accounted for by father's occupation in the two constructs is only 6% and 8% respectively. These findings do, however, fit with previous research (Sewell, Hauser, and Alwin 1975) which shows that much of the effect of father's occupation on their children's ability and achievement works through father's income and education.

Hypothesis 1d.

The dilution hypothesis was partially supported; the path coefficients from the number of siblings to intellectual ability at age 18, adult performance at T3, and adult performance and adult verbal ability at T4 were negative. However, the path to adult verbal ability at T3 was positive, although the value is nearly zero (.01). In fact, the size of the coefficients would lead me to question the substantive value of any of the relationships. The largest value is for the path from number of siblings to intellectual ability at age 18 (-.10), accounting for 1.4% of its variance. While these effect are very small, they reflect the findings by Blake (1989) for the effect of siblings on intellectual ability and educational achievement in that the effects are not large, but are consistently negative.

The results of this analysis generally support the argument that interactions in the home environment contribute substantively to the intellectual development of the individual. Parents' education, the number of siblings, and father's occupation together account for 40% of the variance in educational achievement, and 16% of the variance in IQ at age 18. The time ordering of events add to the strength of this conclusion as parents' education, the

number of siblings, and father's occupation all occur before the baseline measure of intellectual ability at age 18 and the measure for educational achievement. These findings support the argument made by Sameroff et al. (1993) that the effects of background factors are cumulative; no single factor can account for the majority of the variance in either intellectual ability or educational achievement. Rather it appears that the effect of each is small to moderate, but consistent, and additive.

Hypothesis 2a.

The hypothesis that IQ at age 18 will have a direct, positive effect on educational achievement is supported. The baseline measure of intellectual ability accounts for 21% of the variance in educational achievement (with a path coefficient of .39). This finding is in line with previous research on the relationship between intellectual ability and educational achievement. As discussed in the previous chapters, IQ tests were developed to identify individuals who were at risk for failure in the educational arena, and so have good predictive validity for educational achievement (Thorndike and Lohman 1990).

Hypothesis 2b.

The hypothesis that IQ at age 18 will have a direct, positive effect on the later intellectual ability constructs is also supported. IQ at age 18 accounts for 49% of the variance in adult verbal ability at T3 and 29% of adult performance ability at T3. The effects decrease at T4, to 12% and 4% respectively. It appears that for this sample, one's intellectual ability in late adolescence is the best predictor of adult intellectual ability, particularly the verbal dimension. Its predictive power, however, is not perfect and diminishes over time. The R-square values for the later intellectual ability constructs indicate that much of the variance not

accounted for by IQ at age 18 comes from the other variables in the model. Eighty-one percent of the variance in the adult verbal intellectual ability at T4 and 70% of the variance in adult performance intellectual ability at T4 is accounted for by the variables included in the model. More than half the explained variance in each can be accounted for by previous measures of intellectual ability, with parents' education and father's occupation accounting for most of the remainder. Again, the home environment, and the significant others within it appear to have a strong influence on adult intellectual ability throughout the life course.

Hypothesis 2c.

Hypothesis 2c, is only partially supported. Intellectual ability at age 18 has a direct, positive effect on the complexity of work of the first occupation, but the direct effect (in the first model) at T3 is quite small and in the opposite direction (-.02). When the path from IQ at age 18 was dropped, there was no change in the R-square for the complexity of work at T3, indicating the effect was actually zero. It appears that intellectual ability has some predictive validity for job complexity upon entry into the workforce, but loses its predictive ability for later occupational placements.

Hypothesis 2d.

The indirect effect of IQ at age 18 (through educational achievement) on the complexity of work at first occupation work (.19) is nearly the same as the direct effect (.15). The combined effect size for both direct and indirect paths is .34. The indirect effect of IQ at age 18 on the complexity of work at T3 (through educational achievement) is slightly smaller (.13) than at first occupation. Hypothesis 2d is supported; the effects of IQ at age 18 are both direct and indirect, through educational achievement. It appears that individuals with

higher intellectual ability find themselves in jobs with higher demands of complexity. In addition, these individuals are more likely to achieve higher levels of education which contributes to their placement in more demanding (in complexity) occupations. The fact that the direct and indirect effects are nearly equal points to the contribution of both ability and credentials in occupational placement.

Hypothesis 2e.

Hypothesis 2e essentially posits that IQ at late adolescence (age 18) will be a better predictor of later measures of intellectual ability than will be the complexity of work. The data from this sample support the hypothesis. The direct effects of IQ at age 18 on intellectual ability at T3 are .61 for verbal ability and .52 for performance. The direct effects of the complexity of work at first occupation are only substantive for the adult verbal construct at T3 (.14); the path to adult performance at T3 was redundant (-.06), and was dropped from the model. The paths from the complexity of work at T3 predicting the adult intellectual ability constructs at T4 were also redundant (-.04 and -.10 respectively) and were dropped from the model. While the complexity of work has very little predictive ability for adult intellectual ability, IQ at age 18 is a good predictor of adult intellectual ability later in life.

The results of hypothesis 2e indicate that the complexity of work contributes very little to adult intellectual ability. More than half the variance in adult intellectual ability can be predicted by knowledge of one's IQ at age 18. The rest of the variance (that is accounted for in this model) can be attributed to parents' education and educational achievement. The

complexity of the first occupation predicts only a very small portion of the variance in verbal ability at T3, and has no predictive power at later points in time.

Hypothesis 3a and 3d

Education was expected to be a strong predictor of adult intelligence at both T3 and T4. Additionally, the effect of education on intellectual ability was expected to decrease over time. These hypotheses were only partially supported.

The direct effects of education on verbal intellectual ability at T3 and T4 are .17 and .15, accounting for 11% and 10% of the variance in each. The effect of education on adult performance ability, however, was either redundant or not substantial and its paths were dropped from the final model. Education does have a moderate degree of predictive ability for adult verbal ability later in life, but its influence on the performance dimension of intellectual ability is minimal.

The evidence for hypothesis 3d (that the effects would decrease in over time) is questionable. The effect of education on verbal ability shows only a small decrease from T3 to T4 (.17 to .15) indicating it is fairly stable over time.

These findings are interesting because of the lack of predictive power for the performance dimension of intellectual ability. However, as posited in chapter three, the goal of formal education is to instruct students in the use of cultural symbols, particularly those used for communications via language. These findings support the general theoretical argument presented--that education will have greater predictive power for the verbal dimension of intellectual ability.

Hypothesis 3b

Hypothesis 3b states that the effects of education on adult intellectual ability will be greater than those of the complexity of work. Only lagged effects are measured, as theoretically, only variables occurring previous to the outcome variable can be premised as having predictive ability. This hypothesis has strong support in the model presented here. As discussed above, the direct effects of education on intellectual ability at T3 and T4 are limited to the verbal constructs. Educational achievement accounts for 11% and 10% of the variance in verbal ability at T3 and T4. The complexity of work for the first occupation has predictive value for only the outcome of adult verbal ability at T3, accounting for 7% of its variance. The paths from the complexity of work at T3 predicting adult verbal and performance ability at T4 were dropped from the model because of their lack of predictive value. The indirect effect of educational achievement on verbal ability at T3 (through the complexity of first occupation) is .07, about half the size of the direct effect of educational achievement (.17) on verbal ability at T3. The total (direct and indirect) effect of education on adult verbal ability at T3 is .24, compared to the total effect of .14 for complexity of work on adult verbal ability at T3. While both independent variables are limited to the prediction of verbal ability, education is the better predictor of adult intellectual ability than is the complexity of work. The influence of education on adult verbal ability is also more persistent over time; the educational environment is experienced before the work environment, yet its influence is still apparent decades after having left it. The work environment on the other hand, has a smaller influence, and the effects do not appear to persist over time.

Hypothesis 3c

Educational achievement is a very strong predictor of the complexity of both the first occupation and occupation at T3. The path from educational achievement to the complexity of work for the first occupation is .48, accounting for 27% of its variance. The direct effect of educational achievement on the complexity of work at T3 is .33, with a total effect size of .52 (the additional effect working through the complexity of first occupation). Educational achievement accounts for 18% of the variance in the complexity of work at T3. While the effect of educational achievement on adult intellectual ability remained stable over time, there is a decrease in the effect of education on the complexity of work. This is an interesting finding in that it supports the contention that the influence of the educational environment will decrease as one is more removed from it. However, it brings into question the continuing effects of educational credentials later in one's career. It appears that credentials may contribute to initial job placement, but the effects decrease over time as other factors influence occupational demands on the complexity of work.

Hypothesis 3e

Again testing the environmental influence proposition, hypothesis 3e states that the effects of the complexity of work on adult intellectual ability will increase over time because as the individual leaves the educational environment, and spends more time in the work environment, the influence of each will also shift. The effect of education will decrease as the effect of occupational experiences will increase. This hypothesis is not supported because of the lack of influence of the complexity of work on the adult intellectual ability. Again, the only predictive ability for the complexity of work comes from the first occupation predicting

the verbal constructs of adult intellectual ability at T3. Since there is only one substantive path, I conclude that the hypothesis is not supported. The effects of the complexity of work on intellectual ability actually decrease over time, becoming essentially non-existent by the final measure.

It appears that the influence of the education environment is not only stronger than that of the work environment, but is also more enduring over time. It is not surprising that the education environment still has some influence on adult intellectual ability at T3, but it is also influential at T4, some 40 years after the baseline measure. Work, on the other hand, appears to be influential for only a short period of time (immediately after the first occupation) and its effects disappear the first decade after entry into the career path. This is supportive of the influence of the educational environment, and its decreasing effects over time, but it does not support the argument that the current environment has a greater influence than do experiences in previous environments.

Hypothesis 4a

The results of hypothesis 4a have been addressed previously. Following the Kohn (1977) thesis, this hypothesis states that the complexity of work at both measures will have a direct, positive effect on adult intellectual functioning (again the effects are hypothesized to be lagged). This hypothesis is only partially supported. The only substantial effect for complexity of work on adult intellectual functioning is for the first occupation on verbal ability at T3 (.14). This effect is small, but does account for 7% of the variance in adult verbal ability at T3. The complexity of work at T3 does not predict adult intellectual ability at T4, nor does the complexity of first occupation have substantial predictive ability for

performance ability at T3 (the total effect of the complexity of first occupation on performance at T3 is .09, but it has been dropped from the model).

Tests of General Hypotheses

The general argument of this paper is that education holds greater predictive value for adult intellectual ability than does the complexity of work. The theoretical propositions presented and explicated in chapters one and two argue that the outcomes for educational achievement and intellectual ability are the result of complex interactive processes which take place within environmental contexts throughout the life course. I have discussed the results of the specific hypotheses for this study, and now turn to a discussion of the results for these two general propositions.

The formal hypotheses tested here focus mainly on the direct effects of the variables of interest upon those occurring later in time. In order to get a better overall picture of the relationship between the variables in the model, a discussion of the indirect and total effects is necessary. The specific hypotheses concerning the effects of educational achievement on adult intellectual ability have been supported (see hypotheses 3a, 3b and 3d). One inconsistency, however, is noted in the lack of effect for education on adult performance ability at T4. Because the results in this one area were contrary to expectations, further exploration of the relationship between the intellectual ability variables is warranted. A better understanding of these counterintuitive results might be found by examining the total effects for education on adult verbal and performance ability at both T3 and T4.

Total Effects on Adult Intellectual Ability

The total effect of one variable on another may be found by adding the direct and indirect effects. While the direct effects for the final model are shown in Table 6, the procedure in the example which follows is used to compute the indirect and total effects for the variables in the model.

The effects of education on adult verbal ability at T3 work both directly, and through the complexity of work for first occupation. The direct effect size is .17, while the indirect effect through the complexity of work for first occupation may be computed by multiplying the effect of educational achievement on the complexity of first occupation (.48) by the effect of the complexity of work at first occupation on adult verbal ability at T3 (.14). The product of these two effects (.07) is the indirect effect of education on adult verbal ability at T3 through the complexity of work for first occupation. The sum of the two effects (indirect and direct) are the total effect of educational achievement on adult verbal ability at T3 (.24).

I used the same statistical process to examine the effects of education on the other adult intellectual ability variables. The total effect (indirect and direct) of educational achievement on adult performance at T3 is zero. The total effect of educational achievement on verbal ability at T4 is .30. The total effect of educational achievement on performance ability at T4 is zero. These results point to two conclusions: the performance and verbal constructs for intellectual ability measure two dimensions of intellectual ability and, for this sample, education contributes to only the verbal portion of intellectual ability. The performance component of intellectual ability at both T3 and T4 is predicted by other variables in the model. Interestingly, 38% of the variance in performance at T3 and 70% at

T4 is accounted for by the variables included in the model. Since the complexity of work and educational ability do not have any predictive power for adult performance, parents' education, father's occupation and intellectual ability must be accounting for the explained variance in the variables. Before breaking down the indirect and direct effects on verbal ability, I separate the effects of the other variables on the performance components of adult intellectual ability.

Adult Performance Ability

The total effect (indirect and direct) of parents' education on adult performance ability at T3 is .40. The total effect of father's occupation on adult performance at T3 is .08. The total effect of intellectual ability at age 18 on adult performance at T3 is .46. These results indicate that the greatest predictor in the model for adult performance at T3 is intellectual ability at age 18, followed by parents' education. Father's occupation has only a very small indirect effect (.08) on adult performance at T3 (through IQ at age 18). Parents' education has an indirect effect on adult performance at T3 through IQ at age 18 of .14, more than half the value of its direct effect (.27). The indirect effects of parents' education on adult performance at T3 work through IQ at age 18 (.14).

The total effect of parents' education on adult performance at T4 is .33, slightly less than at T3. The total effect of father's occupation on adult performance at T4 is .07 (again slightly less than at T3), and the total effect of IQ at age 18 on adult performance at T4 is .44. Finally, adult performance at T3 has a total effect of .79 on adult performance at T4. By far, adult performance at T3 is the best predictor of adult performance at T4, followed by IQ at age 18 and parents' education.

The performance component of adult intellectual ability is sometimes referred to as the practical component of intelligence while the verbal portion is thought of as the educational component (Thorndike and Lohman 1990). The performance component is more reflective of abilities that may or may not be learned, while the verbal component is more indicative of acquired skills and knowledge (Seligman 1992; Thorndike 1997). The results of this analysis support these observations in that education does predict the verbal ability variables but not the performance dimension of intellectual ability. What does predict performance ability is parents' education and IQ at age 18. In agreement with these findings is the (previously cited) literature which points to parents' education as one of the strongest predictors of childhood and adolescent IQ. Nearly half the variance in adult performance is accounted for by IQ at age 18 and parents' level of education. The performance component of intellectual ability appears to be established at an early age, and is relatively unaffected by experiences in the educational and work environments.

Adult Verbal Ability

The total effect of parents' education on adult verbal ability at T3 is .38. The indirect effects work through IQ at age 18, educational achievement, and the complexity of the first occupation. Most of the indirect effects work through IQ at age 18 (.16). The remaining indirect effects of parents education through IQ at age 18, educational achievement and the complexity of work for first occupation are all quite small (combined effect = .06). It appears that the effect of parents' education on adult verbal ability at T3 is mostly direct, with a small portion working indirectly through IQ at age 18.

The total effect of parents' education on adult verbal ability at T4 is .43. The indirect effects work through IQ at age 18, educational achievement, the complexity of work for first occupation, and verbal ability at T3. The sum of the indirect effects of parents' education on adult verbal ability at T4 is .32. The largest indirect effect is the path through IQ at age 18, and verbal ability at T3 (.10). Worth noting is that the paths from parents' education to adult verbal ability at T4 which pass through the complexity of work for first occupation are all less than .01; the combined effect of all three indirect paths passing through the complexity of work is only .02

These findings support the proposition that parents contribute to the intellectual ability of their children in several ways. First, they contribute the genetic makeup of their offspring and then they provide an environment that either nurtures or hinders the development of the individual carrying those genes. Parents with higher levels of education are more likely to possess the genetic makeup which contributes to higher intellectual ability, as their own ability has most likely contributed to their higher level of education. Parents' higher level of education provides them with a larger store of symbolic knowledge, increasing their ability to model cultural symbols and rules. Their relatively more extensive experiences in the formal educational environment provide them with the skills which lead to success in that environment and consequently, their increased ability to model those skills for their offspring.

Conclusions

General Relationship Between Constructs

As proposed in the previous chapters, the relationships between parents' education, intellectual ability, educational achievement, and the complexity of work are elaborate, and

cannot be easily summarized. I attempt to do so, but do not claim to offer an *explanation* of the outcomes, only a description of the outcomes and how they fit the context of my theoretical foundation. Neither is my summary exhaustive, although I do believe it describes the dynamics of the major variables influencing the outcome of adult intellectual ability.

The most notable finding for this study is that the complexity of work offers only a small amount of predictive value for adult intellectual ability. Soft modeling allowed me to keep both educational achievement and the complexity of work in a single model and the results show that rather than education dropping out, as Kohn proposed, it is the complexity of work that has little predictive power and is dropped from the model. Educational achievement predicts both the complexity of work and adult verbal intellectual ability. The complexity of work for the first occupation accounts for a small amount of the variance in adult verbal intellectual ability at T3, but drops out of the model at T4.

The indications for these findings are that education provides skills and credentials which start the individual on a career trajectory. Those with high levels of ability and educational achievement find jobs which demand more in the way of complexity of the work, and offer more self-direction. It appears, however, that the influence of the job is short-lived, lasting for only about a decade after the first job placement. The influence seen in this model may be reflective of the learning of new job skills in the first few years of a new career, and the leveling of learning demands following the novice stage of occupational employment. Once one learns the skills of a trade or profession, they become better at what they do, but may not acquire new knowledge at the rate experienced while in the educational setting. This may be so because most jobs are focused on production, with new skills learned only with that

end in mind. The educational institution, on the other hand, is focused on providing a foundational base of new skills and knowledge with the application of those skills a secondary concern.

Neither educational achievement nor the complexity of work has any predictive power for the performance component of intellectual ability. The performance dimension is predicted mostly by parents' education and IQ at age 18. The performance dimension of intellectual ability appears to be less flexible in the adult years. Once established (in this study, by early adulthood) it seems to change very little compared to the verbal component. The difference between the predictor variables of these two dimensions of intelligence should be of interest to researchers who are interesting in increasing IQ scores. The verbal component appears more malleable over the life course, while the performance component is fairly stable after adolescence.

The overall picture derived from the model presented here is that intelligence is both influenced by environmental factors, and influential in individual selection of environmental settings over the life course. The theories presented here are supported in that both biological and environmental influences appear to be at work. The family is a biological (genetic), physical, and social environment. Parents are an important influence in this environment both for innate ability and ability that is achieved and developed throughout childhood and adolescence. Innate intellectual ability is nurtured or inhibited by environmental influences such as parents' educational achievement and ability. Intellectual ability contributes to the individual's success in the academic arena which in turn allows them to be placed in higher level occupations. What is so interesting in this study is that the effects of the family and

educational institution are felt far into adulthood, while the work environment has little effect except immediately following the first career placement.

Recommendations for Future Research

My recommendations for future research also reflect my theoretical perspectives. In the Bronfenbrenner tradition, I assume that there is no single, narrow research question that will further our understanding into how innate ability and environmental factors interact to produce outcomes. This study adds to the literature by providing researchers with a solid theoretical foundation for designing future studies, and by adding support to previous empirical findings on the relationship between the influences of the family, education and occupational environments on intellectual ability. Its weakness lies in that it does not test all the theoretical constructs that are proposed to have a significant influence on adult intellectual functioning. Researchers designing studies in the future could benefit from this study by using a design which fits the Bronfenbrenner conceptualization of nested environmental systems, and adding the measures for constructs discussed in this dissertation which are posited to influence the outcomes of intellectual ability and educational achievement.

An example of this type of research would include a nested research design with measures at each systems level. The microsystem would include measures of IQ, self-efficacy, self-esteem, parent/child interaction (in both quantity and quality), language usage (in the Berenstein 1977 tradition), and the level of material stimulation in the home. The mesosystem level would include measures of neighborhood characteristics including material resources (income, property ownership and tax rate, and zoning), measures of social and human capital (Coleman 1988), the proportion of single parent, step-parent, and dual wage

earner homes, average family size, and levels of safety, interdependence, and interaction among neighbors. Measures reflecting macrosystem influences would include the classification by region (e.g., Northeast, Deep South, Southwest, Northwest, Pacific Coast, or Midwest) and within region, a break-down by smaller community type (e.g., farm, rural, suburban, urban). Within these categories, measures of expenditures for social and educational programs, the structure of the educational system (i.e., administered by the city, county or state), the political disposition (e.g., conservative vs. liberal ideology), economic climate (e.g., growth vs. stagnation), and occupational structure for the area. Measures should be constructed at the highest level of statistical measurement possible to allow for the use of regression procedures to estimate effect sizes. By including in a single model multiple levels of environmental influence, researchers will be able to fill in the details of these complex relationships.

While this type of model may seem overwhelming, it is a tool for social scientists to advance to the next stage in understanding the relationship between these constructs. The focus for researchers developing these types of model is my second concern. While adult intellectual ability is still an important outcome, I believe that social researchers have a responsibility to prioritize research agendas by their usefulness for society. The United States as a society holds equality as an ideal that is worthy of pursuit for all. I recognize that this is only an ideal, and that men and women are not born equal, however, we should strive to offer everyone an equal opportunity for increasing their own life-chances and quality of life, given these innate differences. Researchers, therefore, should keep this valued ideal at the forefront of their agendas. This in mind, the findings of this study indicate that given the

inherited ability of the individual, intellectual ability is most influenced by educational achievement--both the parents' and the individual's. Educational experiences in the first two decades appear to have an enduring effect throughout the life-span. The question for social researchers should be: how can we maximize on the inherited intellectual ability of individuals in the educational setting so that they can achieve success and have a fair chance at the credentials so important in job placement?

While interactions in the microsystem should be one target for research, the mesosystem, including neighborhood influences and regional differences in structure and culture, is a neglected area of research. While comprehensive, nested models would be ideal, social scientists can still improve on their measures in studies of a smaller scale. A few researchers have seen the need to delve more deeply into these environmental influences (Brooks-Gunn, Duncan, Klebanov and Sealand 1994; Duncan, Brooks-Gunn and Klebanov 1994; Sameroff 1993) and their findings have pinpointed some of the more specific areas for future research. The SES composition of the neighborhood, for example, has some influence on IQ in young children. In the future, SES should be broken down into its components of education, income and occupational prestige to determine the effects of each on neighborhood influence. Cultural influence on educational achievement should also be explored. Most children start out life with high aspirations for achievement. What influences those changes in aspirations and when do they occur? While previous research has utilized survey and secondary data to explore these questions, I would encourage future researchers to plan longitudinal studies designed to explicate the mechanisms working within these environments that influence both intellectual development and educational achievement in childhood,

adolescence, and throughout the life course. For example, educational achievement as a single entity is useful in determining the effects of credentials on occupational placement and job mobility, however, educational achievement as it influences intellectual ability is a coarse measure and must be broken down further into its component parts. These component parts include the interactions between the individual and significant others within the educational setting, the development of the self, and individual decision-making processes.

The questions presented here cannot be answered solely by examining the interactions within the environments of the family and school. There are larger influences that shape these institutions, thereby influencing the interactions which take place within them. Of primary interest for educational researchers, particularly at this point in our history, is the inequality of educational opportunity for citizens living in the United States of America. What are the most important influences on the school system which affect the educational achievement of those within it? Is it money, parent choice, discipline, a whole language approach to teaching, or some mix of these components that contributes most to the educational achievement and subsequent occupational placement of students? Again, researchers must go beyond coarse measures and models to include more fine grain concepts and measures of influence. Rather than looking at the coarser indicator of per pupil spending to gauge student achievement, for example, look at how those dollars are allocated between administrative salaries, building maintenance, books, direct instruction and student counseling. This shift in focus from our standard coarse measures to the development of more detailed, finer measures will increase our ability to predict outcomes for educational achievement and adult intellectual ability, and consequently our ability to make recommendations for social policy in this area.

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APPENDICES

APPENDIX A

CORRELATION MATRIX FOR MANIFEST VARIABLES

Appendix A. Correlation Matrix For Manifest Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	100																										
2	39*	100																									
3	-09	-13	100																								
4	74*	41*	-09	100																							
5	33*	32*	-13	36*	100																						
6	44*	38*	-14	47*	54*	100																					
7	19*	17	-15	20*	37*	56*	100																				
8	12	17	-14	17*	37*	45*	67*	100																			
9	-03	09	-05	-05	05	01	-03	24*	100																		
10	17	13	-10	16	36*	56*	62*	48*	09	100																	
11	21*	-04	04	15*	27*	43*	36*	41*	20	65*	100																
12	11	07	11	05	-01	-14	-11	-03	46*	-14*	01	100															
13	41*	33*	-15	42*	74*	62*	46*	40*	03	62*	21*	-06	100														
14	38*	33*	03	49*	59*	48*	40*	34*	-09	44*	28*	-11	58*	100													
15	34*	27*	-14	42*	65*	42*	38*	26*	-13	40*	21	-01	56*	55*	100												
16	36*	28*	-17	43*	74*	62*	48*	41*	-15	44*	24*	-11	74*	65*	64*	100											
17	29*	25*	02	25*	40*	08	-08	-03	03	-13	05	22*	22*	22*	24*	25*	100										
18	30*	33*	-05	28*	37*	27*	02	05	00	07	10	08	28*	32*	14	27*	43*	100									
19	36*	34*	-02	29*	51*	30*	17	30*	19	12	20	16	44*	36*	34*	38*	57*	50*	100								
20	11	23*	-26*	18	41*	22*	19	27*	13	16	15	08	32*	35*	37*	30*	32*	33*	33*	100							
21	40*	39*	-15	41*	66*	62*	42*	38*	07	38*	22	-05	87*	52*	56*	72*	29*	26*	48*	32*	100						
22	47*	32*	-16	49*	59*	55*	29*	36*	-04	27*	23	-09	50*	59*	48*	62*	30*	27*	46*	29*	54*	100					
23	47*	31*	-20*	52*	68*	54*	37*	28*	-02	41*	33*	-01	64*	54*	67*	68*	36*	33*	48*	40*	65*	59*	100				
24	42*	28*	-16	45*	72*	62*	43*	44*	-05	43*	25*	-06	70*	56*	60*	87*	34*	28*	51*	34*	73*	72*	69*	100			
25	36*	23*	00	23*	27*	10	-02	-03	08	-08	05	26*	18*	22*	25*	17*	63*	37*	65*	32*	27*	34*	33*	25*	100		
26	27*	18*	-17	17	46*	27*	13	04	-05	05	05	11	45*	36*	26*	43*	37*	53*	43*	32*	35*	33*	39*	38*	46*	100	
27	28*	30*	-01	18	45*	22*	03	20	16	03	12	20*	30*	29*	30*	24*	56*	37*	76*	34*	38*	38*	34*	36*	63*	38*	100
28	24*	15	-18	26*	44*	22*	07	05	-06	01	02	06	36*	26*	32*	42*	43*	43*	44*	51*	35*	27*	43*	43*	34*	52*	31*

1 Father's education
2 Mother's education
3 Siblings
4 Father's occupation (Hollingshead)
5 IQ at age 18
6 Years of education
7 Complexity of work with people- first occupation
8 Complexity of work with data- first occupation
9 Complexity of work with things- first occupation
10 Complexity of work with people- T3
11 Complexity of work with data- T3
12 Complexity of work with things- T3
13 Information T3
14 Comprehension T3
15 Similarities T3
16 Vocabulary T3
17 Object assembly T3
18 Picture arrangement T3
19 Block Design T3
20 Picture completion T3
21 Information T4
22 Comprehension T4
23 Similarities T4
24 Vocabulary T4
25 Object assembly T4
26 Picture arrangement T4
27 Block design T4
28 Picture completion T4

* Significant at $\alpha = .05$

APPENDIX B

HUMAN SUBJECTS APPROVAL

Office of Research Services and Sponsored Programs
Akron, OH 44325-2102
(330) 972-7666 Office
(330) 972-6281 Fax

February 3, 1999

Ms. Margaret Tonkin
257 Greenwood Avenue
Akron, OH 44313

Dear Ms. Tonkin:

The University of Akron's Institutional Review Board for the Protection of Human Subjects (IRB) processed your Application for Review of the research project entitled:
The Effects of Education and Complexity of Work on Intellectual Ability.

The IRB determined that the project:

___ was exempt of need for further review.
_X_ required expedited review conducted on January 28, 1999.
___ required convened meeting held on ___.

The IRB concluded that your project was:

_X_ Approved without further qualifications. This approval is valid for one year, or until modifications are proposed in the project's protocol, whichever occurs first. In either instance, an Application for Continuing Review must be completed and submitted to the IRB.
___ Project is eligible for approval contingent upon your written confirmation of the IRB's recommended changes.
___ Project was disapproved.

Please retain this letter for your files. If this research is being conducted for masters thesis or doctoral dissertation, the student must present a copy to the Registrar's office along with the thesis or dissertation.

Sincerely,

Steven R. Hoagland, Ph.D.
Associate Director, Research Services and Sponsored Programs
Vice Chair, Institutional Review Board

pc: Dr. R. Frank Falk
Dr. John Zipp