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EXAMINING THE ROLE OF SCHOOLING IN THE HIV AND AIDS PANDEMIC: DISENTANGLING SCHOOLING'S EFFECT ON INFECTION, SEXUAL BEHAVIOR, AND DECISION-MAKING

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ABSTRACT

This dissertation is a response to the numerous studies that report on the relationship between education and health and that have called for an increased understanding of how education impacts thinking, reasoning, and problem solving and how these in turn impact health. This dissertation focuses on understanding what schooling uniquely does to influence risk taking and preventative strategies in the context of heterosexual transmission of HIV in sub-Saharan Africa. This dissertation presents the results of three empirical studies that examine different aspects of the role of schooling on the HIV and AIDS pandemic in sub-Saharan Africa. The research uses Demographic Health Surveys from 11 SSA countries with data collected in 4 relatively homogenous and remote villages in the *Eastern* region of Ghana on cognitive and decision-making abilities. The empirical studies yield data to test the effect of schooling on HIV infection, engagement in sexual behavior, mathematic ability, cognitive skills, and decision-making capacities related to the HIV and AIDS pandemic. This study presents the results of both logistic regression and structural equation modeling that examines hypotheses that link schooling with basic cognitive skill enhancement and how these relate to risk assessment and decision-making. This line of inquiry is a new approach to consider how schooling has such a wide impact on health behavior, a major social issue facing the future of numerous societies. This dissertation presents findings that extend existing lines of research of health and decision-making into a very different and important population (the non-schooled and low-schooled) in SSA. This dissertation also introduces the effect of schooling to enhance cognitive skills in the health behavior and decision-making paradigms. This analysis is a step in understanding how attending school protects an individual from HIV infection and engagement in protective behavior above and beyond the acquisition of facts and attitudes.

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Chapter 1

Introduction

Background and Context of Study

Formal schooling has been identified as having a consistent and significant effect on health outcomes such as mortality, fertility, alcohol consumption, smoking, HIV and AIDS and various diseases (Bloom, 2007). Mirowski and Ross (2003) note that education has "an enduring, consistent, and growing effect on health" (pg, 6). Demographers, sociologists, economists, and educational researchers have all studied the relationship between schooling and various health outcomes (Axinn & Barber, 2001; Behrmen & Nevzer, 1997; Boonstra, 1998; Caldwell, 1980; Crum, Helzer, & Anthony, 1993; Deaton & Paxson, 1999; Lleras-Muney, 2005). In regards to the HIV and AIDS pandemic in sub-Saharan Africa (SSA), most public health policy-makers and medical experts agree that formal schooling has played, and continues to play, a significant role in the HIV and AIDS pandemic (Vandermoortele & Delamonica, 2000). But the exact nature of the role of schooling and its future potential as a source for prevention against HIV infection are not well understood (Horton & Das, 2008; Merson, O'Malley, Serwadda, & Apisuk, 2008; Wilson & Halperin, 2008).

For example, early epidemiological analysis indicated that more educated and wealthier individuals in SSA had a higher risk of contracting HIV (Hargreaves et al., 2008; Kirunga & Ntozi, 1997). Recent studies have begun to challenge the assumption that schooling increases an individual's risk of AIDS, however the actual relationship between schooling and HIV and AIDS is still under question (de Walque, 2005; Hargreaves et al., 2008).

Even though research consistently reports associations between formal schooling and health outcomes, investigations have not delved into what it is about schooling that is creating

positive health outcomes (Grossman, 2004). The majority of these studies have credited schooling effects on health outcomes based on human capital, socioeconomic, and psychological theories that focus on specific outcomes of schooling. These theories examine how schooling relates to income, social status, or an individual's ability to delay self-gratification or exhibit self-efficacy in various aspects of adult life, but ignore the actual process of schooling. A major limitation of these past studies is that the majority of these studies have only examined the relationship between schooling and health in developed Western countries, primarily in the US, Europe, or Israel and have not examined the relationship in low income or developing countries (Grossman, 2004).

Schooling is assumed to increase people's cognitive ability in the forms of reasoning, assessing information, and decision-making, but there are very few studies that actually study the connection between schooling and cognition (Alexander, Natriello, & Pallas, 1985; Ceci, 1991; Heyns, 1978; Shavit & Featherman, 1988; Spaeth, 1976; Wiley, 1976). Modern formal schooling can be seen as a massive intervention in the lives of children and adolescents, as formal schooling provides a multi-year daily intervention into the lives of children, adolescents, and increasingly more adults. The schooling process not only transfers information but trains students to think, reason, problem-solve, develop strategies, and assess information. Yet these central functions of schooling have rarely been incorporated into research on schooling and health.

In the HIV and AIDS pandemic, schooling has often been relegated to a venue where interventions can be implemented to increase acquisition of facts and attitudes about the modes of HIV transmission in society (Kelly, 2000). These hypotheses under-theorize the role of schooling by ignoring the actual schooling process that individuals experience and its impact on their cognitive ability to reason, assess information, and make decisions. This study focuses on the HIV and AIDS pandemic in sub-Saharan Africa as these countries have a very different history of educational access than Western more economically wealthier countries. Beginning in the 1950s,

former colonial countries, economically less-developed nations, and multilateral development agencies began seeking ways to improve access to formal schooling in predominately uneducated populations as a means to develop human capital for national economic and social development. The recent access to schooling for many populations in SSA has created vast disparities in educational attainment throughout the region and within countries (UNESCO, 2008). The implications of the rise of schooling throughout the developed world on an individual's cognitive and decision-making skills have been under-represented in the schooling and health outcomes literature.

SSA was chosen for this study as the SSA continent has been the hardest hit by the AIDS pandemic. Nearly two-thirds of all AIDS infected individuals live on the SSA continent (UNAIDS, 2006) and HIV/AIDS is the leading cause of death in sub-Saharan Africa, where the disease is responsible for 25% of all deaths, with one in every seven members of the adult population being infected (Björkman, 2002; Brown, 2004; UNAIDS, 2007). HIV is transmitted primarily through heterosexual sexual intercourse in SSA (UNAIDS, 2007). Several parts of the African continent have been dealing with the disease since the 1970s, however national and medical acknowledgement of the disease's existence has been slow in numerous countries allowing the disease to spread rapidly during the 1980s and 1990s.

SSA has also been experiencing massive expansions in educational access since the 1950s, although countries are still struggling at ensuring primary access to all school-age youth (UNESCO, 2007). As countries began to gain political independence from former European colonial countries, SSA governments began to invest heavily in education. The educational expansion was not equally distributed creating a wide diversity in educational attainment in the adult population (UNESCO, 2007). Unlike educational disparities in western countries that relate to both family and school level variables, most historical educational disparities have been

associated with limited access based on residence, gender bias for males, and poverty rather than an inability to perform in a schooling environment (UNESCO, 2007).

The Demographic Health Surveys (DHS) employed in this study were administered in SSA between 2003 and 2005. The DHS data enable analysis of HIV infection across education groups, and statistically model the impact of schooling on both HIV infection and engagement in sexual behavior in several SSA countries. The spread of AIDS on the SSA continent is not evenly distributed, and each region has a distinct history and reaction to the AIDS pandemic. The representation of different sections of the African continent provide opportunity to explore the "historical development" of the schooling and HIV relationship in countries with different AIDS prevalence rates, different government responses, and different durations of the disease being present in the country. Past epidemiological research has shown that early in the pandemic, education was a risk factor for contracting HIV and AIDS. Recent DHS data enables a multi-nation examination of whether schooling continues to act as a risk factor of HIV infection, or if as more information has become available about the disease, whether schooling has become a protective factor against HIV infection.

Guiding Research Questions

This dissertation extends past research on schooling and health by examining the relationship between schooling and HIV and AIDS in SSA. Using secondary nationally representative data in connection with individual level data collected in Ghana I examine the relationship between schooling and HIV and AIDS among a population with vast disparities in educational attainment. The dissertation is organized around three driving research questions informed from the schooling and health and decision-making literatures. The over-arching

research question in this study is what is the relationship of schooling and HIV and AIDS in SSA? This question has been conceptualized around three inter-related questions:

1. What is the relationship between formal schooling and HIV infection in sub-Saharan Africa?
2. What is the relationship between formal schooling and engagement in sexual behavior and how is this relationship moderated by the acquisition of facts and attitudes about HIV?
3. What is the relationship between an individual's schooling, decision-making, and engagement in sexual behavior?

Chapter Overviews

Chapters 2 provides an overview of the historical relationship between schooling and HIV and AIDS in SSA. In this chapter I discuss not only the relationship between schooling and HIV infection, but how schooling has been framed as a tool in a nation's response to the HIV pandemic. Chapter 3 presents the conceptual framework for this dissertation by bridging the health and education literatures with a branch of decision-making. Past studies that have examined the relationship between schooling and health have ignored the cognitive impact of schooling and as such have under-estimated schooling's effect on health. This dissertation brings a new perspective to the existing literature that examines the relationship between schooling and health by examining schoolings impact on an individual's cognitive and decision-making skills.

Chapter 4 presents the data used in this dissertation. To examine the relationship between schooling and HIV and AIDS in SSA I use two sets of data, Demographic Health Surveys and individual survey data from Ghana. In this chapter the methods, variables, and data limitations are discussed.

To better understand the role of schooling in the HIV and AIDS pandemic, I developed three empirical studies and present the findings in Chapters 5 through 7. First, the relationship between formal schooling and HIV and AIDS infection is estimated using large-scale survey data collected between 2003 and 2005 in 11 SSA countries and is presented in Chapter 5. Early in the HIV pandemic schooling was identified as increasing a person's risk of HIV infection, and that class, economic resources, and mobility that schooling provided helped to fuel the spread of the disease (Kirunga & Ntozi, 1997). However, as the epidemic matured and more information became available, infections appeared to shift down towards the less educated population within certain SSA countries (de Walque, 2004; Glyn et al., 2004). There is no clear explanation of why increasing a person's schooling with or without the inclusion of an HIV intervention would impact a person's changing level of risk to HIV.

Second, using the DHS data, the relationship between formal schooling and engagement in sexual behaviors that are associated with HIV infection is estimated for youths and out of school adults. This second study is presented in Chapter 6 and models the relationship between schooling and sexual behavior and modeling the moderating effects of acquisition of facts and attitudes predominately targeted in HIV curricula. In this chapter I examine actual influence of schooling on out of school adult populations' engagement in sexual behaviors to identify whether schooling has an independent effect on behavior or whether schooling only has an indirect effect on an individual's health via the acquisition of basic facts and more positive attitudes. To better understand the relationship between schooling and HIV and AIDS in the out of school population, I examine how schooling impacts engagement in both protective and risky sexual behaviors. Examining schooling's effect on engagement in risky and protective sexual behaviors allows a better understanding of the role that schooling plays in exposing or protecting a person to HIV infection. The DHS data allows the parceling out of schooling effects while controlling for

an individual's knowledge and beliefs that are believed to significantly impact an individual's behavior.

The third study tests if schooling influences an individual's ability to reason, problem solve, and make decisions using a sample of unschooled and schooled adults. This individual level data analysis is presented in Chapter 7 to examine how schooling effects could lead to improved health outcomes related to HIV and AIDS in the region. Numerous studies that report on the relationship between schooling and health have called for an increased understanding of how schooling impacts thinking, reasoning, and problem solving and how these in turn impact health (Lleras-Muney, 2005; Phelan et. al., 2004; Ross & Wu, 1995). Over the last several decades decision-making has been the focus of a considerable amount of research, however, these studies typically use educational attainment as a control and do not directly examine the role of schooling on decision-making (Kim et al., 2001). Much of the decision-making research has been collected through testing the American undergraduate which holds schooling relatively constant (Peters et al., 2006). Using the Ghana data, I examine the relationship between schooling and decision-making while including a person's cognitive skills to test how cognitive effects of schooling moderate the relationship.

The concluding chapter in this dissertation discusses the theoretical and policy implications of the findings presented in Chapters 5 though 7. Chapter 8 contextualizes the findings of this dissertation and indicates extensions to this study. The implications of the role of schooling in the HIV and AIDS pandemic are discussed and policy recommendations are provided to increase access to the protective nature of schooling in SSA.

What is particularly unique about this study is the extension of the second and third research questions to empirically assess the role of schooling in the HIV and AIDS pandemic. The empirical study presented in Chapter 6 analyzes my second research question by examining the two most commonly held assumptions about the means by which schooling impacts behavior:

primarily the acquisition of facts and positive attitudes. My findings indicate that these past theories do not adequately reflect the actual effect of schooling on engagement in sexual behavior. The perpetual utilization of information-transmission and attitude change theories that try to explain the role of schooling in the fight against HIV and AIDS lack the ability to explain the independent direct effect of schooling on behavior.

The third empirical study, described in Chapter 7, presents the results of analyses that examine how individuals with the same information and attitudes, but different levels of schooling, make decisions about engaging in sexual behavior. I use a sample with significant variation in educational attainment ranging from completely unschooled to tertiary completers. These analyses extend past studies by examining how cognitive skills via reasoning and decision-making moderate the relationship between schooling and health outcomes. Drawing on hypotheses that posit schooling's ability to enhance cognitive ability (Blair, Gamson, Thorne, & Baker, 2005), Chapter 7 tests how attending school impacts reasoning and decision-making skills that in turn can be used to inform debates on the role of schooling at the societal level to improve health outcomes.

Chapter 2

Education and HIV and AIDS in sub-Saharan Africa: Re-examining the Association

The HIV and AIDS pandemic has severely impacted the development of several countries in the sub-Saharan African (SSA) continent. The disease has reduced the economic and human capital stock in the region's countries, lowered life expectancy and exacerbated poverty among the region's 788 million people (Haub, Skolnick, & Jacobson, 2007). In 2005, approximately two-thirds of all AIDS infected individuals lived on the SSA continent, with an estimated one in seven adults infected with HIV. As a result of high HIV infection rates, HIV has been the leading cause of mortality in the region, accounting for a quarter of all deaths (Björkman, 2002; Brown, 2004; Lamptey, Johnson, & Khan, 2006; UNAIDS, 2007; UNDP, 2002). Individuals, families, communities, and even whole nations have had to deal with increased social, political, and economic instability. The pandemic has not been felt across the region equally. The eastern and southern regions of the continent have reported significantly higher HIV prevalence rates than the western part of the continent.

Historical Progression of HIV in sub-Saharan Africa

On the African continent, AIDS is believed to have originated in the Great Lakes region in the mid 1970s and spread via main transportation routes. Although news of the disease first burst onto the world's media in the early 1980s as a mysterious ailment among American homosexual males, in SSA it was, and still is, predominantly spread through heterosexual contact to both males and females, as well as to infants in-utero (UNAIDS, 2007). It is believed that the disease spread outward from the Great Lakes region following transportation routes (Karim &

Karim, 2002), a silent killer whose magnitude was not readily identified until 1987. Most individuals who died from AIDS were diagnosed as dying from opportunistic infections such as tuberculosis that took advantage of the victim's weakened immune system. In the region, infected individuals were said to have "slim disease," as undiagnosed victims were wasting away, dying from opportunistic infections, so that the actual death toll from AIDS is unknown.

The first AIDS case in South Africa was reported in 1982 (Karim & Karim, 2002) and in March 1983 five individuals from Central Africa were diagnosed with HIV (Sepkowitz, 2001). Although the disease was officially diagnosed in the US in1981, the structure of HIV and how it affected the body was only slowly being understood within the medical community between 1984 and 1986 (Sepkowitz, 2001) and accurate knowledge about the viral transmission of HIV did not emerge until between 1985 and 1987 (Grmek, Maulitz, & Duffin, 1990). Even though the first heterosexual cases of HIV infection were reported as early as 1982 in the US, the medical community, media, and governments continued to focus on homosexual transmission during the late 1980s and early 1990s. Even as the medical community was beginning to understand the epidemiological nature of the disease, rumors and media interpretations began to circulate in 1986 and 1987 in SSA that AIDS was a genetically created disease by the Americans being transmitted via injections as a means of biological warfare (Girard, 1987; Revel 1987 in Grmek, Maulitz, & Duffin, 1990). The relentless focus in the West on homosexual transmission and rumors and distortions in the SSA region discounted the notion of heterosexual transmission of the disease. It was not until 1987, that the medical community came to a more complete understanding of the extent and nature of the disease and its transmission in Africa. At which time, the definition of AIDS was expanded to include the symptoms and characteristics of the East African "slim disease" and a year later approximately 40% of Ugandan hospital patients were being diagnosed as HIV seropositive (Bond & Vincent, 1997; Caputo, 1988).

Spread of HIV in SSA

HIV infection spread throughout the region during the 1980s virtually undetected. Figure 1 presents the HIV infection rate averaged for 40 SSA countries between 1980 and 2005. As depicted in Figure 2-1, HIV infection on the continent remained extremely low and unreported until the late 1980s and early 1990s. Once HIV was acknowledged by the medical community to be an issue in SSA, we see that reporting of infection rates begin to dramatically increase until about 2003.

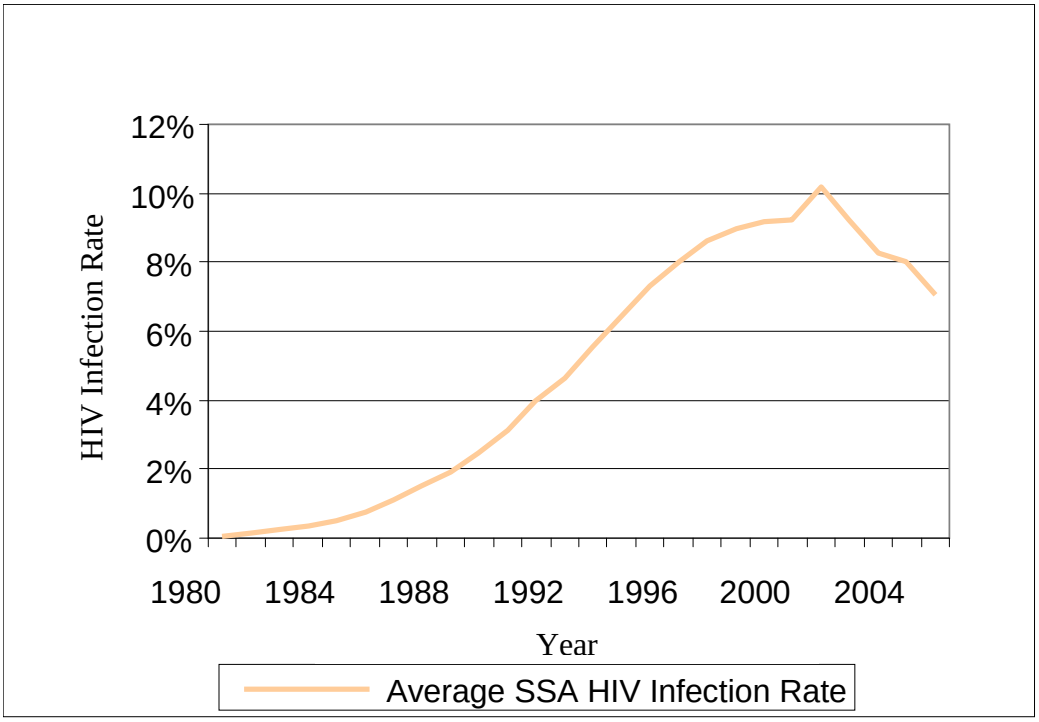

Figure **2-1:** HIV and AIDS Infection Rate for SSA from 1980 to 2005.
Source: Compiled by author from data from Joint United Nations Program on HIV/AIDS (UNAIDS) & the World Health Organization (WHO).

However, as shown in Figure 2-2, during the 1980s, HIV most severely affected the Eastern African region and it was not until the 1990s that the pandemic escalated in the South and Central African regions reporting higher infection rates than the Eastern region by 2001. The

Western African region has had significantly lower infection rates than the other regions of the continent even though HIV infections were identified as early as 1985 in western Africa (Beck et al., 2006; Simms, Salif Sow, & Sy, 2006). A caveat should be included with these figures as the absolute level of HIV infection in the different SSA regions during the 1980s and into the early 1990s is certainly underestimated because of a lack of awareness, testing, and appreciation of unprotected heterosexual activity as a risk factor. The lack of acknowledgement of the disease in many parts of SSA allowed the spread of the disease to go unidentified in many areas, so that once testing became more prevalent, countries saw significant increases in new infections, dramatically increasing the reported infection rates (Rushing, 1995).

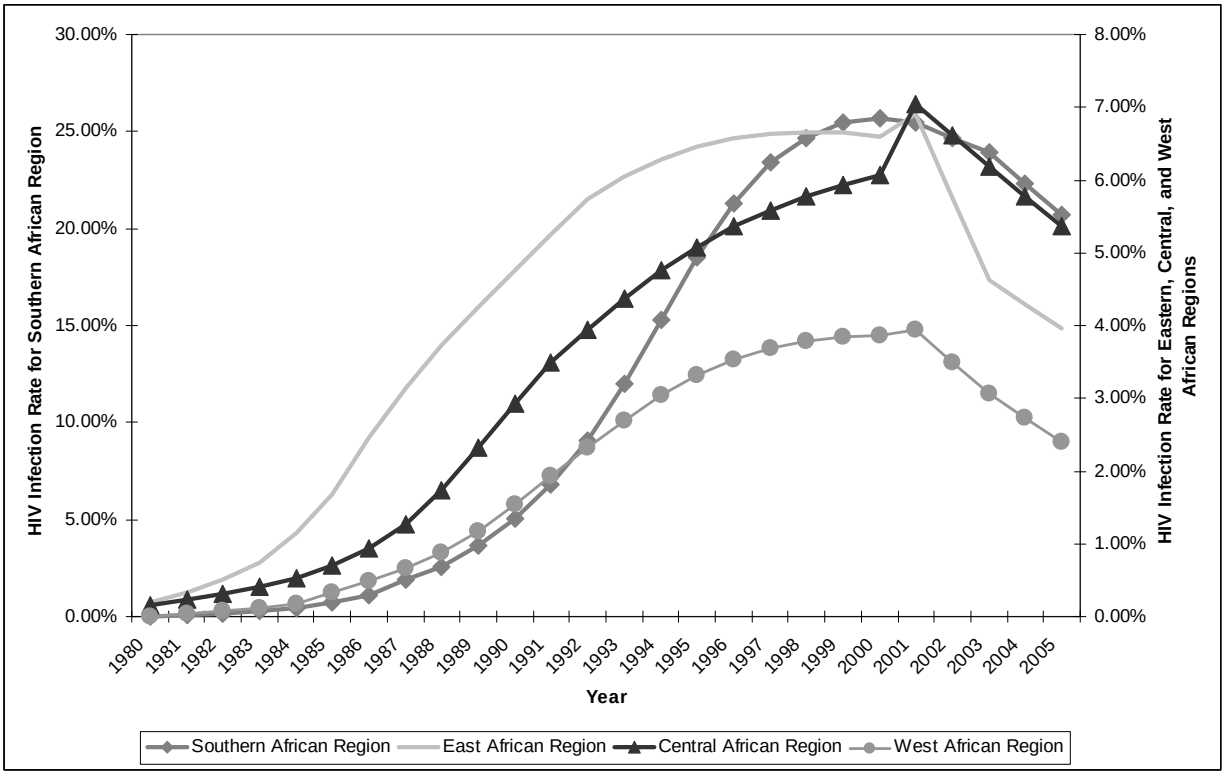

Figure **2-2**: HIV and AIDS Infection Rates by SSA Region between 1980 and 2005.

Source: Compiled by author from data from Joint United Nations Program on HIV/AIDS (UNAIDS) & the World Health Organization (WHO).

The spread of HIV in SSA has been the result of a convergence of numerous factors. Issues of poverty, illiteracy, cultural practices of wife-inheritance, transactional sex, high incidence of sexually transmitted infections (STIs), cultural preferences for dry sex and general dislike for condoms among male populations being but a few (Nyindo, 2005). Although there is no single event or issue that can account for the rapid spread of HIV in SSA, observers of early victims in SSA noted that the disease appeared unusually frequently among the wealthy and more educated (Hargreaves & Glynn, 2002). Early epidemiological studies of the HIV and AIDS pandemic found a strong positive correlation between education and HIV infection rates indicating that more educated individuals had a higher likelihood of being infected than their lesser educated peers (Kirunga & Ntozi, 1997; Smith et. al., 1999).

The positive association between educational attainment and HIV infection in SSA was a surprising and unexpected finding that often emerged as a secondary finding of research examining other HIV related issues (Hargreaves et al., 2008; Mmbaga et al., 2007). Theories explaining the relationship between education and health outcomes typically report education as a protective factor against disease and the unexpected finding of education as a risk factor for HIV infection in SSA challenges prior assumptions of these theories. The remaining sections of this chapter will examine the prominent theories that have been developed to explain the relationship between education and health, a historical description of the relationship between education and HIV infection in SSA, and the proposed role of education in HIV prevention.

Relationship between Schooling and HIV and AIDS in SSA

Early in the HIV pandemic in SSA, there was generally no acknowledgement of the disease existing in most African nations (Rushing, 1985). Cases of HIV in SSA have been reported as early as the late 1970s and early 1980s but most of these cases were not public

knowledge. The denial of the disease within countries by governments and the emphasis on homosexual transmission provided very little information or sense of susceptibility to the general public (Baker, Collins, Leon, 2009). Educated heterosexual men in SSA were on average more sexually active with multiple sexual partners then their less educated peers (Caraël, 1995). Formal schooling has been correlated with greater wealth in the region (Mishra et al., 2007; Mmbaga et al., 2007). Regardless of the economic development of the country in SSA, education, even in relatively modest amounts, affords males higher status with greater disposable income, mobility, leisure time, access to more sexual partners including commercial sex workers, and exposure to sexually transmitted diseases that facilitate contraction of HIV (Ainsworth & Semali, 1998; Kirunga & Ntozi, 1997; Mishra et al., 2007; Mmbaga et al., 2007; Shelton, Cassell, & Adetunji, 2005; Wojciki, 2005). Mobility and financial resources increased male risky behavior and also spread infection to both educated and uneducated women (Berkley et al., 1989; Dallabetta et al., 1993; Filmer, 1998; Grosskurth et al., 1995; Hargreaves & Glynn, 2002; Kirunga & Ntozi, 1997; Michelo, Sandøy, & Fylkesnes, 2006; Quigley et al., 1997). In study after study this pattern was so frequently reported that it is widely accepted that the spread of HIV into rural sub-Saharan Africa in the early 1980s and 1990s was fueled by infected wealthy, highly educated, and mobile men (Barnett & Blaikie, 1992; Rushing, 1995).

Cultural gender norms that support transactional sexual relationships reflect the relationship between a man's financial resources and an increased number of sexual partners. Transactional sex is the widespread practice of an exchange relationship, in which men and women exchange material goods and sex. Researchers have documented that most sexual relationships in many regions of sub-Saharan Africa have a transactional element, from short- and long-term relationships, non- and extra-marital partnerships, to marriage (Caldwell, Caldwell, & Quiggin, 1989; Hunter 2002; Swidler & Watkins, 2007). Reasons for engaging in transactional relationships range from poor women trying to provide food and basic necessities for their

families to highly educated women who desire more luxury goods and items. Unlike prostitution where there is an agreed upon fee for sex between the woman and male client, transactional relationships are based on gifts (Swidler & Watkins, 2007). These gifts are determined by the male and can range from buying a girl bus fare, a soda, or paying entrance to a club, to large and expensive gifts of jewelry, cell phones, or clothing (Kaufman & Stravou, 2004). Gifts are seen as expressions of love by males and represent an expression of value towards a partner or girlfriend. There is no agreed upon price of the gift that is required for sex, and the gifts can precede or be given after the sexual relationship (Swidler & Watkins, 2007).

These sexual exchange relationships are based on an economic system that represents male access to financial resources and female's historic inability to access financial resources except through males. Swidler and Watkins (2007) note that in rural Malawi, similar to other SSA contexts, a man's financial standing is directly related to his sexual access to women and failure by a man to provide financial support justifies infidelity by his partner. Also, a woman in need of financial support is justified in seeking either a husband or sexual partner to meet her financial needs. This transactional partnership creates a patron-client relationship based on sex in exchange for financial support (Swidler & Watkins, 2007). This patron-client relationship where there is an exchange of sex for money and gifts reflects social and cultural norms of women being dependent on males for financial support, and men needing women to serve as outward displays of power, prestige and social dominance (Swidler & Watkins, 2007).

A patron-client sexual relationship reflects unequal power relationships within transactional sexual relationships where women must transfer their power and control over their sexual and reproduction rights to males in order to provide for herself and her family. Studies in South Africa have reported that many sexual relationships had some form of exchange basis with material gain via gifts and sex as a currency for exchange. Transactional sexual relationships were seen particularly with older men, but also within adolescent sexual relationships, which

limit women's ability to negotiate for condom use (Jewkes, Vundule, Maforah, & Jordaan, 2001; Kaufman & Stavrou, 2004).

One example of transactional sex can be seen in the practice of bride-price or bride-wealth found throughout SSA. The bride-price is a material transaction of money, jewelry, livestock, or other goods paid by the prospective groom to the prospective bride's family as a symbol of his ability to care for the daughter and repay the family for the cost and effort of raising her (Gray, 1960; DeRose, Dodoo, & Patil, 2002). The payment transfers fertility and lineage rights to the husband and his family and sexual access to the wife (Gray, 1960). Men who have paid higher bride-prices are often less tolerant of their wives' preferences about their own fertility or sexual wishes (DeRose, Dodoo, & Patil, 2002; Isiugo-Abanihe, 1994; 1995). The issue of transferring sexual rights away from a woman to a male in exchange for money or gifts directly relates to how much control women, whether in a marriage or partner relationship, can exert in engaging in protective sexual behavior or avoiding risky sexual behaviors.

It is assumed that these cultural gender norms around sexuality are partly responsible for early studies that indicated that education was a risk factor for HIV (Mmbaga et al., 2007). As HIV spread and the rate of infection began to be examined in SSA, studies reported that education was a risk factor for HIV infection in several populations throughout SSA (Dallabetta et al., 1993; Fylkesnes et al., 1997; Grosskurth et al., 1995; Hargreaves et al, 2008; Hargreaves & Glynn, 2002; Smith et al., 2007; Taha et al, 1998). A literature review on the relationship between education and HIV infection by Hargreaves and Glynn (2001) found that education was a risk factor in SSA while a protective factor in other regions of the world. Studies conducted during the early 1990s repeatedly found that the more educated had much higher odds of HIV infection than their less educated peers (Crampin et al., 2003; de Walque, 2005; Hargreaves & Glynn, 2002) and that more educated men spread infection not only to their more educated partners but started infection throughout rural regions (Glynn et al., 2001; Crampin et al., 2003). For example,

antenatal clinics by 1999-2000 in Uganda began to report a shift in new HIV infection rates from highly educated to uneducated females (de Walque, Nakiyingi-Miiro, Busingye, & Whitworth, 2005). More recent antenatal and voluntary counseling and testing centers in Zambia and Ethiopia have also seen a shift in new HIV infection moving from the higher educated to the lower educated (Bradley et al., 2007; Michelo, Sandøy, & Fylkesnes, 2006). However, even within these countries, studies are continuing to provide mixed findings about the role of education as either a risk or protective factor. In Ethiopia, Fontenat et al., (2000) found education to be a protective factor for sugar estate residents while Abebe et. al. (2003) found education to be a risk factor for Ethiopian army recruits.

Education everywhere affords higher status and greater income on average, yet as documented in the theories outlining the relationship between education and health in the next chapter, schooling rarely plays a risk factor in health. In the 1980s and early 1990s within the brewing pandemic two additional factors specific to SSA caused education to become a risk factor. Unlike other regions of the world, HIV/AIDS infection in SSA spread rapidly during the 1980s before public health information was available to the public. Second, many governments denied the existence of the disease in their countries and did not provide the needed resources or services to address the pandemic (Ainsworth & Teokul, 2000; Hargreaves & Glynn, 2002). South Africa did not develop a strategy to address HIV until the African National Congress took office in 1994, but by 1998, the South African government response was classified as a “neat book on the shelf” that was not actually addressing the AIDS pandemic in the country (Schneider & Stein, 2000, pg 724). The Kenyan and Zimbabwe governments up until about 2000 were seen as being in a state of denial about the AIDS pandemic in their countries, while the Botswana, Nigerian, Namibian, and Malawi governments only began to acknowledge the existence of AIDS in their countries after 1995 (Gow, 2002).

These factors meant that information, a key component to developing an everyday theory of a health problem, was not readily available to many people in SSA until the early 1990s and even later in some countries. As discussed below, a major way in which education acts as a social vaccine is through schooling's enhancement of individuals' capacity to use accurate information to reason and form working theories that in turn help to mitigate risky behavior. Along with the disease's long incubation period that reduced people's ability to informally learn of the causes of infection, limited access to medical information, some spread of misinformation, and lack of public validation of accurate information severely retarded the usual impact of education as a social vaccine (Gregson, Waddell, & Chandiwana, 2001; Mmbaga et al., 2007). Instead, associations reflected the indirect effect of education acting through status and resources that often increased risky sexual behavior (Caraël, 1995; Rushing, 1995).

Studies conducted during the second half of the 1990s and early 2000s started to find a changing relationship between education and HIV infection (Hargreaves et al., 2008). As more information became available about the modes of transmission, non-governmental organizations, governments, and international organizations implemented informational campaigns targeting the general populations. These interventions varied in scope and national political support depending on the country. However, studies reported that as countries have passed through stages of increased HIV infection and awareness of HIV, interventions and information dissemination has been seen as an integral component of HIV prevention.

Education as Intervention

One of the driving mechanisms of education in promoting health is believed to be the ability to disseminate information to a large segment of the population in a cost-effective manner (Mirosky & Ross, 2003). As accurate information became available about the modes of

transmission of HIV, governments and non-governmental organizations (NGOs) in the region developed mass information campaigns and quasi-educational HIV interventions for adults and school-aged youth to transmit this information to both in-school and out-of school adolescent and adult populations (Hargreaves & Boler, 2006). There are over 40,000 international non-government organizations (INGOs), and several million local, national, and grassroots groups that attempt to provide interventions to address social problems such as poverty, drug and alcohol abuse, HIV infections, education and literacy, culture, and so forth, often among unschooled or under-schooled people (Anheir, Glasius, & Kaldor, 2004; Lloyd, 2005). These interventions have followed a three-tiered model that targets: a) increasing individual's factual knowledge about the modes of transmission and means of preventing the spread of HIV; b) correct attitudes and beliefs about the rights, caring for, and interacting with people living with HIV and AIDS; and c) changing sexual behaviors by reducing risky sexual behavior and increasing protective sexual behavior.

HIV interventions directly target specific sexual behaviors that are related to reducing a person's risk of HIV infection. The mantra of HIV curricula have focused on, stressing Abstinence (A), once sexually active Be faithful (B) to one partner, and if you are not going to be faithful but have multiple sexual partners, then use a Condom (C) or the ABC's of HIV. The health intervention literature has documented how accurate information and attitudes and beliefs are directly related to behavior and must be targeted in any behavior change intervention (Ross & Rosser, 1989). Although schooling was linked early to the spread of the disease, education has been identified as a major tool in HIV prevention plans.

Objectives and Research Questions

The HIV and AIDS pandemic in SSA, provides an important case study to examine the relationship between education and health as it has not followed the traditional association between higher educational attainment and lower risk. The fact that the disease has only been medically diagnosed for just over 25 years, allows analysis of adults with varying levels of education to see if there are educational differences in decision-making and sexual behavior change. To understand and bring to light the differences that emerge from different levels of schooling, this dissertation is organized based on the following research questions.

Research Questions

1. What is the relationship between formal education and HIV status in sub-Saharan Africa?
    a. *Education has a positive relationship with HIV infection in sub-Saharan Africa.*
2. What is the relationship between formal education and sexual behavior?
    a. *Education has a negative relationship with risky sexual behavior in sub-Saharan Africa.*
3. What is the relationship between formal education, decision-making, and behavior?
    a. *Education impacts person's cognition decision-making ability via working memory and reasoning.*

To address the first research question, this study analyzes multinational comparative analyses of Demographic Health Surveys (DHS) that were administered in SSA between 2002 and 2004. Using the nationally representative samples of adults cross-nationally in SSA from the DHS, it is possible to examine both the prevalence of HIV infection rates (subjects were tested for HIV infection) across education groups, and statistically model the impact of education on

HIV infection and sexual behavior in 11 SSA countries. The 11 countries included in the study represent West Africa, East Africa, Central Africa, and Southern Africa. The spread of AIDS on the SSA continent is not evenly distributed, and each region has a distinct history and reaction to the AIDS pandemic. The representation of different sections of the African continent provide opportunity to explore the "historical development" of the schooling and HIV relationship in countries with different AIDS prevalence rates, different government responses, and different durations of the disease being present in the country. Recent epidemiological research has started to show education moving from a risk factor to a protective factor in parts of SSA. This question will be addressed in Chapter 5 of the dissertation as a multinational analysis using DHS data provides the opportunity to examine whether education continues to act as a risk factor for HIV infection, or if as more information has become available about the disease, whether education has become a protective factor against HIV infection.

To examine the first research question, and to empirically test the assumption stated in the literature that education was a risk factor for HIV and AIDS, Hypothesis 1 was developed. As noted, early in the epidemic it was determined that education was positively related to HIV infection, and that class, economic resources, and mobility that education provided helped to fuel the spread of the disease (Kirunga & Ntozi, 1997). However, as the epidemic matured and more information became available, infections appeared to shift down towards the less educated population within certain countries and sub-populations (de Walque, 2004; Glyn et al., 2004). There is no clear explanation of why increasing a person's education with or without the inclusion of an HIV intervention would impact a persons' changing level of risk to HIV. This leads to questioning the actual influence of education on adult out of school populations. Is there an actual "education effect" or does education only have an indirect effect on an individuals' health via knowledge. The question whether education is a risk factor or protective factor in a person's risk of contracting HIV needs to be evaluated.

If education is a protective factor, then are there educational differences in protective and risky behaviors as more information becomes available? The moderating role of information in the relationship between schooling and sexual behavior is the second research question examined in this dissertation and is presented in Chapter 6. Does education impact the amount a person engages in risky behavior, adopts protective behaviors, or an interaction of both risky and protective behaviors? The DHS data provides data on individuals schooling and sexual behaviors. As HIV is most often obtained in SSA by heterosexual sexual intercourse, examining education's relationship on risky and protective sexual behaviors allows a better understanding of the role education plays in exposing or protecting a person from contracting HIV. In an effort to understand the effect of education on sexual behavior, DHS data on individuals' knowledge and attitudes allows the parceling out of schooling effects while controlling for an individual's facts and attitudes that are believed to significantly impact an individual's behavior.

Recent descriptive analyses of DHS datasets and studies examining HIV infection have identified schooling differences in knowledge, attitudes and sexual behaviors related to abstinence, being faithful to one partner, and condom use for individuals with multiple partners. Through this dissertation I test whether these differences are significantly related and if so, then what aspects of schooling drive these differences? If the education as intervention hypothesis is accurate, then controlling for the amount of facts and attitudes that a person has should create a null effect of schooling on participation in the three sexual behaviors of abstinence, being faithful and condom usage for individuals with multiple sexual partners. As knowledge and attitudes are believed to impact behavior and most educational interventions are geared towards changing an individual's knowledge and attitudes about HIV these variables will be included as mediating factors in the relationship between education and behavior. As schooling differences remain, Chapter 7 will examine the relationship between schooling and cognition and decision-making as a potential explanation for these schooling differences.

The third research question examines how schooling impacts an individual's ability to reason, assess consequences, develop strategies, and assess risk. In this chapter I present the findings of how reasoning, planning, and the ability to retain information (cognition) relate to decision-making and a person's behavior. This question is not examined with the DHS data, but with data I collected using a quasi-naturally occurring experiment of schooled and unschooled adults in four rural communities in Ghana on reasoning, and decision-making tasks during the summer of 2007. This section of the study incorporates measures and constructs that examine a person's cognition. In this study cognition is measured by two tasks: 1) the ability to maintain information in his/her head and recall that information for later use (working memory), and 2) the ability to assess a situation, plan and develop a strategy and carry out a task to its successful completion (reasoning). This section of the study unpacks education's influence on a person's cognition, and how cognition impacts decision-making and behavior. This section will present the results of interviews with 190 individuals living in rural Ghana. Respondents completed several cognitive and decision-making tasks around HIV as well as responding to surveys and questionnaires measuring their knowledge and attitudes about HIV in addition to some risky and protective behaviors. This section will focus mostly on how education and cognition relate to decision-making, and how this relationship can account for part of the explained education and health relationship.

This dissertation is a response to the numerous studies that report on the relationship between education and health and that have called for an increased understanding of how education impacts thinking, reasoning, and problem solving and how these in turn impact health (e.g. Ross & Wu, 1995; Phelan et. al., 2004; Lleras-Muney, 2005). Over the last several decades decision-making has been the focus of a considerable amount of research however there are few studies focusing on individual differences in decision-making. Rather, research focuses on explaining how and why most humans consistently make certain kinds of errors as they reason

and make decisions (Tversky & Kahneman, 1981; Gigerenzer & Goldstein, 1996; Reyna, 2004; Reyna, Lloyd, & Brainerd, 2003). The majority of these studies have focused heavily on the college undergraduate and have not examined education's influence on decision-making. Using the Ghana study, the relationship between educational attainment and a persons reasoning and working memory (cognition) can be examined. In these communities it is possible to draw a representative sample of normally developed adults from each community from a continuum ranging from unschooled and illiterate through marginally schooled to the completion of university education. In these communities it is possible to examine the relationship between cognition and decision-making among normally developed unschooled adults living in the same villages and doing the same type of farming as schooled adults all with the same cultural-linguistic background and having similar SES characteristics. This studies moves past previous research by directly examining the relationships between schooling, decision-making, and health in a non-Western setting, with a heterogeneous schooled population.

Chapter 3

Conceptual Framework

Education is widely acknowledged as a significant predictor of health and for HIV, education is seen as a social vaccine (Kelly, 2000; World Bank, 2003). As mentioned in Chapter 2, earlier epidemiological evidence showed a contrary positive relationship between education attainment and HIV infection in SSA. More recent evidence that this dissertation supports, demonstrates that among younger cohorts, education now operates as an important social vaccine against HIV/AIDS infection. Clearly, despite the seeming importance of education, we do not have a firm grasp of how education works, and what are the mechanisms underlying education as

a social vaccine in general, and specifically against heterosexual HIV transmission. Related to this, the intervention strategy of many NGOs working to combat HIV and AIDS in Africa is based on educational curricula developed with little understanding of the underlying factors between schooling and health.

This dissertation adapts a framework developed by Baker, Blair, Gamson, and Thorne, identified as the *Schooling-Decision-making Model* to examine how schooling relates to cognition and cognition relates to sexual behavior and decision-making (Baker, Collins, and Leon, 2009). This model is applied to the HIV pandemic and tests whether schooling develops cognitive and numeracy ability that in turn enhance decision-making and risk assessment skills that influence heterosexual risky behavior, use of preventative strategies, and reduce HIV infection in sub-Saharan Africa (SSA).

In SSA, where national HIV prevalence rates are among the highest in the world, most infections arise from high-risk heterosexual behaviors, including early sexual debut, lack of condom use, and multiple and high-risk partners. Although a substantial literature on health (described later in this chapter) consistently reports that years of formal education is negatively related with disease and unhealthy risk-taking, early in the HIV pandemic in SSA education was associated with risky behavior such as multiple partners and greater participation in transactional sex leading to the unusual classification of education as a risk factor. Even though there is overwhelming evidence of schooling's association with disease and health, to date there is not an understanding of the underlying mechanisms that make education a social vaccine in general or in heterosexual HIV transmission in particular.

Schooling-Decision-making Model

Existing hypotheses that examine the relationship between education and health under-theorize the role of education by ignoring the actual schooling process that individuals experience and its impact on their cognitive ability to reason, assess information, and make decisions. Education is assumed to increase people's cognitive ability in the forms of reasoning, assessing information, and decision-making, but there are very few studies that actually study the connection between schooling, cognition, decision-making and health outcomes. Modern formal education can be seen as a massive intervention as formal schooling provides a multi-year daily intervention into the lives of children, adolescents, and increasingly adults. The schooling process not only transfers information but trains students to think, reason, problem-solve, develop strategies, and assess information. Yet these central functions of schooling have rarely been incorporated into research on education and health.

Understanding the relationship between education and health outcomes is one of the main objectives of this dissertation and focuses on understanding what schooling uniquely does to influence risk taking and preventative strategies in the context of heterosexual spread of HIV. There has been speculation that the education effect on health outcomes is because schooling "teaches one to think" (Ross & Wu, 1995; Phelan et. al., 2004; Lleras-Muney, 2005). But the kind of "thinking" is normally unspecified, and the actual cognitive effect of schooling on thinking is only assumed to exist.

The Schooling-Decision-making model is based on three assumptions: 1) over the course of teaching academic material such as mathematics and reading, even in small amounts, schooling enhances basic cognitive abilities and basic numeracy; 2) these school-enhanced cognitive capacities influence reasoning about heterosexual risk assessment and decision-making skills; and, 3) better risk assessment and decision skills lead more schooled individuals to avoid

risky heterosexual behavior and use of preventative strategies that ultimately lower likelihood of HIV infection within the context of HIV and AIDS in SSA.

Early research starting in the 1930s, comparing normally-developed schooled and unschooled adults, supports the first part of the basic argument behind the hypothesized model that within a genetically determined range of capability schooling can significantly enhance cognitive skills (Ceci 1991; Cole 2003, Luria 1976). Although these earlier studies could not control for major sources of endogeneity, I have attempted to control for two types of endogeneity in this study: 1) ensuring that schooled and unschooled adults do not differ in cultural or linguistic backgrounds and; 2) controlling for the possibility of the effects of more complex post-school jobs and lives.

As to the second part of the model about the influence of school-enhanced cognition and numeracy on decision-making and risk assessment, there has been promising past research on the relationship of cognition and decision-making (Dougherty, Gronlund, & Gettys, 2003; Reyna, Lloyd, & Brainerd, 2003; Stanovich, 1999), but little attention has been spent on these processes as abilities that can be enhanced through schooling and that can improve decision-making in turn. Numeracy, a cognitive competency that also can be schooled and may be critical to good decisions, has received more empirical attention, but most of this prior research has been on samples of American undergraduates with little variation in education (Peters, et al, 2006).

The third part of the model concerning a link between better risk-assessment and decision-making skills with better decisions has had some support in past literature. Bruine de Bruin and her colleagues (2007) found that individuals in the U.S. who were less susceptible to heuristics and biases demonstrate better decision-making skills, and experience fewer negative outcomes from decisions such as bouncing a check or being in a jail cell overnight.

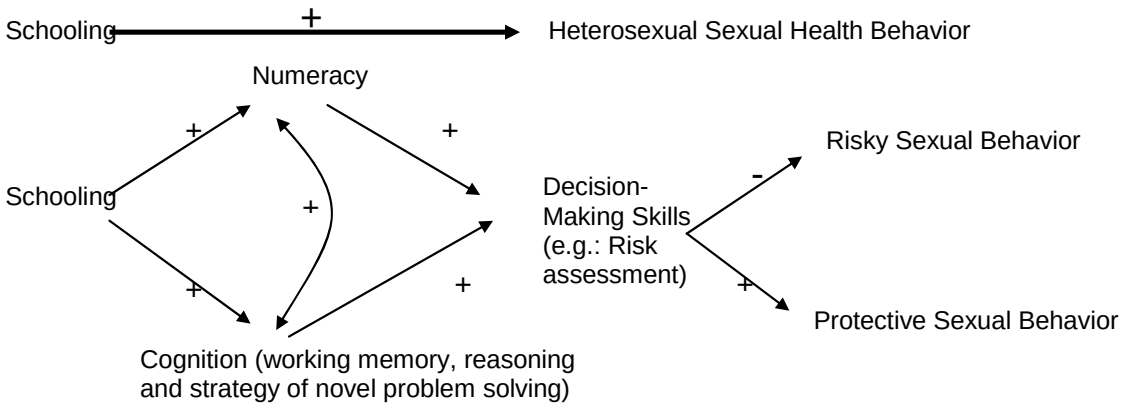

Figure **3-1:** The Schooling and Decision-making Model of the Education Effect on Heterosexual Risk-Taking and Prevention Strategies Related to HIV Serostatus.

The Schooling and decision-making model is proposed as an extension of past research that has examined the relationship between education and health. This model attempts to examine the direct effects of schooling on an individual's cognition and decision-making ability. Consequently most public health policy-makers and medical experts agree that formal education has played, and continues to play, a significant role in the HIV and AIDS pandemic. But the exact nature of this role, how it has developed over the course of the pandemic, and its future potential as a source for prevention have been under-researched (Mmbaga et al., 2007). This research tests one underlying pathway between education and health via cognition and decision-making that has been predominately ignored in past literature.

Past Theories Outlining the Association between Education and Health

In the 1960s a revolutionary concept was introduced into economic thought: Human Capital. Countries began to look at their national assets as more than just physical infrastructure and natural resources, but the amount and quality of their labor force (Schultz, 1961; 1971). During this same historical period, the world was experiencing an explosion in access to formal

schooling. Beginning in the 1950s, former colonial countries, (economically) less-developed nations, and multilateral development agencies began seeking ways to improve educational access to large segments of out-of-school populations. The educational expansion was supported through international development agencies, as assumptions about the benefit of education in economic development began to take hold during the 1960s. This educational expansion has brought formal education to every country in the world and with it additional unintended consequences in the forms of social and cognitive impacts on populations (Inkeles, 1969; 1975; Meyer, Ramirez, & Saoysal, 1992; Baker & LeTendre, 2005). The rapid spread of formal schooling to populations previously denied access has allowed researchers to document the effect of formal schooling, (referred throughout this dissertation as schooling) on numerous economic and social development both at the individual and national levels. One social development that has been researched over the last several decades is the relationship between education and morbidity, mortality, and other various health outcomes in both the developed and the developing world.

Since the 1970s demographers, sociologists, economists, and educational researchers have all studied the relationship between education and these various health outcomes involving mortality, fertility, disease, and wellness (Axinn & Barber, 2001; Behrmen & Nevzer, 1997; Boonstra, 1998; Caldwell, 1980; Crum, Helzer, & Anthony, 1993; Deaton & Paxson, 1999; Lleras-Muney, 2005). Educational attainment has been identified as having a consistent and significant effect on health outcomes such as mortality, fertility, alcohol consumption, smoking, and various diseases (Bloom, 2007). However, there is significant debate about the direction and pathways driving the perceived associations between education and health outcomes. Researchers have argued that that the reported association between education and health is a result of: 1) a spurious association being driven by a third exogenous variable that is driving simultaneous improvements in both education and health outcomes; 2) childhood health that directly relates to

educational access and adult health; 3) access to resources and information through the schooling process that enable people to access and obtain better adult health; and 4) skills and abilities acquired through the schooling process which include self-efficacy and a long-term goal orientation.

Spurious Relationship between Education and Health

Researchers have argued that the perceived association between education and health is not a result of a direct relationship between the two but is the result of a third outside variable that is directly related to both, primarily social class. These exogenous variables could range from cultural, social, economic, environmental, to institutional. Sen (1999) reports that cultural preferences for boys over girls in many societies create barriers for girls and women to gain access to both education and healthcare. This preference also favors infant health care and nutrition with boys getting more resources in terms of healthcare, nutrition, and education in relation to females of the same family. In this context cultural norms may be driving a perceived association between education and health when examined by gender in these societies (Bhan et al., 2005). Similar to cultural barriers, social barriers based on racial or religious identity that prevent equal access to education and healthcare services are another exogenous variable attributed as driving the perceived association (Christenson and Johnson, 1995). An individual's social status, including the assets and resources that a family has at its disposal, will directly relate to the type of healthcare and educational opportunities that the family can provide for its children.

In addition to the family, the surrounding environment, neighborhood, and community are argued to impact education and health outcomes (Bond Huie, Hummer, & Rogers, 2002). The type of community where one lives, availability and quality of amenities, services, and

institutions within the community, has been identified as another exogenous factor to explain the perceived association between education and health (Blomgren, Martikainen, Makela, & Valkonen, 2004). If schools and health clinics are not available, then individuals will report both lower education and poorer health than those that have access to these institutions. Under this perspective, community development and access might be seen as the driving mechanisms in the reported education-health association. In a similar vein, the largest set of literature addressing the health-education association has identified education as a facet of an individual's social class or socioeconomic status. As such, numerous studies do not examine the effect of education independently but use it as a measure along with income, employment status of the individual or their parent, and parental education to assess how status within society leads to health. In this regard, education is seen as solely bestowing status and wealth upon an individual.

In response to these arguments, researchers have examined the effects of family, resources, and access within similar cultures to test whether there is a persistent and independent relationship between education and health. In terms of cultural and social barriers to access to education and health, a study conducted in Saudi Arabia on maternal mortality found that women with no or lower education even after controlling for socioeconomic status were more likely to die than their more educated female peers during pregnancy and childbirth (Al-Meshari, Chattopadhyay, Younes, Hassonah, 1996). A study in Kenya on data collected during the 1960s and 70s finds that even after controlling for income, residence, community assets, access to, and usage of health facilities, the completion of more than five years of schooling and gaining literacy remained statistically significant in reducing mortality (Anker and Knowles, 1980). A historical study in the US examining healthy life expectancy in 1970, 1980, and 1990, finds that large racial differences exist in healthy life expectancy at lower levels of education but that racial differences diminish as individuals gain more education (Crimmins and Saito, 2001). These and other studies

have persistently found education effects independent of wealth, access to health resources, and social barriers.

The relationship between education and health in terms of mortality, morbidity, fertility and various diseases has been most extensively researched as to how education acts as an intermediate factor of an individual's socioeconomic status (SES). As early as 1973, Kitagwa and Hauser identified independent educational differentials in US mortality in the earlier half the 20th century, although education was classified under the SES composite variable. They state that "education differentials probably provide more reliable indicators of socioeconomic differentials in mortality…than do the income differentials" and that the educational effect as a protective factor for diseases is stronger where information is more available and can be connected to specific behaviors that fall within an individual's sphere of control (23). Even with these consistent results, education is repeatedly subsumed under the SES variable of most analyses.

Backlund, Sorlie, and Johnson (1999), attempt to disaggregate the SES variable by examining the independent effects of education and income. They find different relationships between education and mortality and income and mortality, and that education is more important in determining US mortality at the upper end of the socioeconomic stratum, while income is more important in determining US mortality at the lower end of the socioeconomic range. However, little is known about whether these results would replicate in countries with significantly lower educational attainment than the US. The continuing and persistent effect of education even after controlling for access, SES, income, social and cultural barriers, and a country's economic development has led many researchers to try and understand the direction of causality between schooling and better health.

Childhood Health leading to Increased Educational Attainment

Early childhood health is seen as instrumental in the cognitive development of individuals. In addition, childhood health will impact the ability of an individual to attend school. In this sense early childhood health would relate directly to access and quality of schooling for children. Studies have reported that children with poor childhood health had lower educational attainment and consequently lower social status and health as adults (Case, Fertig, & Paxson, 2005). Those children that are ill more often will be in school less than their non-sick peers. As a result they will achieve less and are more likely to drop out. Thus adult educational attainment is an extension of infant and childhood health status. If individuals are sick or have a weaker immune system, making them more prone to illness, then the association between poor adult health and low educational attainment is really a result of initial health which resulted in low educational attainment and not the amount of educational attainment leading to current health.

It is true that in some cases individuals who have poorer childhood health do have lower educational attainment and that poor nutrition at a young age can reduce child learning. Low birth weight has been identified as an important childhood health indicator and that children with low birth weight obtain less schooling and poor health later in life (Barker, 1995; Behrman and Rosenzweig, 2004; Black, Devereux, & Salvanes 2007; Roseboom et al., 2001). While recent research has shown that deworming and malarial interventions in early childhood can significantly increase educational attainment (Bleakley, 2002; Clark et al, 2008; Miguel and Kremer, 2004). If childhood health was the driving mechanism for adult health, then the United States, where relatively few children are unable to attend school because of health, should be witnessing a diminishing effect of education on health over time instead of the increasing effect of education on adult health (Cutler & Lleras-Muney, 2008). When considering adult health and the impact of early childhood illness, research continues to find schooling as the primary factor in

determining adult health (Cutler, Deaton, & Lleras-Muney, 2006; Cutler & Lleras-Muney, 2006; Smith, 2005). Although early childhood illness can impact educational attainment, it is the educational attainment that remains the principle factor related to adult health.

Access to Information and Resources

Schooling provides information about health and risks to students, and this information translates directly into better decisions about risk and health (Nayga, 2001; Mirowsky & Ross, 2003). Inclusion of information on health issues such as human sexuality and birth control in school curricula are thought to be the chief way education influences health, and hence unschooled, or less schooled individuals, do not receive this information as readily as their more educated peers. Goldman and Smith (2002) find that educational differences in adherence to diabetic treatments decreased after highly structured and regimented training, although they did not completely disappear. Studies have shown that the more educated were the first to change smoking behavior once the risks and negative effects of smoking became available during the late 1950s and early 1960s (de Walque, 2007). Studies that have attempted to understand the role of information on health find that information only explains a small part of the educational differences in health (Meara 2001, Kenkel 1991). The risks of smoking are known across educational groups and yet Cutler & Lleras-Muney (2006) find that smoking in the US is more prevalent among the uneducated and de Walque et. al. (2005) report a persistent education effect even after controlling for recall of HIV facts and involvement in an HIV intervention. Studies measuring the effect of information-transfer drug programs like DARE, that specifically target basic knowledge about drugs, do not impact decision-making about drug risk and hence drug abuse (e.g. Ennett et al. 1994). In short, while information is needed to understand risk, it is not in and of itself sufficient to explain educational differentiation in health outcomes.

Skills and Capabilities via Educational Attainment leading to Improved Health

There has been a small emerging literature on the direct effects of education on health outcomes independent of SES in an effort to demonstrate a causal relationship between education and positive health outcomes. Research examining the impact of changes in compulsory schooling laws in Sweden (Spasojevic, 2003), Denmark (Arendt, 2002), and the US (Adams, 2002; Lleras-Muney, 2005) for mortality and health, find significant educational effects. Rogers, Hummer, and Nam (2000), identify educational stratification in the US as one significant factor in mortality differences, even after controlling for demographic, social, economic, and behavioral factors in the 1980s and 1990s. Damien de Walque (2004) investigated the relationship between education and health behaviors that lead to negative health outcomes by examining smoking behaviors. His analysis indicates that earlier in the century when positive health outcomes were connected with smoking, more educated individuals had a higher propensity to smoke. However, as more information became available about the negative health risks associated with smoking, more educated individuals became less likely to smoke than their lower-educated counterparts. One plausible reason for these educational differences in smoking behavior has been credited to education's ability to impact reasoning skills, yet the majority of these studies only examine US populations and do not empirically test the hypothesis, nor have they examined the hypothesis in different cultures or contexts (Smith, 2005).

Even though research has consistently reported associations between formal education attainment and health outcomes, investigations have not delved into what it is about schooling in its own right that could influence health outcomes (Grossman, 2004). The majority of these studies have credited educational effects on health outcomes to its ability to impact income, social status, or an individual's ability to delay self-gratification or exhibit self-efficacy in various aspects of adult life. Jonathan Feinstein (1993) reviews the literature examining the relationship

between social status and health outcomes. Feinstein's review notes that research on this relationship has documented the existence, persistence, and extent of health inequalities but still lacks the ability to explain why these inequalities persist, or to understand the relationship at the individual level. Feinstein's review highlights the numerous studies that have been conducted to examine the relationship between education via social status and health outcomes, however as Grossman (2004) notes the majority of these studies have only examined this relationship in developed Western countries, primarily in the US, Europe, or Israel and have not been done in low income or developing countries.

The Association between Schooling and HIV and AIDS

The association between education and HIV has focused almost exclusively on education's indirect effect via external factors or via secondary effects of going to school. By examining the secondary effects of schooling, analyses disregard any direct effects of the schooling process and schools are only seen as a means of transmitting large amounts of information to a target population while ignoring any cognitive components. Past hypotheses that have attempted to explain the role of education in reducing HIV risk can be classified as 1) transferring information to individuals, 2) investing in human capital, 3) developing a sense of delayed gratification, and 4) perceived self-efficacy. These hypotheses ignore the cognitive benefit of schooling that allow an individual to assess and process information as they make everyday decisions and engage in both risky and protective behaviors.

Information Transfer Hypothesis

The growing literature that examines the relationship between education and HIV has focused on the ability of education to transmit information to a large young population before they engage in sexual activity. According to this information transfer hypothesis, education provides direct instruction about health to more educated individuals that are not available to the less educated or uneducated. Under this hypothesis, schooling provides opportunities for people to be exposed to information that directly relates to health (Nayga, 20001; Mirowsky & Ross, 2003). The composition of the curriculum is a central component of this hypothesis, as it argues that improved health has not been a result of schools, but the inclusion of health and nutrition curricula into classroom instruction (Feinstein, 1993).

Furthermore in the education and HIV/AIDS literature, formal education has been touted as a "social vaccine" that if used effectively can curb the spread of the disease and even reverse the trends in the spread of the disease (Vandemoortele & Delamonica, 2000; Coombe & Kelly, 2001; Ubaidullah, 2004). The education system has been seen as an essential component of many countries multisectoral response to combat the AIDS virus (UNAIDS-IATT, 2002), as education has historically been highly correlated with the overall health within a country (World Bank, 2002). As there is no cure for HIV, and the majority of individuals infected with HIV in SSA contracted the virus through penetrative heterosexual sex, direct transfer of information about the disease is seen as the most efficient and effective means to influence knowledge and create behavior changes in youth and adults (Kelly, 2000; Kirby et al., 1994; Kinsman et al., 2001). The "education solution" or "vaccine" draws from its ability to act as a major mode of transmission for various HIV interventions. Students reduce their risk of HIV via educational interventions that impact an individual's knowledge, behavior, and attitudes towards HIV. Students that are in school exhibit more accurate knowledge about HIV, delay their first sexual experience until a

later age, and use condoms more often than their out of school peers (Jacob & Collins, forthcoming).

Implementing school interventions were seen as a means to directly impact students' sexual behavior, based on assumptions that behavior is an extension of an individual's knowledge and attitudes (Ajzen, 1991). Formal educational interventions focused on changing students' behavior by increasing knowledge and attitudes regarding sexual behavior and HIV. For within school populations, schooling and educational credentials were seen to increase male and female social interactions outside of parental control which provided more opportunities for sexual encounters. Others have argued that education increases individuals risks of contracting the disease, particularly women who have less cultural control over their own sexuality and may feel obliged to engage in transactional sex with men who will pay for school fees, buy school materials and uniforms, or pay other incidental fees. In an effort to reduce risky behavior, education was seen as a "window of hope" to increase knowledge about HIV and thereby reduce risky sexual behavior (Kelly, 2000; World Bank, 2002; 2003).

In regards to the information transfer hypothesis and in the context of HIV in SSA, most schools have only recently implemented HIV curricula into classroom instruction. In many places, HIV information is part of the external curriculum found in after-school clubs and only a minority of students participate (Jacob, Morisky, Nsubugu, & Hite, 2006). However, for those countries that do have HIV curricula in the schools, there is uneven implementation of the curriculum within and between schools. Furthermore, early in the spread of the AIDS pandemic, very little information was available to the general population. As more information became available, mass media campaigns were developed, as well as specific interventions for at risk groups. These media campaigns were available via the radio, TV, billboards, church services, and community outreach programs to target all adult populations. Most adults left school long before

information was available about the disease and did not benefit from any information transfer that could occur via direct instruction about HIV within schools.

A major limitation of this hypothesis is its inability to explain educational effects for new diseases before they are incorporated into school curricula, or why adults who are no longer in school react differently to the same information based on different levels of educational attainment. In cases where communities have received direct instruction about the disease, understanding of the disease, behaviors, and reasoning and decision-making vary by education. Another problem with the information transfer hypothesis deals with the distinction between a person's ability to identify facts about the disease versus a person's ability to understand the connections between his/her personal behaviors and the spread of the disease. As a result the information transfer hypothesis cannot answer the question of why different behaviors and decisions emerge among individuals with different levels of education when both educated and uneducated individuals receive the same facts via informational campaigns. Nyindo (2005) notes that there is an increasing saturation of facts presented in HIV interventions across educational strata that people are able to provide to researchers, and yet the ability of individuals to accurately regurgitate facts has not led to consistent behavior change across educational strata.

Human Capital Hypothesis

One potential explanation as to why educated individuals react differently to the same information is explained by the human capital hypothesis. This hypothesis asserts that people who have invested in their own human capital stock via educational investment will engage in less risky behavior in order to maximize the return on their educational investment (Schultz, 1961; 1971; Mirowsky & Ross, 2003). This hypothesis assumes that people assess decisions based on how a decision will impact their economic productivity and in turn their economic return on their

educational investment. This means that people who delayed entering the labor market, and invested in increased educational attainment, will assess situations based on whether engaging in an activity will diminish or enhance the rate of return on their educational investment. In this sense, people will not engage in risky behavior because they want to maximize the financial return to their educational investment (Feinstein, 1993).

This concept mirrors a credential hypothesis that states degree attainment is more important than the years of schooling or even the content of school instruction (Berg, 1970). In this perspective an individual will increase their productive ability as seen via a credential and be more valuable to an employer who will then be willing to pay higher wages to the individual. It is these higher wages that a person who has invested in their own human capital stock via educational training is trying to protect and increase the number of years that they can remain productively economically active. By increasing their educational attainment, people increase their income. It is this justification that is often used to use education as a measure of socioeconomic status or class. This belief that education does not endow an individual with any set skills or abilities other than those connected with employment and income generation ignores all learning that is connected with the schooling process.

One problem with this argument is that in many developing countries, particularly in SSA, the economy is plagued with high unemployment rates. High unemployment rates create large highly educated populations that continue to engage in subsistence agriculture and credentials and degrees do not necessarily have a strong correlation with income in all communities. Although there are strong associations between education and wealth in many urban centers in SSA, rural populations do not reflect the same associations. The human capital model applies an economic rational choice approach to individuals' decision-making process and stresses the economic returns over other social or non-market benefits of education. As such, it ignores differences that exist in developing countries where market systems are not as developed,

or stable, and long-term investments are often more risky than short-term. Several African economies have seen their currencies devalued repeatedly, high levels of poverty and unemployment, as well as high levels of disease, making long-term planning tenuous. Although there is often a hope that increased education will result in higher lifetime earning, the reality is a large unemployed educated population.

Furthermore, early in the AIDS pandemic, studies noted a strong correlation between education and HIV infection rates (Smith et. al., 1999; Hargreaves & Glynn, 2002). As the human capital hypothesis postulates, education afforded individuals with greater income and mobility, however, this led to more opportunity to engage in risky behavior (Michelo, Sandøy, & Fylkesnes, 2006). The increased resources enabled individuals to engage in high-risk sexual behavior that included multiple sexual partners and transactional sex that exposed them to other sexually transmitted infections in addition to HIV and AIDS (Kirunga & Ntozi, 1997; Grosskurth et al., 1995; Swindler & Watkins, 2007). Under these assumptions, people who invested in their own human capital stock via education were engaging in more risky behavior. As a result of such findings, education was classified as a risk factor for HIV and AIDS infection presenting education and the human capital stock as leading to adverse health outcomes. Studies on sexual behavior in SSA have repeatedly shown more educated and wealthy individuals engaging in higher risk activities than their less educated peers. These findings call into question the notion of people avoiding risk in order to maximize their educational investment.

Psychological Outcomes: Delayed Gratification

The third hypothesis linking education to health outcomes addresses the concept of delayed gratification. According to this hypothesis more educated individuals have formed habits that allow them to delay immediate gratification and therefore do not engage in risky behavior.

Through the schooling experience of having to take classes, remain in a seat all day, and listen to a teacher, individuals learn to do things that they do not enjoy or want to do and replace a short-term focus on personal benefit for a long-term perspective (Mirowsky & Ross, 2003). Schooling delays short-term gains and benefits for long-term benefits. This concept translates into delaying short-term physical, sexual, or emotional gratification that could carry potential risks or damage long-term benefits for long-term benefits of better health, higher income, and increased happiness. Education teaches the individual that doing something today does not provide direct results or benefits to an individual but the long-term results are better than multiple short-term benefits.

One problem with this hypothesis is that high risk behavior is often engaged in by highly educated individuals which is why early in the pandemic it was the highly educated who were the most at risk. The concept of delayed gratification assumes a Bayesian rationality where people are continually calculating a cost-benefit analysis and making decisions based on the best probability. However, decision-making is rarely done with full information and is not normally an either/or situation where there are only two options (Gigerenzer & Goldstein, 1996). For the concept of delayed gratification to hold, we would expect to see lower engagement in risk activities by higher educated than lower educated individuals, however, this is not the case. Engagement in sexual activity can be a highly emotional, hormonal, and non-rational behavior where decisions are made based on a pre-existing automated belief system over a logic-based reasoning process (De Neys, 2006). Sexual behavior is often linked to other risky behaviors such as alcohol consumption which impairs an individual's cognitive capacity which could impair a person's logic-based decision-making capacity. Understanding the reasoning and decision-making process of individuals with varying levels of educational attainment is needed to better understand why individuals adopt different strategies and behaviors for the same sexual activities.

Self-efficacy

In an effort to address why the more educated adopt protective behaviors as they engage in risky sexual activities, the final hypothesis focuses on an individual's self-efficacy (Phelan, Link, Diez-Roux, Kawachi, & Levin, 2004). The self-efficacy hypothesis asserts that education instills a greater sense of control in an individual's life allowing them to develop protective behaviors that even if they do engage in risky behavior they will develop patterns that offset any perceived risks. The concept of self-efficacy also identified as learned effectiveness, asserts that people develop techniques to control their own lives via the schooling process (Mirowski & Ross, 2003). This is done as schooling replaces traditional notions and ideas with modern concepts of social change, progress, and the role of the individual over communal or family obligations.

Education provides a variety of tools and resources to the students, via literacy and computation, and enables an individual to substitute or create resources that may not exist in the community or home. Education helps people identify what needs to be done, how to accomplish those tasks and creates habits in the individual that stress progress, accomplishment, and change. The ability to change a person's environment increases a person's sense of control and ability to influence the external environment and not just be acted upon by that environment (Hiroto, 1974).

As stated at the end of the delayed gratification discussion, educational differences do emerge in protective strategies developed to offset risk. However, the hypothesis does not explain why these educational differences exist. This requires looking within the educational black-box and examining what about schooling increases an individual's ability to increase their self-efficacy? It has been posited that education exposes individuals to new ideas and requires individuals to complete exercises, solve problems, and meet educational goals that transfer into other aspects of an individual's life. However, the hypothesis assumes an underlying cognitive process that is occurring via the schooling process without acknowledging those contributions.

The inclusion of the impact of schooling on cognition would help to explain the external factor of self-efficacy that continues to be highly correlated with education.

Schooling and Decision-making

Decision making is fundamental to health. It is recognized that quite competent individuals can make seemingly irrational health decisions, such as delaying or declining necessary treatment, smoking cigarettes, drinking or eating heavily, or making choices that conflict with their stated values and preferences (Nelson, Stefanek, Peters, & McCaul, 2005). Such decisions in real life can be quite difficult and involve a complement of values, skills, knowledge, and emotional reactions. They often require decision makers to manage uncertainty inherent in decisions: Will I get lung cancer from smoking?; How likely is an accident if I drink before driving and what might the consequences be?. Decision-making is difficult at best and susceptible to a variety of cognitive and affective biases and heuristics (Loewenstein, Weber, Hsee, & Welch, 2001; Peters et al., 2006; Slovic, Finucane, Peters & MacGregor, 2004).

The judgments people make about the probability of some problem occurring (i.e., their risk perceptions) have important health implications. At an individual level, risk perceptions can guide protective actions, such as getting vaccinations or quitting smoking (McCaul & Tulloch, 1999; Weinstein, 1988). Risk perceptions are also relevant to decisions about home life such as treatment of waste and hygiene practices that can greatly influence health. Since many decisions are made under conditions of uncertainty, understanding of risk is a critical part of the decision-making process (Edwards et al., 2005; Gattellari, Butow, & Tattersal, 2001; Parascandola, Hawkins, & Danis, 2001). For example, a woman who elects to store and prepare food in a particular way would need to weigh its potential positive and negative outcomes (e.g., food poisoning, diarrhea, missed workday, unnecessary effort) with the likelihood of each outcome.

People do not always have a clear understanding of health risks, however, or of the likelihood of various outcomes of their own actions. People estimate risk in a variety of ways. For example, they may make risk judgments based on intuition, a recent experience, a vivid memory, or gossip from a neighbor. Others may approach risk estimation more systematically and analytically, basing their risk estimates on "hard data." When facing uncertain situations and complex decisions, people tend to rely on mental shortcuts to simplify the decision-making process, and thus reduce its cognitive demands and psychological stress. Research shows, however, that individuals differ in their use of these approaches (Epstein, 1994). Numeracy differences, in particular, have been associated with health risk perceptions and risky decision-making, and as hypothesized here cognitive differences could also be associated with decision-making around health (Bruine de Bruin et al., 2007; Goldman & Smith, 2002).

In the U.S. and other developed nations low numeracy has been associated with a host of undesirable health outcomes, including self-reported poor health, health disparities, poor health knowledge and disease self-management skills, and choosing lower-quality health options (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004; Berkman, DeWalt, Pignone et al., 2004; Baker, Parker, Williams, Clark, & Nurss, 1997; Sentell & Halpin, 2006; Williams, Baker, Parker, & Nurss, 1998; Hibbard, Peters, Dixon, & Tusler, 2007). In other studies, individuals with inadequate health literacy were more likely to be hospitalized, poor disease management, and less likely to use clinical preventive services than those with adequate health literacy (Apter, Cheng, Small et al., 2006; Baker, Parker, Williams, & Clark, 1998; Estrada, Martin-Hryniewicz, Peek, Collins, & Byrd, 2004; Scott, Gazmararian, Williams, & Baker, 2002). Although the ability to understand and interpret nutrition labels is not a health outcome per se, it has important implications for health and disease management. A study examining comprehension of nutrition labels found that numeracy was significantly associated with comprehension and that this association held after adjusting for schooling and income (Rothman, Housam, Weiss et al., 2006).

Similarly, medication refill adherence is not a health outcome but is a critical component of disease management. In a prospective study of Medicare patients with low health literacy was associated with poor medication refill adherence (Gazmararian, Kripalani, Miller et al., 2006).

In conclusion, most hypotheses that have been put forth to explain the link between formal education to positive health outcomes do not fit within the context of SSA. Formal education interventions are a recent strategy and actual implementation of HIV curricula is unevenly applied in many SSA countries. As a result, most educated adults did not receive HIV information while attending formal schools and the education as a role for information transmission hypothesis does not hold for adult populations. The fact that educated individuals were the most at risk at the start of the pandemic for HIV infection challenges the human capital hypothesis and fits the tenets of the decision-making literature, which requires a certain amount of information for people to make informed decisions. This has been documented by de Walque and colleagues (2005) and Hargreaves and colleagues (2008) who identified a shift in HIV infection away from the most educated to lower educated populations as more information has become available. de Walque's findings support part of the self-efficacy argument, but does not explain why these different patterns are emerging. These shortcomings illustrate the need to understand how past educational experience impacts people's ability to assess new information, and make decisions that impact an individual's health.

In response to past theoretical shortcomings, as mentioned in Chapter 2, this dissertation will examine the relationship between schooling and HIV infection and sexual behaviors in 11 SSA countries using DHS data that was collected between 2003 and 2005. This data is coupled with data collected on out of school adults 30-65 to test how cognition and decision-making relate to behavior and health. This research examines an underexplored facet of the relationship between schooling and health and provides important insight into the cognitive effects of schooling that are important to decision-making and risk behavior.

Chapter 4

Data and Methods

The data used in this dissertation to examine the role of schooling in the spread of HIV and AIDS come from two sources: Demographic Health Surveys (DHS) and Ghana fieldwork. The DHS data is secondary data from the Demographic Health Surveys administered in 11 sub-Saharan African countries between 2002 and 2004. The second data source comes from primary data collected during the summer of 2007 in the Eastern region of Ghana. In this chapter I will explain the two different data sources, variables, and methods employed in this dissertation. The actual data analysis for each chapter will be explained within each chapter where the findings are presented.

Demographic Health Surveys

I examine the relationship between schooling and HIV and AIDS in 11 sub-Saharan African countries (SSA). SSA was chosen for this study as this region has been the hardest hit by the AIDS pandemic. Nearly two-thirds of all AIDS infected individuals live on the SSA continent (UNAIDS, 2008) and HIV/AIDS is the leading cause of death in sub-Saharan Africa, where the disease is responsible for 25% of all deaths, with one in every seven members of the adult population being infected (Björkman, 2002; Brown, 2004; UNAIDS, 2008). As noted in Chapter 2, several parts of the African continent have been dealing with the disease since the 1970s; however, national and medical acknowledgement of the disease's existence has been slow in numerous countries allowing the disease to spread rapidly during the 1980s and 1990s. As a

result, AIDS has spread rapidly in certain regions increasing mortality, decreasing productivity, and creating economic and social instability within families and communities (Kelly, 2000).

To examine the relationship between schooling and HIV and AIDS in SSA I have used all 11 DHS surveys that were administered between 2003 and 2005 that had HIV testing data available. The DHS surveys, funded by the United States Agency for International Development (USAID), have been administered by Macro International since 1984 and are available by request from www.measuredhs.com. Over 200 DHS surveys have been conducted in over 75 countries since 1984.

The surveys are nationally representative household samples ranging between 5,000 and 6,000 households using representative probability sampling techniques. Countries are geographically divided into enumeration areas that consist of approximately 500 households identified from national census data or previous nationally representative surveys conducted in the country. The survey respondents are selected using a two-stage stratified sampling technique where all households are first identified in randomly selected enumeration areas, and then households within each enumeration area are randomly selected with each household having an equal probability of selection. All women between the ages of 15-49 and males between the ages of 15-59 of the selected household are eligible to be included in the surveys (Rutstein & Rojas, 2003).[1]

The cross-sectional surveys include questions that assess respondents' fertility, family planning, maternal and child health, child survival, malaria, and nutrition in addition to an HIV and AIDS component. The DHS surveys collect national, population-based HIV prevalence data on internationally-recognized facts, attitudes, and sexual behavior that consist of questions

[1] Age 15 is the minimum age to be included in the DHS as it is assumed that by this age most individuals have started to develop secondary sexual characteristics. Information is collected in interviews with parents about children residing in the home as well as past health histories, deaths, and health treatments of children. However, HIV information is not collected from children under 15.

designed to measure respondents' knowledge of HIV and AIDS and HIV and AIDS prevention methods, attitudes towards those with HIV and AIDS, and HIV and AIDS related behaviors such as higher-risk sexual activity and HIV testing (Rutstein & Rojas, 2006). The DHS surveys are typically conducted every five years. Surveys began collecting HIV and AIDS knowledge, attitudes, and behavioral data in the early 1990s and began conducting HIV biomarker testing after 2000 on a sub-sample of the total participants interviewed in the household, female, and male surveys.[2]

After 2000 a sub-sample of the total sample population was selected to be administered a dried blood spot sample HIV test. A recognized laboratory did the testing in each country and informed voluntary consent was granted from the respondent before the dried blood spot test was administered. All results were anonymous and all selected participants received a free HIV test voucher for a neighboring voluntary counseling and testing center (www.measuredhs.com). Individuals could refuse to take the dried blood spot test and still participate in the rest of the DHS surveys.[3]

For the analysis on HIV infection I use all 11 surveys conducted between 2003 and 2005 in SSA that included HIV datasets. Table 4-1 indicates the countries used in the HIV infection analysis,[4] the year the survey was conducted, sample size and the HIV infection rate in the country during the year of the survey. The 11 countries represent a wide range of countries that represent significant variation in geographic and HIV prevalence in SSA.

[2] DHS data analyzed in Chapters 5 and 6 comes from all three questionnaires on the household, on women, on males, and the HIV biomarker data that tested individuals for HIV infection.
[3] Individuals that refused to take the HIV test are not used in the analysis on HIV infection in Chapter 5 but are used in the analysis of sexual behavior presented in Chapter 6.
[4] The analysis on sexual behavior in chapter 6 only uses 10 counties due to missing data in Guinea. Guinea was dropped from the analysis as whole sections of the sexual behavior questions were missing nationally.

Table **4-1:** Countries included in DHS Analysis

Country	Year of Survey	Sample Size	HIV Infection Rate
Burkina Faso	2003	7,530	1.9%
Cameroon	2004	10,269	5.5%
Ethiopia	2005	11,025	1.4%
Ghana	2003	9,554	2.1%
Guinea	2005	6,767	1.4%
Kenya	2003	6,188	6.7%
Lesotho	2004	5,254	22.9%
Malawi	2004	5,268	11.8%
Rwanda	2005	10,391	3.0%
Senegal	2005	7,716	0.6%
Tanzania	2003	10,743	7.0%

Table **4-2:** Educational Distribution of the DHS Sample

	Female Education Levels			**Male Education levels**		
Country	**No education**	**Primary education**	**Secondary education or higher**	**No education**	**Primary education**	**Secondary education or higher**
Burkina Faso	83.5	10.4	6.0	69.4	16.6	13.9
Cameroon	21.1	41.4	37.5	10.7	37.2	52.1
Ethiopia	71.5	17.0	11.5	49.1	29.1	21.8
Ghana	37.3	19.7	43.0	25.8	14.3	59.9
Guinea	82.0	9.4	8.6	56.0	14.6	29.5
Kenya	17.5	54.2	28.2	8.5	52.9	38.6
Lesotho	3.1	62.8	34.1	22.7	53.7	23.6
Malawi	25.4	61.8	12.8	11.1	63.7	25.2
Rwanda	28.6	60.7	10.7	20.2	66.1	13.7
Senegal	70.3	20.8	9.0	46.6	25.5	27.8
Tanzania	24.7	69.6	5.7	11.5	79.5	9.0

Because of the relative slower growth in mass education in SSA, the DHS provides representative samples of adults with a wide range of educational attainment including significant proportions with small amounts of or no formal schooling up to completed university. As shown in Table 4-2, educational attainment ranges widely between countries, but all have significant variation within each country. These samples maximize the schooling effect and thus allow more thorough analysis of pathways between schooling and both HIV infection and engagement in sexual behaviors.

Methods

I examine the association between schooling and HIV and AIDS through two different methods. I examine the relationship between schooling and HIV infection using logistic regression in Chapter 5 and examine the relationship between schooling and three sexual behaviors using structural equation modeling in Chapter 6. As each chapter presents the findings of two very different forms of data analysis, each chapter will provide an overview of the data analysis used in each analysis. The variables used in the analyses come from the three DHS questionnaires for the household, women, and men as well as the biomarker data.

Variables

Independent variable. The independent variable of interest for all analyses is years of schooling and is the numerical value of the last grade successfully completed by the participant.

Controls. All models have been controlled for gender, marital status, socioeconomic status as measured by a wealth index, and the respondent's place of residence.

- *Gender* is the respondent's gender and is reported as male (0) and female (1).

- *Marital status* indicates whether the person is married or currently living in a marriage-like partnership. For individuals who were not married, nor living in a marriage-like partnership were coded as (0) and individuals who were married or currently living in a marriage-like partnership were coded as (1).
- *Place of residence* indicates whether the person lives in an urban or rural setting. Urban was coded as (0) and rural was coded as (1).
- *Socioeconomic status* is measured by a wealth index. The wealth index is a variable in the DHS dataset that was created through principal component analysis of background variables collected in the household survey on a household's ownership of assets, materials used for housing construction, and on household amenities such as type of water access, sanitation facilities, and access to electricity. The wealth index is a factor score that places individual households on a continuous scale of relative wealth with scores being standardized with a mean of zero and a standard deviation of one.
- *Country* is a control used in the sexual behavior analyses reported in Chapter 6. Country is dummy coded and indicates which country the respondent lived in at the time of the survey. In the analyses reported in chapter 6 Burkina Faso is used as the reference country.

Dependent variables. The DHS data allow me to analyze four different dependent variables of interest. In Chapter 5 the dependent variable of interest is HIV infection while in Chapter 6 the dependent variables of interest are three sexual behaviors: abstinence, being faithful, and condom usage.

- *HIV infection* is the result of the dry blood spot test given to a sub-sample of the DHS sample. The variable is a dichotomous variable reported as either HIV positive or HIV negative. A score of 0 was coded for HIV negative and a score of 1 was given if the respondent was HIV positive.

- *Abstinence* is a categorical variable created from the question which asked the participant the length of time since last sexual intercourse. Time was recorded in days, weeks, and months. Reported time was transformed into corresponding time in months and any period that extended past 12 months was coded as 12 months plus.
- *Being faithful* is a categorical variable that was constructed from a series of questions that ask the respondent to indicate the number of sexual partners in the past 12 months and their relationship to each individual. Polygamy was accounted for by recoding responses for whether the sexual partner was a spouse or non-spouse. If a person had multiple sexual partners but all were identified as spouse, then the person would receive a value of 0, the same value as an individual with only one sexual partner that was their spouse or permanent partner. Individuals that reported sexual partners other than their spouse were given a score of 1 for each additional sexual partner other than their spouse. The score was truncated at 5 or more and any respondent who had more than 5 non-spousal sexual partners in the last 12 months was given a score of 5.
- *Condom usage* is a dichotomous variable that only examined individuals with multiple non-spousal sexual partners. Using the procedure to identify non-spousal sexual partners in the being faithful dependent variable, this variable only examines respondents that were identified as having multiple non-spousal sexual partners. [5] Individuals with multiple non-spousal sexual partners and did not use condoms was given a code of 0 and individuals with multiple non-spousal sexual partners but did use condoms was given a code of 1.

[5] Although polygamists report multiple sexual partners, their sexual partners are all identified as spouse and as such polygamists were included in the analysis of condom usage for individuals with multiple sexual partners.

Moderating variables. The moderating variables used in the SEM analysis presented in chapter 6 include one observed variable, basic facts about modes of HIV transmission, and two latent constructs, attitudes and applied facts.

- *Basic facts* about the modes of HIV transmission is a count variable that reports the number of correct prompted responses the individual could give to the interviewer about the modes of HIV transmission. Prompted questions include items such as: Can people reduce their chances of getting the AIDS virus by having just one sex partner who is not infected and who has no other partners?; or Can people reduce their chances of getting the AIDS virus by using a condom every time they have sex?.
- *Attitudes* is a latent construct that is comprised of three questions the respondent was asked that attempt to gauge a person's attitudes toward people living with HIV and AIDS. The three questions used include: 1) If a relative of yours became sick with the virus that causes AIDS, would you be willing to care for her or him in your own household?; 2) If a female teacher has the AIDS virus, should she be allowed to continue teaching in school?; and 3) Would you be willing to buy fresh fruits and vegetables from a vendor with AIDS?. The variable is constructed through a confirmatory factor analysis of the three questions.
- *Applied facts* is the second latent construct used as a moderating variable. In addition to prompted responses to how HIV is transmitted, respondents were given questions about general misconceptions or myths related to HIV transmission and were asked to spontaneously provide information about signs and symptoms of male and female sexually transmitted diseases (STDs). A count variable was tabulated for each question, the number of myths the respondent could accurately dispel, and the number of STD signs and symptoms that the respondent could spontaneously generate for males and

females respectively. These three count variables were factored together to create a latent construct that I have labeled: applied facts.

Ghana Fieldwork

Ghana is a country of around 20 million inhabitants and is situated on the southern coast of West Africa. The country is comprised of diverse languages and cultures (Ghana Statistical Service, 2006; Salm & Falola, 2002). Ghana's HIV epidemic is characterized by a pattern of persistent localized variations, with some districts experiencing severe generalized epidemics while other areas remain virtually untouched by HIV (Oppong & Agyei-Mensah, 2004). In 2007 Ghana was estimated to have a 1.9% prevalence rate among the 15 and older adult population. For the 15-24 year olds, known as a high risk heterosexual group, female prevalence was 1.3% compared to 0.4% for males of the same age cohort. According to the 2006 Ghana Multiple Indicator Survey, only 33% of adult males and 25% of adult female respondents could correctly identify ways of preventing the sexual transmission of HIV and reject major misconceptions about HIV transmission. The Eastern region has the highest HIV prevalence in the country. The region has an HIV prevalence rate of 3.7% for the 15 and older adult population, with the 15 and older female population increasing to a rate of 4.4% compared to a rate of 2.9% for the adult male population (Ghana Statistical Service, 2004).

The data used in Chapter 7 to examine cognitive and decision-making skills comes from a collaborative research project between the Pennsylvania State University (PSU) and the Regional Institute for Population Studies (RIPS) at the University of Ghana. I acted as the principal investigator and worked with a team of six Ghanaian researchers from RIPS. As a research team we went over the instruments and made modifications to the instruments based on role plays and how instruments and items were interpreted to adjust for cultural variations. To

ensure cultural appropriateness, the research team interviewed proxy participants as part of the instrument development process. We spilt up into three groups and the research team interviewed multiple rounds of female and male proxy participants. The proxy participants were interviewed in Twi and would respond in English, creating a reverse translation process where I could understand how the participant was interpreting the questions in Twi. All proxy participants had participated on research teams in rural Ghana and attempted to apply their experience in those settings to answer the questions posed to them. In cases where the English responses did not match the questions original intention, I would then ask how the question had been asked in Twi and we would discuss the meaning of the question, at which point the question would be discussed and restated in Twi. After the proxy interviews our research team would sit down and discuss the interviews. The research team would express problems that they encountered and we would address each issue. As a result several of the tasks were completely modified and a new group of proxy participants would be brought in and we would repeat the process of reverse translation in testing the instruments.

The issue of the research team being “experts” was raised as a serious threat to our research. Due to notions of deferring to experts by villagers, the fear that as soon as a prompted idea or question was posed, respondents would defer to our prompt and agree with our ideas even if they would not normally have agreed or stated it as an option. In an effort to not create an event where the participant deferred to our ideas, the format was changed to more open-ended questions and reserved culturally relevant prompted responses that required an assignment of low and high level of likelihood until after the respondent had answered all open-ended questions remove researcher bias and influence on responses.

In addition, the survey was redesigned to facilitate interviewers filling out the forms, the collapsing of a couple of questions into a single one, moving the placement of certain items into new locations, and the addition and subtraction of a few items. All researchers were trained in the

consenting process and when to use either the verbal consent form while approaching people or the signed consent form. The Ghanaian research team mentioned that signed documents often are mistrusted in rural Ghana. Signed documents often have obligations attached and people are suspicious of ulterior motives involved with signed consent forms. A signed form raises the fear that there is a chance that the person trying to get the form signed is trying to take advantage of the person either financially or in some other way. As a result, we decided, as a research team to verbally consent each participant in an effort to reduce duress to the individual.

After two weeks of training with the research team, we traveled to the Eastern region of Ghana where four homogenous villages were selected as study sites. The Eastern region was selected as this region has the highest AIDS prevalence in Ghana and has a history of schooling as reported by the Ghana AIDS Commission's district level reporting of HIV and AIDS infection (http://www.ghanaids.gov.gh/gac/index.php). The Eastern region also had large sections of the region with large Akan populations that spoke Twi.

Villages were selected within the region using purposeful sampling techniques. Districts within the Eastern region that were predominately Akan ethnically and Twi linguistically were identified. Rural regions of these Akan districts were identified. In order to limit effects of migration, of the rural villages in the Twi speaking regions, communities were selected that had minimal in and out migration and primarily agrarian which was determined by informants from RIPS who are familiar with the region. An additional criterion used to select the communities was village size. The selected villages in the sample range in size from 200 inhabitants to 4,000 inhabitants. Four different communities were selected that were all rural, primarily agrarian, and ethnically Akan and Twi speakers and had minimal in and out migration. All interviews were conducted in Twi, the local language of the research participant, and only communities that were predominately Akan and spoke Twi were selected as research communities.

I have examined the schooling effects among adults on cognition, reasoning, and decision-making skills using a sample that maximizes variation on schooling and controls for major sources of endogeneity that have limited prior research. There are two major sources of endogeneity that my study's design directly addresses: 1) schooled and unschooled adults differed in cultural and sometimes linguistic backgrounds; and 2) studies did not control for the possibility of the effects of more complex post-school jobs and lives.

Study Communities

The Eastern region of Ghana contains villages where normally developed, unschooled and schooled adults with the same cultural-linguistic backgrounds live and work together. The ability to examine adults living in the same communities and engaging in the same lifestyles allows me to control for sources of endogeneity mentioned previously. To better understand the schooling effects, and test the relationship between formal schooling, cognition, and decision-making around sexual behavior, data was collected in four homogenous and remote villages in the Eastern region of Ghana. In addition to questions about schooling, cognitive skills, and decision-making skills, the 190 adults also reported levels of schooling, reasons for discontinuing or failing to attend school, SES (as measured by type of house, available amenities such as electricity and running water, and agricultural assets), religion, occupation, and access to information.

As a research team we tested a sample of 190 adults aged 30-65 who ranged from unschooled to completed secondary school for numeracy abilities, cognitive capacities, decision-making tasks, HIV knowledge and attitudes, and sexual behaviors. The 190 adults come from the four different communities and were not tested for HIV infection. Of the participants, the mean

years of living in the community is 26.9 years, while the mean age is 42.5 years and 78.7% report Twi as their first language as seen in Table 4-3.

Table **4-3:** Community Demographics

	Mean years of living in the community	Mean Age	% Twi Speakers
Village A	28.7	46.0	85.4
Village B	29.3	42.8	88.6
Village C & D	24.0	40.9	47.6
Village E	25.9	40.4	93
Overall	26.9	42.5	78.7

Source: Calculated by author.

An advantage of the study site is that the unschooled and schooled have generally similar post-school jobs and life-conditions, which greatly reduces post-school sources of endogeneity. Although the data collection did not allow me to control for pre-school cognitive ability, I did attempt to limit the effect of pre-school cognitive ability by performing in-depth interviews with respondents about the reasons why they did not attend school or for why they stopped attending school. The results of these interviews indicated that the adults' families of origin did not make decisions about which children would attend school based on perceptions of pre-school cognitive ability or even based on student performance in school but were based upon family financial circumstances

Over two-thirds of the people in the Eastern region are economically identified as self-employed—engaging in farming. An advantage of the five study sites selected from the Eastern region is that the unschooled and schooled have generally similar post-school jobs and life-conditions, which greatly reduces post-school sources of endogeneity. Most individuals in the villages are involved in subsistence, or minimal-profit, farming (cassava, maize, cocoa, koala-nuts, and citrus) and the sample represents these trends. Table 4-4 indicates the primary occupation reported by participants in the study. Of the participants in the study, the main

occupations consist of farming (46.3%), agricultural trading[6] (22.1%), vocational[7] (10.5%) and food vendors (8.4%). Although not presented here, of those that report an occupation other than farming, 36.6% report farming as a secondary occupation.

Table **4-4:** Occupational Status of Sample

Occupation	N	%	Cumulative %
Farming	88	46.3	46.3
Agricultural Trader	42	22.1	68.4
Vocational	20	10.5	78.9
Food vendor	16	8.4	87.4
Not working/Retired	13	6.8	94.2
Teacher/Civil Servant	8	4.2	98.4
Other	3	1.6	100
Total	190		

Source: Calculated by author.

While education has led in some cases to other livelihoods as seen in Table 4-4, regardless of occupation, individuals live in similar conditions in each community. Participants were selected from five study sites. Village A had the largest population of approximately 4,000 people and had individual electricity, primarily communal piped water, and sewage facilities. Village B had a population of approximately 2,000 people with some individual access but primarily communal electricity and communal piped water and sewage facilities. Village C and D were neighboring communities and were interviewed at the same time in village C. These villages had a combined total population of approximately 800 people with no electricity and a communal well. Village E had a population of approximately 200 people with no electricity and a communal well. Table 4-5 indicates that 90% of respondents in the sample do not have piped water in their homes, 62% do not have any type of drainage in their home, 38% do not have any electricity in

[6] Agricultural trading refers to trading poultry, feed, crops, tools, and other small items.
[7] Vocational occupations include masonry, beautician/hairdresser, wood worker, tailor/seamstress and painter.

the home, 43% don't have a toilet facility, including outside pit toilets, and 59% have no community telephone or phone access.

Table **4-5:** Household access to Basic Services

Home has:	No (%)	Yes (%)	Total
Electricity	73 (38.2)	117 (61.3)	190
Piped Water	172 (90.1)	18 (9.4)	190
Drainage	119 (62.3)	71 (37.2)	190
Community Phone	113 (59.2)	77 (40.3)	190
Pit Toilette	82 (42.9)	108 (56.5)	190

Source: Calculated by author.

Table 4-6 reports access to different types of mass media for the sample. Of the sample participants have greatest access to the radio and the least access to newspapers, with 68% of the sample listening to the radio daily compared to only 32% watching television daily and only 2% reading the newspaper daily.

Table **4-6:** Access to Mass Media

Access to Media	Everyday N (%)	1 -2 times a week N (%)	1-2 times a month N (%)	Never or almost Never N (%)	Total N
Listen to the Radio	130 (68.4)	34 (17.9)	12 (6.3)	14 (7.4)	190
Watch Television	61 (32.1)	48 (25.3)	29 (15.3)	52 (27.4)	190
Read a Newspaper	5 (2.6)	21 (11.1)	19 (10)	145 (76.3)	190

Source: Calculated by author.

The majority of the people in the region are bilingual and speak Twi and some English. According to the 2003 DHS survey, overall in Ghana 37.3% of females 15 and older have never attended school, whereas 19.7% have completed primary schooling and 43% have completed

junior secondary or more. Male educational attainment is higher overall with only 25.8% of all males 15 and older having never attended school, with 14.3% only having completed primary school and 59.9% having completed junior secondary or higher.

Table **4-7:** Educational Attainment of Sample

Schooling Completed	Gender		
	Male	Female	Total
none	5	31	36
partial primary	4	24	28
primary	10	27	37
Junior Secondary	29	27	56
Senior Secondary +	25	8	33
Total	73	117	190

Source: Calculated by author.

As shown in Table 4-7, in this sample, 26.5% of the female population has never attended school and an additional 20.5% only completed 3 years or less of primary schooling. In contrast, 6.8% of the males in my sample had never attended school and only 5.5% had only completed 3 or less years of primary schooling. Only 23.1% of females in the sample have completed primary schooling compared to 13.7% of males. In terms of completed junior secondary schooling, 39.7% of males in the sample completed junior secondary school compared to 23.1% of females in the sample. For those that completed senior secondary or higher, 34.2% of the males in the sample completed senior secondary school compared to only 6.8% in the female sample.

Methods

I examine the association between schooling and HIV and AIDS by examining the relationship between schooling and condom usage and decision-making through two different methods. In Chapter 7 I examine the relationship between schooling and condom usage using logistic regression and examine the relationship between schooling and decision-making using

structural equation modeling. I will discuss the two forms of data analysis before the presentation of results in Chapter 7. The variables used in the analyses come from the individual interviews with the 190 respondents.

Variables

Independent variable. The independent variable of interest for all analyses is years of schooling and is the numerical value of the last grade successfully completed by the participant.

Controls. All models have been controlled for age, gender, socioeconomic status as measured by household assets and household amenities, and community. The *Independent* variable of interest is years of schooling and is an observed variable that is the numerical value of the last grade successfully completed by the participant.

- *Age* is the respondent's age at the time of the study and is reported as a numerical value representing years.
- *Gender* is the respondent's gender and is reported as male (0) and female (1).
- *Socio-economic status* is measured by two factor scores: household assets and household amenities that resulted from a principle component analysis that created two factors for socio-economic status. The principal component analysis of background variables collected in the demographic survey of the individual's household ownership of assets and amenities.
    - *Household assets* indicate the amount of assets including TV, radio, bicycle, and gas stove,
    - *Household amenities* indicate electricity, piped water, sewage, telephone, and toilet facilities.

- *Community* is dummy coded and indicates which community the respondent lived in at the time of the survey. In the analyses Village A is used as the reference community.

Dependent variables. There are two dependent variables of interest in the Ghana sample: condom usage and decision-making.

- *Condom usage* is an observed variable indicating whether a person has ever used a condom or not when having sex with someone other than their spouse.
- *Decision-making* is a numerical value that represents the respondent's total score on a series of 8 tasks around HIV in which participants were presented with scenarios adapted from previously developed decision–making tasks (Babai, Brecher, Stavy, & Tirosh, 2006; Peters et al., 2006). A participant's score could range from 0 to 8. Each scenario presented two options from which the participant had to choose one of the two options. The participant was presented with two images and informed that each image represented a different family or group, the red stickmen within each image were individuals with HIV and the black stickmen within each image were individuals that did not have HIV. In each image the number of red and black stickmen varied. The participant was asked if they were to visit each family or group, in which image A or B, would it be most likely that the first person they met had HIV. Four of the scenarios provided congruent information where the higher probability also had numerically more red stickmen. The other four scenarios presented incongruent information where the option with a larger numerical number of red stickmen was actually a lower probability of the total group. Decision-making is the dependent variable in the SEM and is used as a moderating variable in the logistic regression model.

Moderating variables. In addition to decision-making in the logistic regression, the other moderating variables used in the logistic regression and SEM analysis include three observed variables: basic mathematic ability, working memory, and planning and strategy.

- *Basic mathematic ability* is the respondents score ranging from 0 to 30 from the Woodcock Johnson III (WJ-III) test of calculation (Achievement subtest 5: Calculation). The first 30 problems from the WJ-III were administered to participants and the score was calculated by adding all of the problems that the participant accurately answered before missing three consecutive problems. The WJ-III test of calculation (Achievement subtest 5: Calculation) has a reliability of 0.85 among adult populations (Woodcock, McGrew, and Mather, 2001).
- *Working memory* is the score of an administered backward-digit task ranging from 1 to 5. The backward-digit task is one of the simplest and shortest tasks for assessing working memory. This test requires the researcher to verbally present digits at a rate of one per second. The backward-digit task requires the participant to repeat the digits back to the researcher in reverse order. The number of digits increases by one until the participant consecutively fails two trials of the same digit span length. For this study, participants were first given 2 one digit numbers and the longest set consisted of 5 one digit numbers. The participant is required to hold all information in their mind and translate their response into reverse order, without writing down the numbers or having any information repeated. Administration stopped when the participant failed to correctly recite both strings in a pair or when the last pair of items was administered. The respondent's score indicates the number of digits they could correctly repeat back to the researcher in reverse order. The test-retest reliability of the backward digit task in the WISC-IV is 0.83 (Wechsler, 1981.)
- *Planning and strategy* is the score ranging from 0 to 8 that the participant received from the D-KEFS Tower test which measures the respondent's ability for planning, strategy, working memory and attention-shifting. The test involves a 3-peg set-up with 5 moveable disks. The participant is given the disks in a set arrangement on the three pegs and then

shown a "goal-state" to which he or she is asked to move the disks on his/her pegs by only moving one peg at a time and by never putting a larger disk on top of a smaller disk. The respondent is timed and the number of moves it takes the respondent to arrive at the "goal-state" is used to calculate the respondent's score for each of 9 trials. Each trial is progressively more difficult. The respondent starts with 2 disks on the first trial, adds the 3rd disk on the fourth trial, the 4th disk on the sixth trial, and the 5th disk on the eighth trial. When participants made moves that were not in compliance with the rules, the examiner moved the disk(s) back to the previous position and counted the incorrect move in the total number of moves. The task has an internal reliability of 0.67 and a test-retest correlation of .44 for all ages for the U.S. population (Delis, Kaplan & Kramer, 2001).

- *Cognitive skills* is a moderating variables used in the SEM analysis presented in Chapter 7 and is a latent variable that is the result of a confirmatory factor analysis of the working memory and planning and strategy variables.

The actual data analyses for and statistical methods employed in each chapter will be reported in each chapter before the presentation of results.

Data Limitations

DHS

The largest limitation of the DHS data is that the DHS is a secondary data source and I am limited by the types of questions that were included in the survey. Not only am I limited by the questions included in the survey but by countries excluding sections from their surveys. Countries are supposed to ask all the questions, but due to sensitivities that exist in certain countries and cultures, often whole sections will be omitted when a survey is administered in a

country. The largest issue resulted when I had to drop Guinea from the behavior analysis, as the country omitted several key behavior outcomes related to condoms. Although information was available about HIV testing, information about behavior was omitted.

In addition, some countries had additional questions about facts, attitudes, behavior, and involvement in HIV interventions while other countries had a smaller set of questions. This resulted in the attitude latent construct only having three questions, as there were too many missing questions from the different country surveys to include additional questions. The DHS survey only focuses on collecting information on an individual's acquisition of facts and attitudes towards HIV and does not examine understanding, reasoning, or perceived risk of HIV infection. Many of the questions remain general and refer to societal level norms and do not require the person to respond at the personal or individual level and assume that how a person responds at the general level reflects their beliefs at the individual or personal level.

Another limitation of the DHS data is that behavior data is limited to the 12 months prior to the survey and only part of the sample took the HIV blood test. Since behavior is limited to only the 12 months prior to the survey, it is not possible to examine long-term trends in individual behavior, nor is it possible to examine socio-economic status as measured in more developed countries. To offset this weakness an asset index was used as a proxy for SES in the DHS data.

Due to limitations of secondary data, the DHS does not allow me to analyze decision-making skills or cognitive abilities of respondents. Although I have attempted to proxy a type of reasoning or advanced understanding of HIV, these results have limited ability to explore a person's decision-making and cognitive abilities. To understand how cognitive skills and decision-making skills moderate the schooling and HIV and AIDS relationship, I had to supplement the secondary DHS data with primary data collected in Ghana.

Ghana

In the Ghana data the sample size is small, comprised of only four communities all located within one region in Ghana. There was no way of ensuring that the sample included in the surveys are representative of their communities. Due to limitations of resources and time, we were limited to the number of people that we could interview in each community. All interviews were conducted during the day and there is no way of ensuring that individuals that could participate in the study are not significantly different than those that could not be interviewed. A second limitation of the study is the over-sampling of females over males, as many men were out on their farms during the day while we were interviewing respondents.

Interviewers attempted to provide confidentiality to respondents, but due to the lack of facilities to preserve confidentiality, interview questions about health outcomes were limited and a broader set of health outcomes need to be included in future studies as well as ways to ensure confidentiality of respondents in the future.

In the Ghana sample, as all the respondents are over 30 and out of school, I cannot account for variations in the quality of schooling that the participant received. Although this study collected information about cognitive skills and decision-making skills, it did not examine the different aspects of the school curricula. The study did not examine actual school curricula and only examined the participant's basic mathematics ability. Originally the study included a literacy component but I could not locate a Twi version of the instrument and therefore I did not collect information about the person's literacy level. Although this study does not identify which curricular components of schooling are driving this relationship, I was able to examine the role of basic mathematic ability. However, my analysis does not rule out other curricular subjects, nor does it support the notion that mathematics is the key curriculum that enhances cognitive abilities.

Additional studies need to be developed that specifically examine multiple aspects of the core schooling curricula and how these relate to cognitive skills.

Several limitations developed that prevent me from analyzing other decision-making tasks that were administered to participants. The study included other measures of risk around HIV. However, due to the construction of the questions that included words such as HIV infection and prostitution, participants ignored all other information in the questions and rated things as high risk. The wording of the questions overshadowed the constructs of interest and resulted in an inability to analyze a second decision-making task.

Chapter 5

Analysis of the Role of Formal Schooling on HIV and AIDS Prevalence

This chapter examines the association between schooling and HIV infection in 11 sub-Saharan African countries using the DHS data described in Chapter 4. In this chapter I examine the relationship between schooling and HIV infection among the sub-sample within the larger DHS sample that was administered a dried blood spot HIV test. A central question that this study addresses is whether formal schooling protects individuals from HIV infection or whether it puts individuals at risk of HIV infection. As indicated in Chapter 4, participants in the DHS study were interviewed about sexual history and engagement in specific sexual behaviors and a subset of the participants were tested for HIV infection. This chapter presents the findings derived from the subset of the samples that were given the HIV test to understand the association between schooling and HIV infection, in order to understand whether: 1) schooling increases a person's risk of HIV infection, 2) there is no relationship, or 3) schooling has shifted to becoming a protective factor against HIV infection

In this chapter I will first examine the DHS data to test whether schooling is directly related to HIV infection. The second half of this chapter will examine how the association between schooling and infection is moderated by a person's age and whether when a person initiated engagement in sexual behavior moderates the relationship between schooling and HIV infection.

This chapter used the DHS data to examine the relationship between schooling and HIV infection by using a nationally representative sample. Past studies that have examined HIV infection rates have used data gathered at antenatal clinics or self-reported measures of HIV infection and have not used nationally representative samples (De Walque 2007; Gregson et al.

1995). Mishra and colleagues (2006) indicate that DHS surveys provide a more accurate and representative understanding of HIV infection than indicators from antenatal clinics in generalized epidemics. The DHS surveys provide a more objective measure of HIV infection by using biomarker data from dried blood spot samples administered on a nationally representative sample of the total population (Mishra et al., 2006).

The use of a nationally representative sample of HIV testing enables analysis of HIV infection on a more representative population than past studies on pregnant women, commercial sex workers, or other high risk groups (Rice et al., 2007). As I reported in chapters 2 and 3, past studies that have examined the relationship between schooling and HIV infection have found mixed results, but Hargreaves et al., (2008) recent meta-analysis indicates that HIV infection in SSA is shifting towards increased HIV infection among the lower educated populations and away from those with more schooling.

In this chapter I examine the relationship between schooling and HIV infection in the 11 countries in SSA found in table 5-1. The countries used in this analysis represent all different geographic regions of SSA that have had very different histories with the HIV pandemic. Most of the countries in this study reported the first cases of individuals diagnosed with HIV in the mid-1980s, with the earliest diagnosis occurring in 1983 in Tanzania and the latest diagnosis occurring in 1987 in Guinea. Although most countries first identified individuals with HIV in the mid 1980s, country responses have varied greatly and HIV infection among the general population has also varied greatly between these countries.

Table **5-1:** Descriptive HIV Infection Rates for each Country

	Year first HIV case diagnosed in the Country	HIV Infection Rate at time of Survey		
		Total	Female	Male
Burkina Faso	1986	1.9	1.8	1.9
Cameroon	1985	5.5	6.8	4.1
Ethiopia	1986	1.4	1.9	0.9
Ghana	1986	2.1	2.7	1.5
Guinea	1987	1.4	1.9	0.9
Kenya	1984*	6.7	8.7	4.6
Lesotho	1986	22.9	26.4	19.3
Malawi	1985	11.8	13.3	10.2
Rwanda	1983	3.0	3.6	2.3
Senegal	1986	0.6	0.7	0.4
Tanzania	1983	7.0	7.7	6.3

* Government did not release information until 1986

Source: HIV infection rates were calculated from the DHS Surveys. The year that the first HIV case was diagnosed in each country came from USAID country reports and UNAIDS, 2008.

The countries used in this study represent a wide range of government responses, as well as levels of HIV prevalence. According to the HIV infection data collected in the DHS data, of the countries in this dissertation, Senegal has the lowest HIV prevalence with a rate of 0.6 and Lesotho has the highest prevalence rate of 22.9 among the total population. Even though all countries report HIV being diagnosed in each of these countries during the mid 1980s, government responses have varied dramatically from complete denial of the existence of the disease in their country as late as 2000 in Kenya while Malawi only began to acknowledge AIDS in the country after 1995 (Gow, 2002). In contrast, countries such as Senegal developed national public responses as early as 1986 (Lom, 2001; Meda et. al., 1999). In addition to differences in the magnitude of HIV infection and government responses, the countries used in this study vary significantly in the distribution of educational attainment among the population as seen in table 5-2.

Table 5-2: Educational Distribution (%) of the DHS Sample

Country	Female Education Levels			Male Education levels		
	No education	Primary education	Secondary education or higher	No education	Primary education	Secondary education or higher
Burkina Faso	83.5	10.4	6.0	69.4	16.6	13.9
Cameroon	21.1	41.4	37.5	10.7	37.2	52.1
Ethiopia	71.5	17.0	11.5	49.1	29.1	21.8
Ghana	37.3	19.7	43.0	25.8	14.3	59.9
Guinea	82.0	9.4	8.6	56.0	14.6	29.5
Kenya	17.5	54.2	28.2	8.5	52.9	38.6
Lesotho	3.1	62.8	34.1	22.7	53.7	23.6
Malawi	25.4	61.8	12.8	11.1	63.7	25.2
Rwanda	28.6	60.7	10.7	20.2	66.1	13.7
Senegal	70.3	20.8	9.0	46.6	25.5	27.8
Tanzania	24.7	69.6	5.7	11.5	79.5	9.0

Sub-Saharan Africa saw significant expansion of educational access since the 1950s and 1960s as countries emerged from colonial control. Even with the massive gains in enrollments, there are still large segments of the population that have very limited access to schools due to a minimal number of primary and secondary schools in the region (Fentiman, Hall, & Bundy, 1999; Foster, 2008). As a result many adults, primarily women, have never attended school, with large segments of the population only having attended school for a few years. Males have historically had greater access to schooling as reflected in disparities between male and female educational attainment reported in Table 5-2. Burkino Faso (83.5%), Guinea (82%), Ethiopia (71.5%), and Senegal (70.3%) have the largest out of school female populations in the sample. Ghana (43%), Cameroon (37.5%), Lesotho (34.1%) and Kenya (28.2%) have the largest percent of women in the sample who have completed secondary school. This variation in both the male and female populations and across countries in educational attainment allows me to examine the relationship

between schooling and HIV infection in order to understand the role of schooling in the HIV and AIDS pandemic in the early 2000s.

Methods

I examine the relationship between schooling and HIV infection by examining the association between formal schooling and HIV infection across age cohorts using cross-sectional nationally representative DHS data for 11 SSA countries collected between 2003 and 2005. As stated in Chapter 4, individuals were tested for HIV infection and interviewed about their education, social status, and a number of demographic information (www.measuredhs.com).[8] Respondents range between the age of 15-49 for women and 15-59 for men.

Examining the DHS data only at the pooled level is limited and the risk of masking schooling effects that result from age cohorts who became sexually active at different points in the HIV pandemic emerge. Most of the respondents over the age of 35 at the time of the survey would have already engaged in sexual activity by 1990 when accurate information began to become available to the general public about the modes of HIV transmission, and many would have already engaged in sexual behavior by the mid 1980s when the first cases of HIV were being diagnosed in there respective countries, while respondents between the age of 15 and 24 at the time of the survey would have initiated sexual behavior after information about the modes of HIV transmission were more available to the general public. To address any age effects that could be masked in the pooled analysis I have created a 15-24 and 35 and older age cohort to analyze the relationship between schooling and HIV infection. The 25-34 year olds would be a mixed group where some would have engaged in sexual activity before HIV information was available

[8] DHS sampled subjects could refuse the HIV infection testing and still remain in the sample, these subjects are excluded from all analyses here.

and others would have engaged in sexual activity after information about HIV had become available and are not used in this analysis. This group serves as a reference group.

Because HIV infection is reported as either HIV positive (1) or HIV negative (0) and HIV infection is significantly smaller than 50%, the errors are not normally distributed, requiring me to use logistic regression to analyze the relationship between schooling and HIV infection. Equation 1 is estimated by 2 logistic, non-linear regressions for each country, and again for the 15-24 age cohort, 25-34 age cohort, the 35 and older age cohort.

Equation 5.1:

$$\ln [p/(1-p)] = B0 + B1\, Xj + B2Ej + B3Cj$$

p : Probability that the event Y (infection) occurs, p(Y=1)

p/(1-p) : is the “odds ratio”

ln [p/(1-p)] : The log odds ratio (logit)

Xj : Matrix of control variables (gender, marital status, socioeconomic status, place of residence)

Ej : Years of schooling.

Cj : Age cohort.

Applying the exponential function to each logit coefficient (exp (B4), exp(B3), exp(B2), exp(B1)) odds ratios were calculated in order to compare the effect of schooling across age cohort groups.

Findings

Schooling and HIV Infection

Table 5-3 summarizes the findings from the logistic analysis of the relationship between formal schooling and the likelihood of infection among adults of all ages, or the pooled sample for each of the 11 SSA countries after controlling for age, gender, marital status, socioeconomic status, and place of residence. The same equation is estimated for each country using logistic regression as described in equation 5.1.

Table **5-3:** Schooling's effect of HIV Infection for the Pooled Sample

Country	Schoolings effect on HIV Infection*		
	Risk Factor	**Null effect**	**Protective Factor**
Burkina Faso		**X**	
Cameroon	**X**		
Ethiopia		**X**	
Ghana		**X**	
Guinea		**X**	
Kenya		**X**	
Lesotho		**X**	
Malawi	**X**		
Rwanda	**X**		
Senegal		**X**	
Tanzania		**X**	

* Controlling for SES, Age, Gender, Marital Status, and Place of Residence

As Table 5-3 indicates, for the pooled sample, schooling remains a risk factor in three of the 11 countries and is not significantly related to HIV infection in eight of the 11 countries, and is not seen as a protective factor in any of the 11 countries. The results of the DHS analysis find that there is no association between schooling and HIV infection in eight of the 11 countries for the pooled population. These results appear to support findings that schooling has begun to

emerge as unrelated to HIV infection (Glynn et al., 2001) and the three countries where schooling can be identified as a risk factor-Rwanda, Malawi, and Cameroon-appear to run contrary to recent findings that schooling has shifted since 1996 to a protective factor against HIV infection (Hargreaves et al., 2008). In the three countries where schooling is identified as a risk factor, schooling only has a small effect on increasing the risk of infection by 5% in Rwanda, 3% in Malawi, and 2% in Cameroon, after controlling for SES, gender, age, marital status, and place of residence.

As Table 5-3 illustrates, by 2005, schooling was no longer a risk factor for HIV infection in eight of the 11 countries and only had very small effects of increasing risk of HIV infection in the remaining three countries. These results indicate that a shift has occurred in these eight countries and that the relationship between schooling and HIV infection is no longer significant in most countries. In contrast to past studies that have reported that schooling was positively associated with HIV infection, the DHS data indicates that schooling has shifted away from a risk factor and for those countries where schooling remains a risk factor, the increased odds of schooling are very minimal.

Age Cohort Analysis

There is no longitudinal data that provides multiple waves of individuals becoming sexually active in SSA over the course of the HIV pandemic for the countries in my study. To offset this limitation, I have created age cohorts to analyze the DHS data to analyze the relationship between schooling and HIV infection for individuals who initiated in sexual behavior at different stages of the HIV pandemic in SSA. Participants in the DHS range between the ages of 15-59. This age range reflects vast differences in the amount of time an individual has been sexually active. I created age cohorts to compare individuals who were sexually active prior to

information being available about HIV with those that initiated sexual behavior after information was available about the spread of HIV.

The age cohort analysis was employed as each age cohort reflects *period effects* of the interaction between sexual maturation of individuals and different historical points in the progression of the HIV in SSA (Alwin, Cohen, and Newcomb 1991). The age cohort analysis will test whether the relationship between schooling and HIV infection is different depending on when a person's age cohort first engaged in sexual behavior and its corresponding relationship with the stage of the HIV pandemic.

The oldest age cohort (35 years and older) became sexually active earlier in the disease's spread when there was little or no accurate information with which individuals could form a working theory of risks related to HIV infection, as such it is hypothesized that there should be more evidence of *schooling as a risk factor* among these older individuals. Starting with the 35 years old and older cohort, the youngest members of this cohort in the DHS went through puberty and became sexually at risk of HIV infection during the mid 1980s when there was very minimal information about modes of HIV transmission and even less understanding and discussion of heterosexual modes of HIV transmission (Rushing, 1995). Heterosexual mode of HIV transmission was neither widely understood nor publicly shared by governments in SSA at this time (Gow, 2002; Grmek, 1990). Older members of this age cohort were already at high levels of sexual activity from the earliest stages of the pandemic in the late 1970s and early 1980s.

In contrast to the 35 and older cohort, the youngest age cohort (15-24 year olds) became sexually active after knowledge about heterosexual modes of HIV transmission was known and SSA regimes were publicly more open about the existence of the disease in the region. These individuals began sexual activity in a period of greater understanding of the modes of transmission and the corresponding sexual behaviors that have been identified with reducing risk of infection, primarily abstinence, being faithful to one sexual partner, and condom usage if a

person is going to have multiple sexual partners. It is assumed that for the younger cohort, schooling would act more as a *protective factor* against HIV infection. At 24 years of age, the oldest members of the youngest age cohort were in puberty in the middle of the 1990s. By the 1990s there was widespread knowledge about how HIV and AIDS could be contracted through unprotected heterosexual intercourse, the primary mode of transmission in the region.

The middle age cohort (25-34 year olds) went through puberty and became sexually at-risk from the late 1980s into the early 1990s, a period that spans the point when there was little information about the disease available to a period when both the biology of infection and modes of transmission became clear and this more accurate information was made available to the public. Therefore among this age cohort there could be *risk and social vaccine processes* counteracting one another to produce a general null effect of schooling all together.

As seen in Table 5-4, when the analysis is divided into age cohorts, the effect of schooling as a risk factor almost completely disappears. The only group where schooling remains a risk factor for HIV infection is in the 25-34 year age cohort in Malawi. As seen in Table 5-4, the relationship between schooling and risk of HIV infection is nonexistent for the 35 and older cohort. Although the 25-34 year old age cohort primarily sees no relationship between schooling and HIV infection, as mentioned, the educated in Malawi are 5% more likely to be HIV infected than their lesser educated peers, whereas in Rwanda, the educated are 5% less likely to be HIV infected than their lesser educated peers. However, there is no relationship between schooling and HIV infection among the other nine countries.

Table **5-4:** Schooling on Likelihood of HIV Infection by Age Cohort

	Schooling Effect		
Country	**Youngest Age Cohort (15 - 24) Effect**	**Middle Age Cohort (25 - 34) Effect**	**Oldest Age Cohort (35+) Effect**
Burkina Faso	Null	Null	Null
Cameroon	**Protective Factor**	Null	Null
Ethiopia	Null	Null	Null
Ghana	**Protective Factor**	Null	Null
Guinea	**Protective Factor**	Null	Null
Kenya	**Protective Factor**	Null	Null
Lesotho	Null	Null	Null
Malawi	**Protective Factor**	**Risk Factor**	Null
Rwanda	Null	**Protective Factor**	Null
Senegal	**Protective Factor**	Null	Null
Tanzania	Null	Null	Null

* Controlling for SES, Gender, Marital Status, and Place of Residence

In contrast to the 25-34 and 35 and older age cohorts, the 15-24 year old age cohort reveals a very different relationship between schooling and HIV infection. More than half of the countries show schooling as a significant protective factor against HIV infection and none of them report schooling as a risk factor. For the youngest cohort, schooling acts as a protective factor against HIV infection ranging from 7% to 34% in these countries. The educated in Cameroon, Kenya, and Malawi are 7% less likely than their less educated peers to be infected with HIV. In Guinea, the educated are 10% less likely to be infected with HIV and in Ghana schooling protects even more with the more educated being 11% less likely than their less educated peers to be HIV infected. The country where the most dramatic protective effect of schooling can be seen is Senegal. In Senegal, the educated are 34% less likely to be HIV infected than their less educated peers making schooling a highly protective factor in preventing HIV infection.

The analysis of the relationship between schooling and HIV infection is better understood by this age cohort analysis than the original analysis conducted on the pooled sample. Contrasting the results from the period effects with the original pooled sample demonstrates that protective nature of schooling was being masked in the pooled sample. The age cohort analysis shows that the younger age cohorts in Guinea, Malawi, Senegal, Cameroon, Ghana, and Kenya show that schooling acts as a protective factor against HIV infection and that having some schooling reduces the risk of HIV infection by substantial amounts ranging from 7 to 34%.

In contrast, for the 25-34 age cohort, the role of schooling is mostly null, with schooling acting as a protective factor in Rwanda, and a risk factor in Malawi. Schooling effects are also smaller than the schooling effects for the younger cohort. For the 25-34 age cohort, schooling increases the risk of infection by 5% in Malawi while reducing the risk of HIV infection by 5% in Rwanda. Among the oldest age cohort, the effect is now completely null with schooling neither acting as a protective factor nor a risk factor for HIV infection.

These results support the argument that schooling is shifting away from a risk factor towards becoming a protective factor against HIV infection even though the many null effects among both the middle and oldest cohorts were partially unexpected. The implication of these findings will be discussed in greater detail in Chapter 8. What is clear by contrasting the age cohort effects with those from the total sample is that instead of concluding that schooling continues to be a risk factor or at most a null effect, there is evidence that schooling is starting to act as a preventative factor to HIV infection in six of these 11 countries. To understand the relationship between schooling and HIV and AIDS in SSA additional analysis is required to examine how schooling is reducing a person's risk of HIV infection among the younger cohort. To better understand how schooling is impacting HIV infection, I examine the relationship between schooling and three sexual behaviors that have been identified as reducing HIV infection in SSA in Chapter 6 (Kirby, 2008).

This secondary analysis examines three sexual behaviors that have been reported as impacting a person's risk of HIV infection: abstinence, being faithful to one sexual partner, and condom usage when a person has more than one sexual partner (the ABC's of HIV prevention). To examine schooling's effect on sexual behavior, I examine how schooling relates to a person's sexual behavior, and whether this relationship is really an effect of a person's access to information and better attitudes that are believed to be associated with increased schooling. An alternative hypothesis is put forth, that schooling has independent effects on sexual behavior above and beyond assumed paths through information and attitudes, but through cognitive ability and reasoning that is gained through the schooling process. Chapters 6 and 7 will respectively examine different aspects of these hypotheses.

Chapter 6

Analysis of the Role of Formal Schooling on HIV and AIDS Sexual Behavior in SSA

One of the assumed driving mechanisms of schooling in promoting health is the ability to disseminate information to a large segment of the population in a cost-effective manner (Mirosky & Ross, 2003). As accurate information became available about the modes of transmission of HIV, governments and non-governmental organizations (NGOs) in the region developed mass information campaigns and quasi-educational HIV interventions to transmit HIV and AIDS information to both in-school and out-of school adolescent and adult populations (Hargreaves & Boler, 2006).

The mantra of HIV curricula and interventions has focused on the ABC's of HIV; abstinence, being faithful to one sexual partner, and if you have multiple sexual partners than use a condom (Cohen, 2004; Collins, Bedford, Halabi, & Baker, 2009; Dailard, 2003; Schoepf, 2003). HIV interventions have taken shape as formal school curricula designed and implemented by NGOs, Ministries of Education, Ministries of Health, and international organizations for adult literacy and training programs (Hyde, Ekatan, Kiage, & Barasa, 2002; Kinsman, et. al., 2001; Kirby et. al., 1994). Mass media campaigns on radio, TV, movies, newspaper, billboards, and comics have been developed in an effort to inform the general public (Kelly, 2000; UNAIDS-IATT, 2002; World Bank, 2002; GOU/UAC/UNAIDS, 2000; UNDP, 2002). Other interventions have targeted specific "at-risk" populations, such as truck drivers, commercial sex-workers, and men who have sex with men, with direct peer education and on-site information dissemination (Campbell & MacPhail, 2002; Campbell & Mzaidume, 2001; Garfein et al., 2007; Laukamm-Josten , 2000; TASO-WHO,1995). The health intervention literature has documented how accurate information and attitudes and beliefs are necessary and directly related to behavior and must be targeted in any behavior change intervention (Ross & Rosser, 1989). Reductions of HIV

prevalence in SSA have been attributed to changes in the behaviors targeted in HIV curricula, primarily abstinence, being faithful to one sexual partner, and condom usage for individuals with multiple sexual partners (Green, Haperin, Nantulya, & Hogle, 2006; Gregson et al., 2006; Kirby, 2008; Murphy, Greene, Mihailovic, & Olupot-Olupot, 2006; Shelton et al., 2004).

HIV curricula and interventions in SSA have followed a three-tiered model that targets: a) increasing individuals' factual knowledge about the modes of transmission and means of preventing the spread of HIV; b) correct attitudes and beliefs about the rights, caring for, and interacting with people living with HIV and AIDS; and c) changing sexual behaviors by reducing risky sexual behavior and increasing protective sexual behavior (King, 1999). This chapter examines the relationships between schooling and engagement in the ABC sexual behaviors, while examining how information about HIV and attitudes and beliefs moderates this relationship.

With the multiple channels of information dissemination, both inside and outside of schools, members of the general public have increased access to information targeting attitudes and facts about HIV. The 15-24 age cohort had a much higher likelihood of receiving information about HIV and AIDS in schools while the 35 and older age cohort in the DHS would have left school before accurate information about the modes of HIV transmission were available. To understand the effect of schooling on engagement in sexual behaviors, the age cohorts described in Chapter 5 will be used to analyze the role of schooling on engagement in abstinence, being faithful to one sexual partner, and condom usage for individuals with multiple non-spousal sexual partners.

If access to information is driving the relationship, then the effect of schools on behavior should be attenuated once facts and attitudes that are targeted in HIV interventions are introduced into the models. My overarching research question in this chapter is whether access to information is moderating the relationship between schooling and engagement in sexual

behaviors, and if they are, for whom is it working. To examine this question, the chapter is based on the following hypotheses and research questions.

Hypotheses and Guiding Research Questions

To understand the role of schooling in the HIV and AIDS pandemic, this chapter examines the relationship between schooling and the ABC sexual behaviors identified as reducing HIV infection in SSA. This leads to my first research question: How is schooling related to engagement in the ABC sexual behaviors? For this research question I hypothesize that:

> **H1**: Schooling will be positively associated with increased engagement in abstinence, being faithful to one sexual partner and condom usage for individuals with multiple non-spousal sexual partners.

Since I hypothesize that schooling is positively associated with increasing engagement in these ABC sexual behaviors, I need to examine the contrasting claims that attempt to explain why schooling is related to the three ABC sexual behaviors. The most common argument is the "information-transfer" hypothesis: Schooling increases individuals' basic facts about health and prevention of disease, and this information translates directly into better decisions about risk and health (Nayga, 2001; Mirowsky & Ross, 2003). In the case of HIV and AIDS in SSA, it is widely assumed that acquisition of basic facts about heterosexual transmission of the virus and facts about abstinence, fidelity, and condoms, leads to engagement in preventative behaviors. A complimentary argument is the "attitude-change" hypothesis: Schooling imparts more positive attitudes about rights of and caring for people living with HIV and AIDS, and such attitudes reduces stigma which leads to openness about preventative strategies and their adoption among more educated individuals.

The assumption that schooling is a venue to transmit facts and attitudes that lead to behavior change has been the driving paradigm in policy and HIV interventions and curricula (Collins et al., 2009) To understand the role of facts and attitudes and how they moderate the relationship between schooling and engagement in the ABC sexual behaviors, my second and third research questions address: How does schooling relate to the acquisition of basic facts about the modes of HIV transmission and the adoption of positive attitudes towards people living with HIV and AIDS? If facts and attitudes are strongly related to schooling, how does the acquisition of facts and attitudes moderate the relationship between schooling and engagement in the ABC sexual behaviors? For these two research questions I hypothesize that:

H2: Schooling will be associated with increased acquisition of basic facts about HIV and AIDS transmission and more positive attitudes about people living with HIV and AIDS.

H3: The acquisition of basic facts about HIV and AIDS transmission and more positive attitudes about people living with HIV and AIDS will reduce the direct effect of schooling on engagement in the ABC sexual behaviors.

Schooling's persistent effect on engagement in sexual behavior requires the addition of a fourth research question. As accumulating basic facts and acquiring positive attitudes around HIV slightly moderate the effect of schooling on engagement in ABC sexual behaviors, they do not sufficiently explain why individuals with the same information and attitudes, but with different levels of schooling, act differently with this same information. Therefore an alternative argument is tested in this chapter.

Recent research on cognitive skills such as reasoning, novel problem-solving, and planning and strategy finds that these skills can be enhanced through environmental factors well into early adulthood (Ceci 1991; Cole 2003, Eslinger, Flaherty-Craig,, & Benton, 2004; Luria 1976). Comparisons of unschooled and schooled adults' cognitive skills (Knipe, Collins, Baker, & Peters, 2008; Collins et al, AERA 2009; Ceci 1991; Cole, 2003; Martinez; 2000); and

assessments of the cognitive demands of commonly used primary school curricula (Baker et al, under review) have demonstrated the shifting cognitive focus of schooling. This research suggests that schooling enables individuals to convert facts into a "reasoning knowledge". Blair and colleagues (2005) have hypothesized that formal schooling, even at its most basic application of the learning of language and mathematics is a cognitively enhancing environment. By teaching academic content, even in small amounts, schooling enhances fundamental cognitive capacities of individuals, leaving them with more skills to turn facts into deeper knowledge and understandings. These lines of inquiry have lead to my fourth research question: In the context of SSA, how do enhanced reasoning skills moderate the relationship between schooling and engagement in ABC behaviors when people have the same facts and attitudes about HIV? To address this question, I hypothesize that:

> **H4**: Schooling will increase a person's reasoning skills as exhibited by an individual's ability to dispel myths and use general information about sexually transmitted diseases (STD) that will moderate the relationship between schooling and engagement in ABC sexual behavior, even after controlling for acquisition of facts and attitudes.

Data Analysis

I test these four hypotheses using the DHS data for ten[9] SSA nations, I statistically examine the effect of schooling on a model reflecting the information and attitude hypotheses and likelihood of engagement in abstaining from sex during the previous 12 months, being faithful to only one sexual partner over the last 12 months, and condom usage for individuals with multiple sexual partners over the last 12 months prior to the survey. I estimated a structural equation

[9] This analysis is only on 10 countries instead of the 11 used in Chapter 5, as Guinea was dropped from the analysis due to missing data for all respondents on condom usage.

model (SEM) using Mplus to analyze the relationship between schooling and engagement in these ABC sexual behaviors. Using SEM, I examine the covariation among observed variables through a system of equations allowing dependent variables (facts, attitudes, and reasoning) to also act as predictors in engagement in the three sexual behaviors (Duncan, 1975; Bollen, 1989; Kline, 1998). SEM estimation allowed me to model direct and indirect effects corresponding to each research question and corresponding hypothesis. The final model examined in the schooling and sexual behavior model consists of both structural and measurement models. A measurement model consists of relationships among observed variables that reflect latent traits. In this analysis I have two latent constructs: positive attitudes and reasoning. The structural portion of the model consists of the direct and indirect effects between schooling, facts, attitudes, reasoning, and engagement in each of the three sexual behaviors.

The independent variable of interest for this analysis is years of schooling. All models have been controlled for gender, marital status, place of residence, socioeconomic status, and country of individual. The three dependent variables of interest are abstinence, being faithful, and condom usage. The moderating variables used in the SEM include basic facts about modes of HIV transmission and two latent constructs, attitudes and reasoning.[10]

To test my first research question-How is schooling related to engagement in the ABC sexual behaviors-I have independently regressed abstinence, being faithful, and condom usage on schooling while controlling for gender, SES, country, marital status, and residency. To test my second research question-Does schooling increase the acquisition of basic facts about the modes of HIV transmission and the adoption of positive attitudes towards people living with HIV and AIDS-I independently regressed basic facts of modes of sexual HIV transmission and attitudes on schooling while controlling gender, SES, country, marital status, and residency. To test my third research question-How does the acquisition of facts and attitudes moderate the relationship

[10] For a detailed description of the variables used in this analysis see chapter 4.

between schooling and engagement in the ABC sexual behaviors-I independently estimate the relationship between schooling and the ABC sexual behaviors while introducing facts and attitudes as moderating variables in the analysis while controlling for gender, SES, country, marital status, and residency. To test my fourth research question: How do enhanced reasoning skills moderate the relationship between schooling and engagement in ABC behaviors when people have the same facts and attitudes about HIV? I independently estimate the relationship between schooling and the ABC sexual behaviors while introducing applied reasoning in addition to facts and attitudes as moderating variables in the analysis while controlling for gender, SES, country, marital status, and residency.

Findings

R1: How is schooling related to engagement in the ABC sexual behaviors?

Figure 6-1 presents the standardized regression coefficients for each behavior run independently on schooling for the 15-24 age cohort while Figure 6-2 presents the standardized regression coefficients for each behavior run independently on schooling for the 35 and older age cohort.

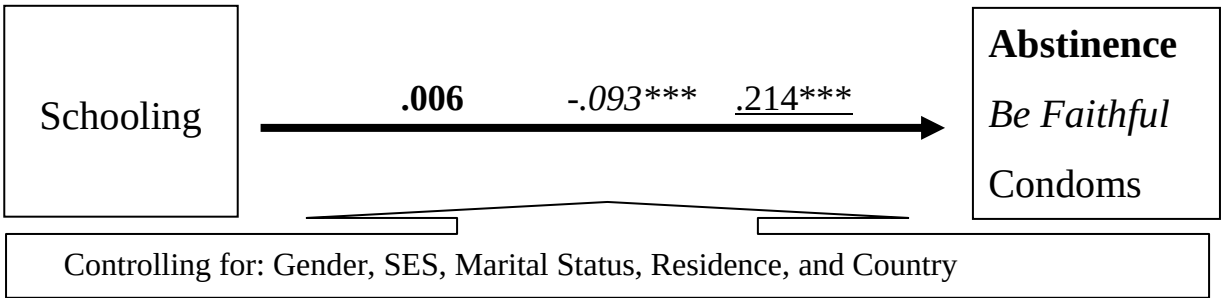

Figure **6-1:** Effect of Schooling on ABC behaviors for 15-24 Cohort

For the 15-24 year old cohort, years of schooling has no significant relationship with abstinence. According to this analysis, schooling is not related to whether a person remained

abstinent or engaged in sexual intercourse. Schooling is significantly related to whether a person engaged in sexual relationships with only 1 person or with multiple sexual partners. For those that have engaged in sexual intercourse, schooling reduced the likelihood of an individual to remain with only 1 partner. At first glance, in regards to the protective behaviors of abstinence and being faithful, for the 15-24 year olds, schooling appeared to either have no effect or increased risky behavior by increasing the number of sexual partners. However, for those who were sexually active and had more than one sexual partner, schooling significantly increases the use of condoms during sexual intercourse for the 15-24 year old age cohort. Although schooling is not related to increased abstinence and is related to an increased number of sexual partners for those that are sexually active, the 15-24 age cohort appears to offset some of the risks of having multiple sexual partners by engaging in increased condom usage.

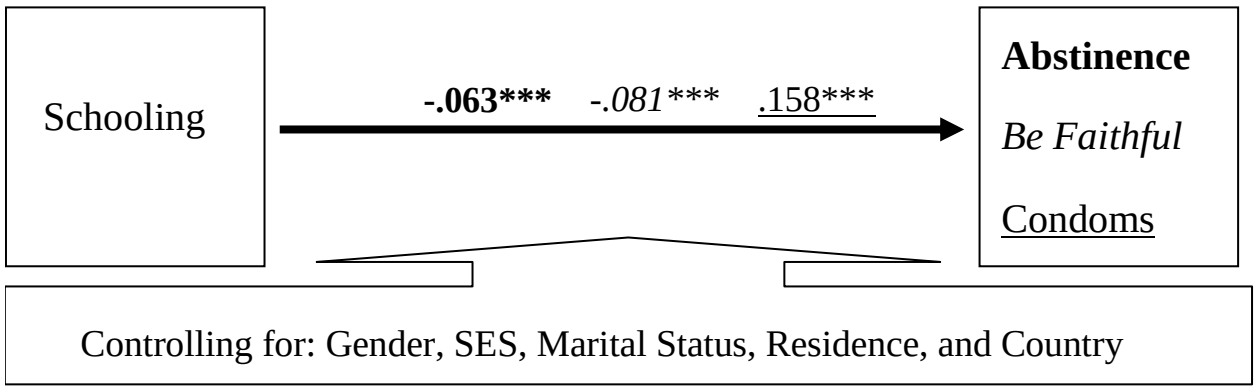

Figure **6-2**: Effect of Schooling on ABC behaviors for 35+ Cohort[11]

The relationship between schooling and engagement in the ABC sexual behaviors for the 35 and older cohort follows a similar pattern as the younger cohort except for abstinence. For the

[11] **Bold font** indicates coefficients related to Abstinence, *Italicized fonts* indicate coefficients related to Faithfulness, and Underlined fonts indicate coefficients related to a person with multiple sexual partners who uses condoms.

35 and older cohort, schooling significantly decreases a person's engagement in abstinence. Similar to the 15-24 year old cohort, for those who have engaged in sexual intercourse, schooling reduces the likelihood of an individual to remain with only one sexual partner for the 35 and older cohort. The effect is slightly smaller for the 35 and older cohort than the 15-24 age cohort: -.081 compared to -.093. For the 35 and older cohort, schooling increases risky behavior by reducing engagement in abstinence, and for those that are sexually active, schooling increases sexual intercourse with more than one sexual partner. Similar to the 15-24 year age cohort, schooling also increases the usage of condoms for those that do engage in sexual intercourse with more than one sexual partner. The effect of schooling on condom usage is smaller for the older cohort than the younger cohort: .158 compared to .214.

These results identify that years of schooling are negatively associated with the practice of being faithful to one's partner, while being positively related to the use of condoms if the person has multiple sexual partners and shows that schooling has no relationship with abstinence for the 15-24 year olds, while it decreases abstinence among the 35 and older cohort. The analysis identifies that for persons 35 years and older, individuals with more years of schooling are less likely to practice abstinence or remain faithful to one sexual partner than their less educated peers. For both the 15-24 and the 35 and older cohorts, when those with more years of schooling do have multiple sexual partners they are more likely to use condoms more frequently than their less educated peers. These associations between schooling and behaviors indicate that although schooling tends to increase risky behavior of engaging in sexual intercourse with more than one partner, the educated are offsetting these risks by adopting protective behaviors of using condoms more than their less educated peers. The use of condoms for individuals with multiple sexual partners reflects the concept presented in HIV intervention that a commercial sex worker who uses condoms consistently has a lower risk of HIV infection than a person who has only three or four partners but doesn't use a condom (GSMF, NDa). One plausible explanation of the perceived

relationship between schooling and engagement in these sexual behaviors is that schooling increases a person's access to information and the more educated have different attitudes.

Basic Facts about HIV and AIDS and Positive Attitudes

R2: How does schooling relate to the acquisition of basic facts about the modes of HIV transmission and the adoption of positive attitudes toward people living with HIV and AIDS?

Figure 6-3 presents the standardized regression coefficients for each analysis between schooling and the acquisition of facts about the sexual modes of HIV transmission and positive attitudes about people living with HIV and AIDS for the 15-24 year age cohort and Figure 6-4 present the standardized coefficients for the same analysis but for the 35 and older cohort. For both the 15-24 year age cohort and the 35 and older cohort, schooling has a significant effect on a respondent's ability to answer prompted questions about basic facts regarding the modes of HIV transmission. For each additional year of schooling, facts about sexual modes of HIV transmission increase significantly by .227 for the 15-24 age cohort and .170 for the 35 and older cohort. Similarly, for every additional year of schooling, positive attitudes toward people living with HIV and AIDS increase significantly by .446 for the 15-24 age cohort and .353 for the 35 and older cohort.[12]

[12] Not presented here, but available upon request, analysis of the two cohorts found statistical significance at the .01 level between the two cohorts for both the relationship between schooling and basic facts and schooling and attitudes.

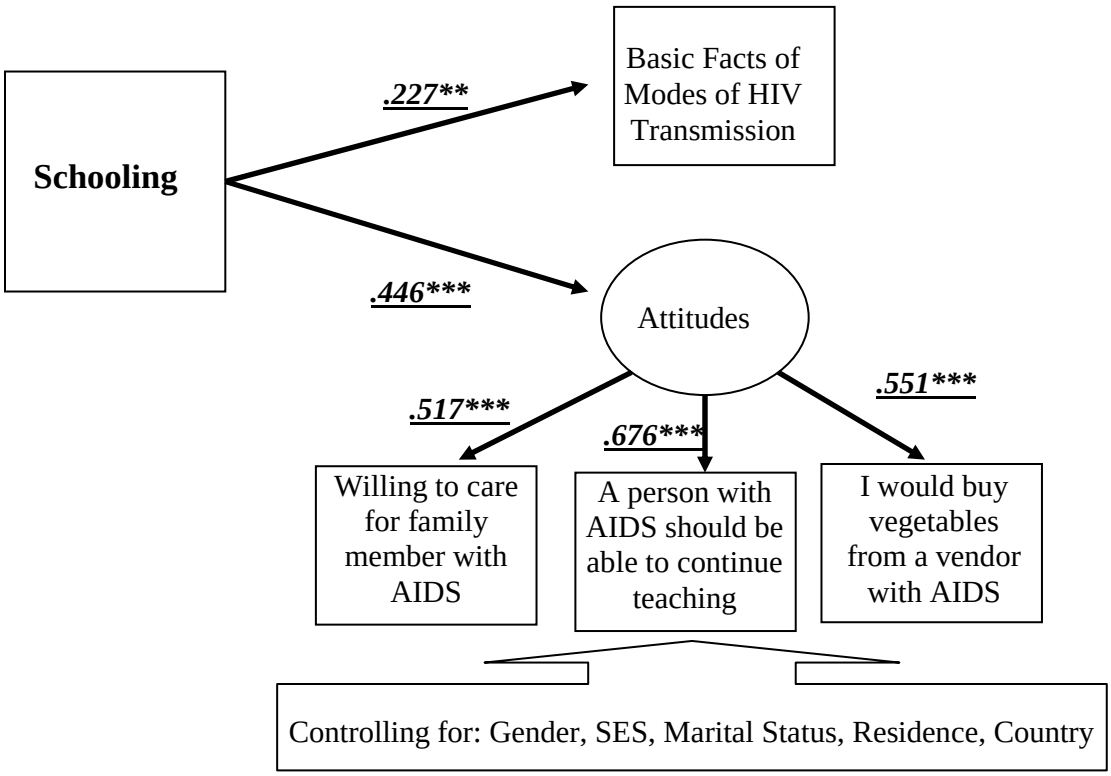

Figure **6-3:** Relationship between Schooling and Facts and Attitudes for 15-24 Cohort

Figure 6-3 and 6-4 indicate that the relationship is slightly stronger for the younger cohort than the older cohort. This could indicate that younger individuals do receive greater HIV information in schools, but that even individuals who have been out of school, and would not have received HIV information in schools, years of schooling significantly increase the acquisition of basic facts and attitudes about HIV. The relationship also appears to be stronger between schooling and attitudes than schooling and basic facts with the coefficients being almost two times larger for the relationship between schooling and attitudes than the coefficient for schooling and basic facts for both age cohorts. Indicating that schools are not only influencing the acquisition of facts but are also important in shaping individual attitudes about non-school related issues, such as HIV.

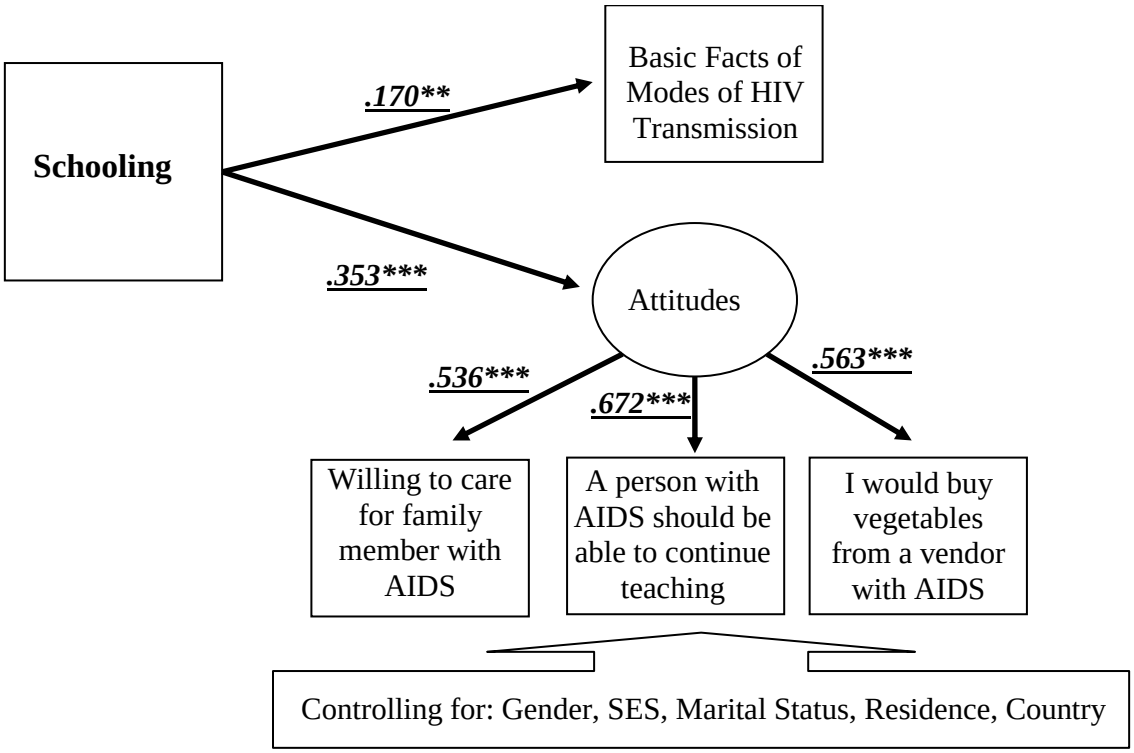

Figure **6-4:** Relationship between Schooling and Facts and Attitudes for 35+ Cohort

Schooling, Facts, Attitudes and ABC Sexual Behaviors

R3: How does the acquisition of facts and attitudes moderate the relationship between schooling and engagement in the ABC sexual behaviors?

Since years of schooling were significantly and positively related with the acquisition of facts about the sexual modes of HIV transmission and positive attitudes toward people living with HIV and AIDS for both age cohorts, I introduce basic facts about sexual modes of HIV transmission and positive attitudes about people living with HIV and AIDS as moderating variables into the model examining the effect of schooling on all three ABC sexual behaviors for both age cohorts.

Figure 6-5 presents the standardized regression coefficients of the 15-24 age cohort analysis of my third research question while Figure 6-6 presents the standardized regression coefficients of the 35 and older age cohort. Table 6-1 presents the calculated direct, indirect, and total effect of schooling on engagement in the ABC sexual behaviors. For both cohorts, the acquisition of basic facts and attitudes moderates the relationship between schooling and engagement in the ABC sexual behaviors but the direct effect of schooling continues to significantly persist in the all of the analyses.

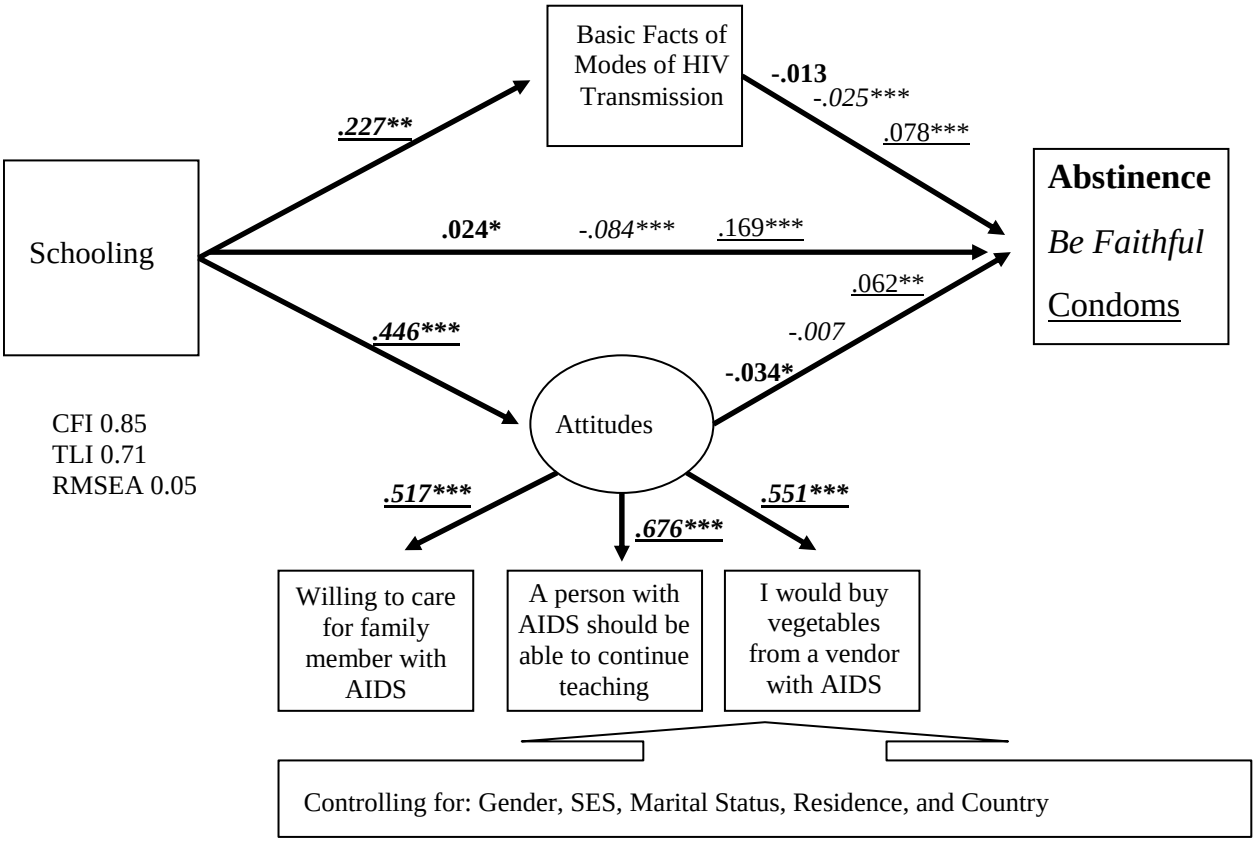

Figure **6-5:** Relationship between Schooling, Facts and Attitudes on ABC behaviors for 15-24 cohort [13]

[13] **Bold font** indicates coefficients related to Abstinence, *Italicized fonts* indicate coefficients related to Faithfulness, and Underlined fonts indicate coefficients related to a person with multiple sexual partners and uses condoms.

For the 15-24 age cohort, when facts and attitudes are included in the model education becomes a significant direct effect on increasing engagement in abstinence (.024) while continuing to reduce being faithful to only one sexual partner (-.084) and increasing condom usage when a person has multiple sexual partners (.169). In addition to these significant direct relationships, years of schooling acts indirectly through the acquisition of facts and attitudes. For abstinence, schooling does not work through the acquisition of basic facts but the acquisition of positive attitudes reduces engagement in being abstinent by -.015. Schooling continues to significantly increase abstinence even after accounting for the reduction of attitudes on decreasing engagement in abstinence. The total effect of schooling on increasing engagement in abstinence is .009. Although this coefficient is significant, the effect size is very small.

The “be faithful” outcome also has indirect schooling effects through the acquisition of basic facts and attitudes. In contrast to the “abstinence” model, for being faithful to one sexual partner, schooling does work through the acquisition of basic facts but does not work through the adoption of positive attitudes. For the 15-24 year age cohort, when schooling passes through the acquisition of positive attitudes, schooling reduces “being faithful” to one sexual partner by -.006. When both the direct and indirect effect of schooling is calculated, the total effect of schooling on being faithful is a decline in faithfulness to one sexual partner by -.090.

The largest schooling effects are seen in the relationship between schooling and condom usage for individuals that have more than one sexual partner. Just as schooling has the largest direct effect on condom usage of all three of the sexual behaviors examined in this chapter, schooling also works through the acquisition of facts and positive attitudes. The indirect effect of schooling on condom usage through the acquisition of basic facts is .018 and .028 through positive attitudes. This creates a total effect of schooling on condom usage for the 15-24 year olds of .214. In regards to the three sexual behaviors targeted in HIV interventions, school curricula, and informational campaigns, schooling has the least effect on abstinence, a larger negative effect

on being faithful to one sexual partner, and an even larger effect on increasing condom usage for individuals that do have more than one sexual partner.

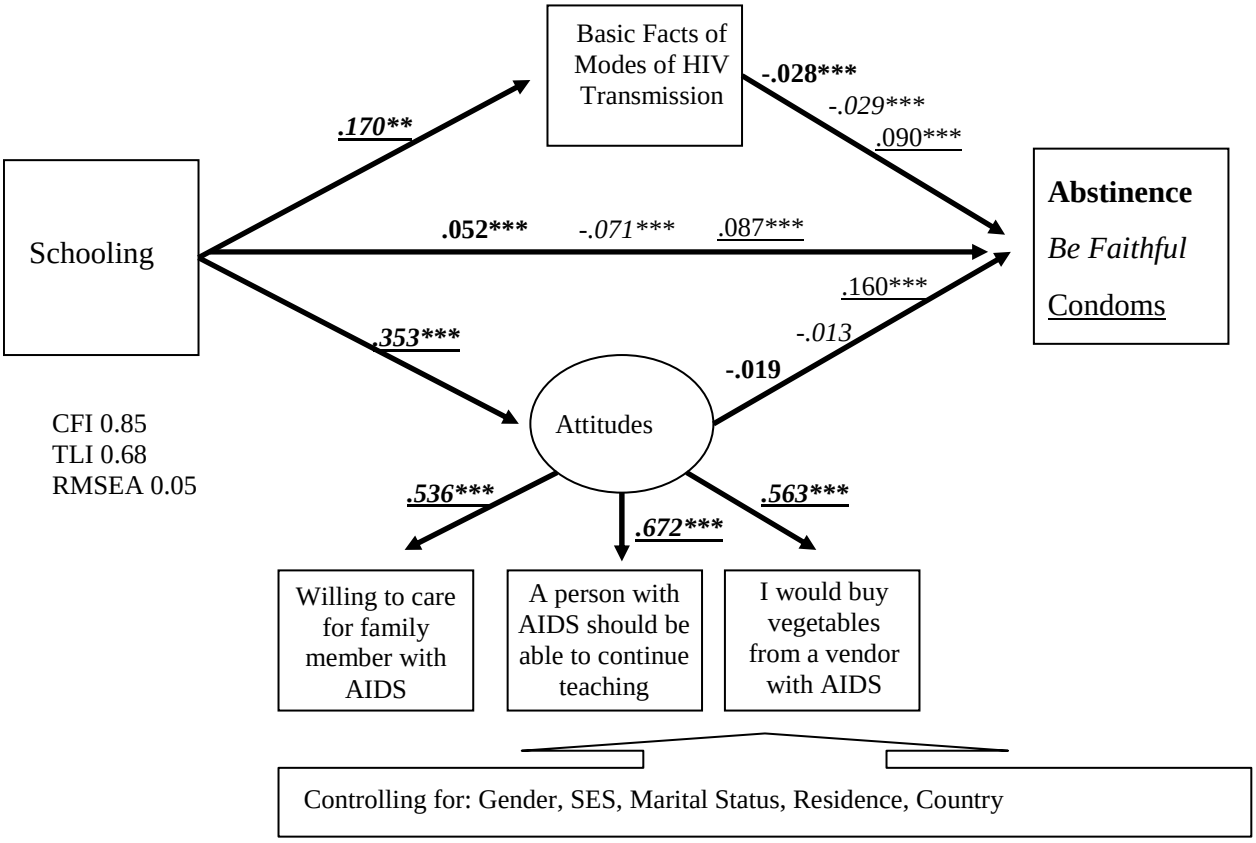

Figure **6-6:** Relationship between years of Schooling, Facts and Attitudes on ABC behaviors for the 35 and older cohort[14]

For the 35 and older cohort (Figure 6-6 and Table 6-1) when facts and attitudes are included in the model education changes from reducing engagement in abstinence to significantly increasing engagement in abstinence by .052 while reducing being faithful to only one sexual partner by -.071. The direct effect of schooling on increasing condom usage when a person has multiple sexual partners even after controlling for acquisition of basic facts and attitudes is .087. Schooling works through the acquisition of facts for all three outcome behaviors while only significantly acting through attitudes for condom usage.

[14] **Bold font** indicates coefficients related to Abstinence, *Italicized fonts* indicate coefficients related to Faithfulness, and Underlined fonts indicate coefficients related to a person with multiple sexual partners who uses condoms.

For abstinence, in contrast to the 15-24 year age cohort, schooling works through the acquisition of basic facts but not through the acquisition of attitudes for the 35 and older cohort. When schooling works through the acquisition of basic facts, individuals are more likely to engage in sex than be abstinent: -.005. Similar to the 15-24 age cohort, the direct effect of schooling persists in increasing engagement in abstinence even with the reduction of abstinence that results from when schooling passes through the acquisition of basic facts resulting in a total effect of schooling of .047 on abstinence. The effect of schooling being stronger on abstinence for the 35 and older cohort than the 15-24 age cohort is a surprising finding as abstinence is targeted more at younger populations than older populations and the abstinence message is believed to be incompatible with most older populations' lifestyles and attitudes (GSMF, NDb).

The "be faithful" outcome also has indirect schooling effects through the acquisition of basic facts but not through the adoption of positive attitudes. For being faithful to one sexual partner, schooling works through the acquisition of basic facts but does not work through the adoption of positive attitudes. When schooling passes through the acquisition of basic facts, schooling increases the number of sexual partners and reduces faithfulness to one sexual partner by -.005 for the 35 and older cohort. The total effect of schooling on increasing the number of sexual partners and reducing faithfulness to only one sexual partner by -.076 is not a surprising finding, particularly as schooling works in both cohorts to reduce faithfulness to one sexual partner.

Similar to the 15-24 age cohort, the largest schooling effects for the 35 and older cohort is seen in the relationship between schooling and condom usage for individuals that have more than one sexual partner. Condom usage has the largest direct and total effect of schooling of all three of the ABC sexual behaviors examined for the 35 and older cohort. Condom usage is the only one of the three outcome behaviors where schooling works through both the acquisition of facts and positive attitudes. The indirect effect of schooling on condom usage through the

acquisition of basic facts is .015 and .056 through positive attitudes. This creates a total effect of schooling on condom usage for the 35 and older cohort of .159.

Table **6-1:** Direct and Indirect Effects of Schooling through Basic Facts and Attitudes on ABC behaviors by age cohort

		Abstinence		Be Faithful		Condoms	
	Age Cohort	15-24	35+	15-24	35+	15-24	35+
	Direct Effect	0.024	0.052	-0.084	-0.071	0.169	0.087
Indirect Effects	Basic Facts	0	-0.005	-0.006	-0.005	0.018	0.015
	Attitudes	-0.015	0	0	0	0.028	0.056
	Total Effect	0.009	0.047	-0.09	-0.076	0.214	0.159

Source: Calculated by Author

In regards to the three sexual behaviors targeted in HIV interventions and curricula, schooling has the least effect on abstinence. The effect of schooling on increasing abstinence for the 35 and older cohort is much larger than the effect of schooling on increasing abstinence for the 15-24 age cohort who are the primary target population of abstinence only information campaigns. In contrast to abstinence, both age cohorts report similar effects on schooling reducing faithfulness to one sexual partner. The largest schooling effects are seen in the use of condoms for individuals that have more than one non-spousal sexual partner. Condom usage when an individual has more than one non-spousal sexual partners is a major component of HIV interventions targeting adults, however, the effect of condom usage is stronger for the 15-24 age cohort who receive a primarily abstinence-only curricula (Collins, et al, 2009).

For both age cohorts, years of schooling have both a direct and indirect effect on engagement in the ABC behaviors. Even with the inclusion of facts and attitudes, schooling continues to have a strong direct effect on engagement in abstinence, being faithful to one sexual partner, and condom usage. These findings reject the information-transfer hypothesis and the attitude change hypothesis that are often used to explain the role of schooling on engagement in

these sexual behaviors. These theories do not adequately account for the persistent direct effects of schooling on engagement on all three sexual behaviors.

Schooling, Reasoning, Facts, Attitudes and ABC Sexual Behaviors

R4: How do enhanced reasoning skills moderate the relationship between schooling and engagement in ABC behaviors when people have the same facts and attitudes about HIV?

The acquisition of facts and positive attitudes do not adequately explain the relationship between schooling and engagement in the ABC sexual behaviors. To test my fourth research question, I introduce applied reasoning as an additional moderating variable in addition to basic facts about sexual modes of HIV transmission and positive attitudes about people living with HIV and AIDS into the model examining the effect of schooling on all three ABC sexual behaviors for both age cohorts.

Figure 6-7 presents the standardized regression coefficients of the 15-24 age cohort analysis of my fourth research question while Figure 6-8 presents the standardized regression coefficients of the 35 and older age cohort. Table 6-2 presents the calculated direct, indirect, and total effect of schooling on engagement in the ABC sexual behaviors when moderated by applied reasoning, basic facts, and attitudes. For both age cohort, the inclusion of applied reasoning moderates the relationship between schooling and engagement in the ABC sexual behaviors and mediates many effects that had previously been attributed to acquisition of basic facts and attitudes.

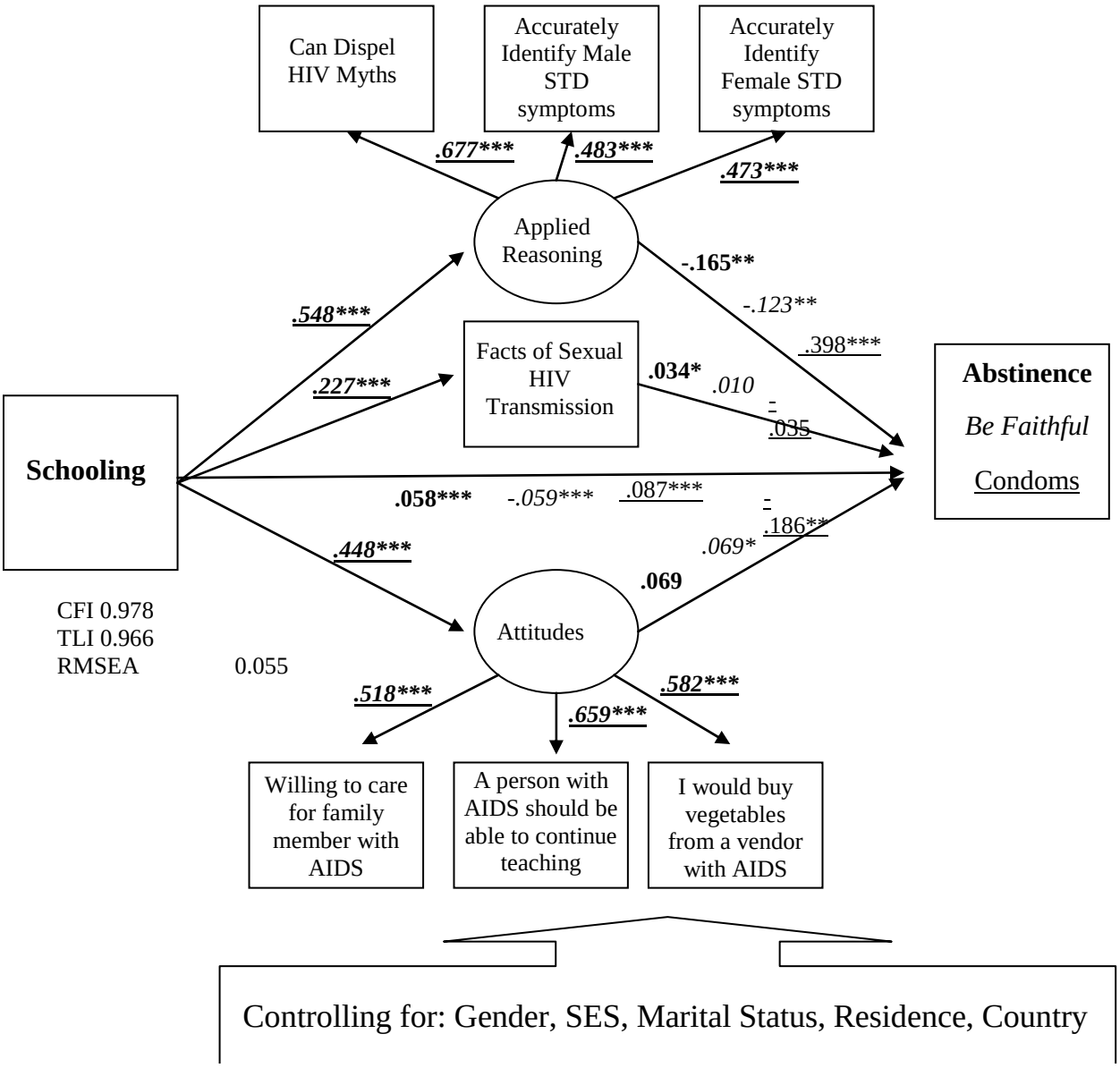

Figure **6-7:** Years of Schooling on ABC Behaviors moderated by Reasoning, Facts, and Attitudes for the 25 to 24 age cohort [15]

When the applied reasoning construct is introduced into the model, the effect of schooling on engagement in the three sexual behavior changes for both age cohorts. For the 15-24 age cohort, the direct effect of education on the ABC sexual behaviors increases the direct effect

[15] **Bold font** indicates coefficients related to Abstinence, *Italicized fonts* indicate coefficients related to Faithfulness, and Underlined fonts indicate coefficients related to a person with multiple sexual partners who uses condoms

of education on abstinence (.058) while reducing engagement in fidelity to one sexual partner (-.059), and increases condom usage for those that have multiple non-spousal sexual partners (.087). The inclusion of applied reasoning changes the effect of schooling through the acquisition of basic facts and positive attitudes on engagement in the ABC sexual behaviors that was reported in Figures 6-5 and 6-6. As seen in Figure 6-7, basic facts about the modes of HIV transmission now significantly increases abstinence but is no longer related to faithfulness to one sexual partner and condom usage for individuals with multiple non-spousal sexual partners, making schooling indirectly increase engagement in abstinence by .008. However, schooling has no effect on being faithful to one sexual partner or condom usage for individuals with multiple non-spousal sexual partners through the acquisition of basic facts.

In contrast to the indirect effect of schooling via basic facts, the relationship between schooling and the three ABC sexual behaviors when it passes through positive attitudes towards individuals with HIV and AIDS has no effect on abstinence but does impact being faithful to one sexual partner and condom use. When schooling works through positive attitudes an increase in engagement in faithfulness to one sexual partner is seen (.031) but at the same time attitudes decrease condoms usage for individuals with multiple sexual partners by -.083. When the indirect effect of schooling works through the applied reasoning construct, schooling has a significant effect on all three ABC sexual outcome behaviors. When schooling passes through the reasoning construct, schooling decreases abstinence by -.090, faithfulness to one sexual partner by -.067, but increases condom usage for individuals with multiple non-spousal sexual partners by .218.

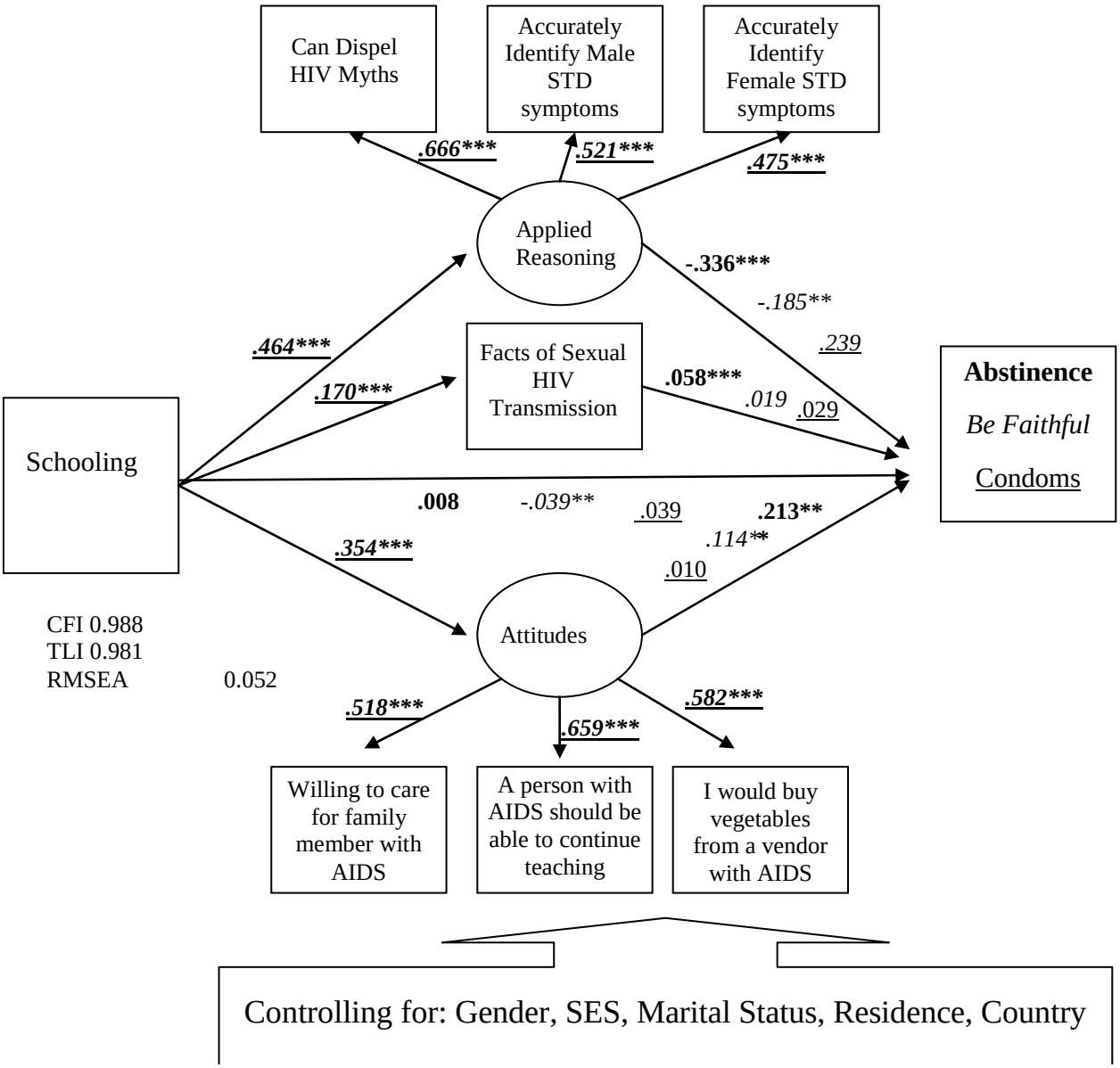

Figure **6-8:** Years of Schooling on ABC Behaviors moderated by Reasoning Facts and Attitudes for the 35 and older age cohort[16]

As reported in Figure 6-8, for the 35 and older cohort, the inclusion of the applied reasoning construct removes the direct effect of schooling for both abstinence and condom usage for individuals with multiple non-spousal sexual partners. Once applied reasoning is introduced

[16] **Bold font** indicates coefficients related to Abstinence, *Italicized fonts* indicate coefficients related to Faithfulness, and Underlined fonts indicate coefficients related to a person with multiple sexual partners who uses condoms

as a moderating variable, the direct effect of schooling on reducing engagement in being faithful to one sexual partner declines from -.059 to -.039. The effect of schooling through the acquisition of basic facts and positive attitudes also changes for the 35 and older cohort once the reasoning construct is introduced into the model. As seen in Figure 6-8, basic facts about the modes of HIV transmission now significantly increases abstinence (.058), but basic facts are no longer related to faithfulness to one sexual partner or condom usage for individuals with multiple non-spousal sexual partners. The inclusion of applied reasoning changes the indirect effect of schooling through the acquisition of basic facts from -.005 to .010. However, as noted in Table 6-2, schooling has no indirect effect on being faithful or condom usage for individuals with multiple non-spousal sexual partners through the acquisition of basic facts.

In contrast to the indirect effect of schooling via basic facts, the relationship between schooling and the three sexual behaviors when schooling indirectly works through positive attitudes towards individuals with HIV and AIDS has no effect on abstinence but does increase being faithful to one sexual partner and condom usage for individuals with multiple sexual partners. When schooling passes through positive attitudes an increased engagement in faithfulness to one sexual partner is seen (.04). For the 35 and older cohort when schooling passes through positive attitudes, schooling indirectly increases the usage of condoms for individuals with multiple sexual partners by .075. When schooling passes through the reasoning latent construct, schooling decreases abstinence by -.156 and faithfulness to one sexual partner by -.086, but increases condom usage for individuals with multiple non-spousal sexual partners by .218.

Table **6-2:** Direct and Indirect Effect of Schooling through Reasoning, Basic Facts, and Attitudes on ABC behaviors by age cohort

		Abstinence		Be Faithful		Condoms	
	Age Cohort	**15-24**	**35+**	**15-24**	**35+**	**15-24**	**35+**
	Direct Effect	0.058	0	-0.059	-0.039	0.087	0
Indirect Effects	**Basic Facts**	0.008	0.01	0	0	0	0
	Attitudes	0	0	0.031	0.04	-0.083	0.075
	Reasoning	-0.09	-0.156	-0.067	-0.086	0.218	0
	Total Effect	-0.025	-0.146	-0.095	-0.084	0.222	0.075

Source: Calculated by Author

For the 15-24 age cohort, once the reasoning construct is added into the model, the total effect of schooling on abstaining from sex shifts from increasing the chance of an individual to not engage in sexual activity from .09 to increasing the chance of engaging in sexual activity and not abstaining from sex by -.025. The total effect of being faithful to one sexual partner for the 15-24 age cohort increases slightly from -.090 before adding in applied reasoning to -.095 once reasoning is added into the analysis. Similar to the being faithful analysis, once reasoning is introduced into the model, the total effect of schooling on condom usage for individuals with multiple non-spousal sexual partners increases from .214 to .222 for the 15-24 age cohort.

Once the reasoning construct is added into the model for the 35 and older cohort, the total effect of schooling on abstaining from sex shifts from increasing the chances of an individual to not engage in sexual activity from .047 to increasing the chances of engaging in sexual activity and not abstaining from sex by -.146. The total effect of schooling on being faithful to one sexual partner for the 35 and older cohort increases slightly from -.076 before adding in applied reasoning to -.084 once reasoning is added into the analysis. In contrast to the effects seen for being faithful, when reasoning is added into the analysis on condom usage, the total effect of schooling on condom usage for individuals with multiple non-spousal sexual partners decreases from .159 to .075 for the 35 and older age cohort.

These findings present an interesting effect of the interplay between schooling and the acquisition of facts, attitudes, and reasoning on the engagement in the targeted ABC sexual behaviors. For both the 15-24 and the 35 and older age cohorts, the inclusion of the applied reasoning construct reduces engagement in abstinence and increases the effect of schooling on not being faithful to one sexual partner. In terms of abstinence, for both age cohorts, the more schooled are less likely to abstain from sex than their unschooled peers although schooling has a much larger total effect on reducing engagement in abstaining from sexual activity for the 35 and older cohort (-.146) than for the 15-24 age cohort (-.025).

Even though HIV curricula for the 15-24 age cohort stress abstinence, it appears that when schooling passes through the acquisition of facts, attitudes, and reasoning constructs, schooling actually decreases engagement in abstinence for the 15-24 age group to a larger effect than for the 35 and older cohort. The total effect of schooling on being faithful to one sexual partner appears to decrease fidelity to one sexual partner in very similar ways for both the 15-24 age cohort (-.095) and the 35 and older cohort (-.084).

The applied reasoning construct acts differently for the 15-24 age cohort and the 35 and older cohort when examining the relationship between schooling and condom usage for those that have multiple non-spousal sexual partners. For the 15-24 age cohort, the inclusion of the applied reasoning construct actually increases the total effect of schooling on condom usage, while decreasing the effect of schooling on condom usage for the 35 and older cohort. This results in schooling having a much larger total effect on increasing condom usage for the 15-24 age cohort (.222) than for the 35 and older cohort (.075).

Schooling and Engaging in ABC Sexual Behaviors

Although schooling reduced HIV infection in six countries among the 15-24 age cohort as reported in Chapter 5, the effect of schooling on engagement in the ABC sexual behaviors presents a more complex effect of schooling. Schooling is believed to reduce engagement in risky behavior, and it was assumed that schooling would increase engagement in abstinence, and fidelity to one sexual partner. However, the results of this study indicate that schooling actually reduces engagement in abstinence and fidelity to one sexual partner for both age cohorts. However schooling significantly increases condom usage for individuals with multiple sexual partners. These findings indicate that schooling may actually increase engagement in risky sexual behavior, yet this risk is being tempered by protective strategies like increasing condom usage if the person engages in higher risk sex such as having multiple sexual partners.

For both age cohorts, years of schooling have direct and indirect effects on engagement in the ABC sexual behaviors. The acquisition of facts and attitudes only have marginal effects on engagement in the ABC sexual behaviors, whereas schooling continues to have a significant and persistent direct effect on engagement in the ABC sexual behaviors even after controlling for information and attitudes. These findings reject the information-transfer hypothesis and the attitude change hypothesis often used to explain the role of schooling on engagement in these behaviors. These theories do not accurately account for the persistent direct effects of schooling on engagement in these sexual behaviors. The inclusion of the applied reasoning construct further supports that the information-transfer and attitude change theories are overly simplistic in explaining the effect of schooling on engagement in ABC sexual behavior.

These findings support the need to further examine the role of schooling on the HIV and AIDS pandemic by analyzing how people with the same information and attitudes but different

levels of schooling make decisions about engagement in sexual behaviors related to HIV and AIDS. The DHS does not collect data on cognition and decision-making. To offset this data limitation, I conducted a study in Ghana that examined the relationship between schooling and decision-making around engagement in HIV related sexual behaviors. Chapter 7 will present the findings of the analysis that examines the relationship between schooling and sexual behavior and how this relationship is moderated by cognitive and decision-making abilities. This analysis is a step in understanding how attending school has effects on health and prevention of HIV over and above the acquisition of facts and attitudes.

Chapter 7

Schooling's Cognitive Pathway to Decision-making and Health Behavior

The limitations of the information-transfer and attitude change hypotheses represent many limitations of past research that have examined the relationship between schooling and health, particularly HIV in SSA. The findings reported in Chapter 6 indicate the need to find an alternative theory that more fully explains the effect of schooling on health and in particular behavior and HIV infection in SSA. Due to the limitations of alternative theories in not actually examining how schooling impacts an individual has hampered attempts to understand the role of schooling in increasing better health and reducing HIV infection. This chapter analyzes how people with the same information and attitudes but different levels of schooling make decisions about engagement in sexual behaviors related to HIV and AIDS.

As the DHS data did not provide information on reasoning and decision-making I use data that I collected during fieldwork in Ghana during the summer of 2007 to examine the relationship between schooling and decision-making around engagement in HIV related sexual behaviors. This analysis is a step in understanding how attending school protects an individual from HIV infection and engagement in protective behavior above and beyond the acquisition of facts and attitudes. As I documented in Chapter 5, schooling is protecting the 15-24 age group from HIV infection in six countries analyzed using the DHS data. I further documented that individuals with the same facts and attitudes are behaving differently in how they engage in abstinence, being faithful, and condom usage as a result of different levels of educational attainment. This chapter takes a cognitive psychological approach to examine how schooling influences people with the same information and attitudes to behave differently?

To better understand the role of schooling and why schooling appears to be acting as a protection against HIV infection and its corresponding effect on sexual behavior, I examined the relationship between schooling, cognitive skills, and decision-making ability, in addition to sexual behavior as seen in condom usage.

This chapter posits that schooling enhances cognitive skills, specifically working memory and planning and strategy abilities that along with basic mathematic ability are related to decision-making ability. Researchers have identified that cognitive skills are related to problem-solving and everyday reasoning (Hambrick & Engle, 2003; Hambrick & Oswald, 2005). A limited number of studies have attempted to connect how schooling directly increases cognitive skills (Knipe et al., 2008; Luria, 1976; Martinez, 2000) while others have documented that cognitive capacities related to problem-solving and reasoning are trainable (Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Perrig, W. J., 2008; Klingberg et al., 2005; Posner & Rothbart, 2005; Sternberg, 2008; Willis et al., 2006). Studies have demonstrated that intelligence and cognitive capacities have been increasing in the general population since the 1930s (Flynn, 1984; Neisser, 1998), paralleling the rapid expansion of public education in many western countries (Shofer & Meyer, 2005).

Recent research has documented how the U.S. elementary mathematics curriculum has become increasingly focused on cognitive activities, including mental math and flexible mental representation and reasoning (Baker et al., forthcoming; Blair et al., 2007; Blair & Razza, 2007). This shift in cognitive focus suggests that school activity may increasingly exercise and enhance cognition, while building mathematical ability or numeracy. Research on decision-making has posited that understanding numbers and using them logically is an essential skill in decision-making and risk assessment (Benjamin, Brown, & Shapiro, 2006; Frederick, 2005).

Several studies have examined the relationship between numeracy and decision-making but have not examined the role of schooling or cognition and how these affect both numeracy and

decision-making (Bruine de Bruin et al. 2007; Peters, et al 2006; 2007; Rothman, Montori, Cherrington, & Pignone, 2008; Stanovich & West, 2000). Some recent research has revealed that individual differences in decision-making are closely correlated with numeracy in highly educated populations even after controlling for intelligence. Highly numerate adults are less likely to be influenced by framing effects (e.g. meat might be presented as 75% lean or 25% fat which is the same but often perceived differently), alternative representations of numbers (20 out of 100 compared to 20% chance which is the same but often perceived differently), or by affective information (deciding based on absolute numbers rather than proportions, selecting on visual appeal) because they are better able to effectively manipulate relevant numerical information and ignore irrelevant information. In general, researchers have found that greater numeric ability improves decision-making performance (Peters, Vastfjall, Slovic, Mertz, Mazzocco & Dickert, 2006).

Although decision-making research has not examined the role of schooling and cognition, aspects of cognition, including working memory and planning and strategy skills have been shown to be strong predictors of mathematics achievement among young children (Bull & Scerif, 2001) and appears to continue to be a strong predictor even among highly educated populations. However, the majority of the decision-making research has been conducted on highly educated populations, primarily undergraduate students, in western countries. Although the decision-making research was conducted with highly educated populations, the results support hypotheses that link cognitive ability enhanced through schooling to decision-making.

The literatures examining cognitive ability, numeric ability, and decision-making have not been bridged. Although both cognitive skills and numeric ability appear to both tap into similar skill sets such as manipulating relevant information and ignoring irrelevant information and problem solving. In this chapter I bring these two research perspectives together to examine how schooling relates to decision-making via both cognitive ability and mathematic ability.

Research Questions

The overarching research question for this chapter is how schooling affects health and health-related behavior and whether decision-making moderates the schooling and health-behavior relationship. To analyze this question I have developed a number of research questions to examine different aspects of how decision-making moderates the relationship between schooling and sexual behavior. The first research question that I examine to understand the relationship between schooling and sexual behavior is: How does schooling relate to condom usage in the Ghana sample? For this research question I hypothesize that:

H1: Schooling will be positively associated with increased condom usage.

Based on the assumption that there is a relationship between schooling and condom usage in the Ghana sample, my second research question is: How does decision-making moderate the relationship between schooling and condom usage? I hypothesize that:

H2: Decision-making will moderate the relationship between schooling and condom usage.

To understand the relationship between schooling and decision-making my third research question is: What factors are moderating the relationship between schooling and decision-making? I hypothesize that:

H3: Mathematic ability will mediate the relationship between schooling and decision-making.

H4: Cognitive skills will mediate the relationship between schooling and decision-making.

Data and Methods

The data used in this chapter comes from a collaborative research project between the Pennsylvania State University (PSU) and the Regional Institute for Population Studies (RIPS) at the University of Ghana. Data was collected from five homogenous villages in the Eastern region of Ghana. The villages ranged in size from 200 inhabitants to 4,000 inhabitants, were primarily agrarian, and interviews were conducted in Twi.[17] Data was collected from a sample of 190 adults between the ages of 30 and 65 who ranged from unschooled to completed secondary school for mathematic abilities, cognitive capacities, decision-making tasks, HIV knowledge and attitudes, and sexual behaviors. Participants also reported levels of schooling, reasons for discontinuing or failing to attend school, SES (as measured by type of house, available amenities such as electricity and running water, and agricultural assets), religion, occupation, and access to information.[18]

Data analysis

To examine how decision-making moderates the relationship between schooling and condom usage, two different methods of data analysis are employed. To understand the relationship between schooling and condom usage, logistic regression was employed. To examine the relationship between schooling and decision-making, SEM estimation was used. This section is divided into two sections each describing the statistical methods applied to the different research questions.

Logistic regression. To model the relationship between schooling and condom usage in the sample I employed logistic regression. Because the dependent variable, condom usage, is a

[17] For a complete description of study sites, criteria for selection and inclusion see chapter 4.
[18] For a complete description of variables see chapter 4.

dichotomous variable, used condoms (1) or never used condoms (0), and condom use is low in Ghana, the distribution of condom usage in the sample is substantially below 50% making errors not normally distributed. Equation 7.1 is the estimated non-linear regression logistic model. To model the moderating effect of decision-making and cognition, independent logistic regression models were run that first added decision-making and then a third logistic regression that included working memory, planning and strategy, and numeric ability.

Equation 7.1. Logistic Regression for Condom Usage

$$\ln [p/(1-p)] = B0 + B1\ Xj + B2Ej$$

p : Probability that the event Y (condom usage) occurs, p(Y=1)

p/(1-p) : is the "odds ratio"

ln [p/(1-p)] : The log odds ratio (logit)

Xj : Matrix of control variables (gender, age, socioeconomic status, community)

Ej : Years of schooling.

To include decision-making, cognitive skills, and the mathematic ability variables, Equation 7.1 is expanded:

$$\ln [p/(1-p)] = B0 + B1\ Xj + B2Ej + B3Dj + B4Wj + B5Pj + B6N$$

B3Dj : Score on stickman decision-making task

B4Wj : Score on cognition task 1-working memory

B5Pj : Score on cognition task 2-planning and strategy

B6N : Score on mathematic ability

Structural equation modeling. I use SEM to examine my third research question: What is the relationship between schooling and decision-making? SEM estimation allows me to examine both structural and measurement components of a model simultaneously. Using SEM, I examine the covariation among observed variables through a system of equations allowing dependent variables (working memory, planning and strategy, and mathematic ability) to also act

as predictors on decision-making (Duncan, 1975; Bollen, 1989; Kline, 1998). SEM estimation allowed me to model direct and indirect effects corresponding to each research question and corresponding hypothesis. The final model examined in the schooling and decision-making model consists of both structural and measurement models. The independent variable of interest for these analyses is years of schooling and the dependent variable is decision-making. All models have been controlled for gender, age, socioeconomic status, and community. The moderating variables used in the SEM include working memory, planning and strategy, and mathematic ability, and a latent construct cognitive skills.

To understand what factors are moderating the relationship between schooling and decision-making I run six different SEM models. The SEM analyses are presented in six figures. I examine the relationship between schooling and decision-making after controlling for age, gender, SES, and community and present the results in Figure 7-1. I test my third and fourth hypotheses by introducing first mathematics ability, then each cognitive skill independently, and then I create a latent construct of cognitive skills by using both cognitive skills into the model. Figure 7-2 presents the results once mathematic ability is introduced as a moderating variable into the schooling and decision-making relationship. Figures 7-3, 7-4, and 7-5 present the results of including the cognitive skills as moderating variables into the schooling and decision-making relationship. Figure 7-3 introduces working memory as a moderating variable independently while Figure 7-4 introduces planning and strategy as a moderating variable independently. Figure 7-5 presents the cognitive latent construct that is created by including working memory and planning and strategy through a confirmatory factor analysis. The last model presented is Figure 7-6 in which both mathematic ability and the latent construct (cognitive skills) are included as moderating variables between schooling and decision-making.

Findings

This section is divided into two parts: the first part reports the findings of the logistic regression model examining the overall schooling and condom-usage relationship, and the second part presents the findings of the SEM model that examines the relationship between schooling and decision-making.

Logistic Regression

The results of the logistic model are used to examine the first and second research questions that examine the relationship between schooling and condom usage and whether decision-making moderates the relationship in the Ghana sample. I use logistic regression and present the findings in Table 7-1 for the first two research questions that ask: 1) How does schooling relate to condom usage in the Ghana sample? and 2) How does decision-making moderate the relationship between schooling and condom usage?

H1: Schooling will be positively associated with increased condom usage.

Model 1 regressed condom usage on years of schooling and finds that the two major transitions in predicting condom usage are: 1) completion of primary school, and 2) completion of senior secondary school or more. A person that has completed primary school is more than four times more likely to have used a condom than an individual who has never attended school. Further, a person that has completed senior secondary school or more is over eight times more likely to have used a condom than an individual who has never attended school.

Table **7-1:** Odds Ratios from the Logistic Regression of Condom Usage on Schooling

	Schooling Model 1	Decision-making Model 2	Cognition & Mathematic Ability Model 3	Controls Model 4
Constant	.167***	.057***	.104**	.073†
Years of schooling				
No schooling = 0				
Partial Primary	1.636	1.367	0.709	1.066
Completed Primary	4.091*	3.554*	3.552*	1.443
Junior Secondary	2.615†	1.911	2.317	0.896
Senior Secondary or more	8.143***	4.992*	7.947**	1.928
Decision-making		1.274*	1.336*	1.318*
Mathematic Ability			.921†	0.934
Cognition				
Working Memory			0.926	0.732
Planning & Strategy			1.041	1.083
Controls				
Gender				
Male = 0				.129***
Age				
50 and older = 0				
30-39				7.974***
40-49				6.735**
SES				
Household Amenities				0.709
Household Assets				1.779**
Community				
Village A = 0				
Village B				3.191*
Village C				1.512
Village D				0.634
Village E				1.434
-2 log-likelihood	221.505	216.345	212.715	165.847
Nagelkerke R^2	0.124	0.159	0.182	0.448
Chi square	17.687	22.847	26.477	73.345
p	0.001	.000	0.001	.000
Cases correctly classified	69.8%	70.9%	73.0%	76.2%

*** p < .001 ** p < .01 * p < .05 † p < .1

H2: Decision-making will moderate the relationship between schooling and condom usage.

In model 2 I introduced decision-making as a moderating variable into the schooling and condom usage model. Decision-making does moderate the relationship between schooling and condom usage and reduces the odds of condom usage for the different schooling levels. I find that completing primary and senior secondary schooling continue to increase a person's odds of using a condom 3.6 times more for a primary school completer and nearly five times more for someone who has completed senior secondary school or higher. Decision-making not only moderates the relationship between schooling and condom usage, but increases the odds of using a condom by 27.4.

Although the SEM models will examine the relationship between schooling and decision-making I included all the variables used in the SEM in models 3 and 4. In model 3 I introduce the variables related to cognitive skills: working memory and planning and strategy as well as mathematic ability, and in model 4 I incorporate all the controls variables.

In model 3 I introduce the mediating variables of mathematic ability and the two cognitive skills: working memory and planning and strategy. Once I introduce the mediating variables in model 3, there is no change seen in the odds ratio (OR) for completing primary schooling, however, the OR significantly increases for a senior secondary school completer. With the moderating variables of mathematic ability, working memory, and planning and strategy, a senior secondary completer is again nearly eight times more likely to have used a condom than someone who has never attended school. Decision-making continues to moderate the relationship between schooling and condom usage and the inclusion of the other moderating variables increases decision-making skills increase the odds of using a condom by 31.7%.

I include all of my control variables in model 4. Once all control variables are included in the model, schooling at all levels loses its significance in predicting condom usage, but decision-making continues to increase condom usage by 31.8%. None of the moderating variables remain

significant in predicting condom usage, but males are 87.1% more likely to use condoms than females and that 30-39 year olds are 7.974 times more likely to use condoms than individuals 50 and older, and 40-49 year olds are 6.735 times more likely to use condoms than individuals 50 and older in the sample. I also find that household assets increase condom usage by 71% while household amenities have no effect on condom usage. Only one community appears to be different than village A and that is village B whose respondents are 3.899 times more likely to use condoms than village A, the largest community in the study.

These results highlight how schooling, decision-making, mathematic ability, and the two cognitive skills appear to relate to condom usage in similar ways. Since I find a relationship between schooling and condom usage, and that this relationship is moderated by decision-making, I model the relationship between schooling and decision-making using SEM to examine the role of mathematic ability and the two cognitive skills to see how these moderating variables impact the relationship between schooling and decision-making.

Structural Equation Model Results

The results of the SEM are used to examine the third research questions to understand what factors are moderating the relationship between schooling and decision-making. To understand the relationship between schooling and decision-making I first examined the relationship between schooling and decision-making while controlling for gender, age, SES, and community.

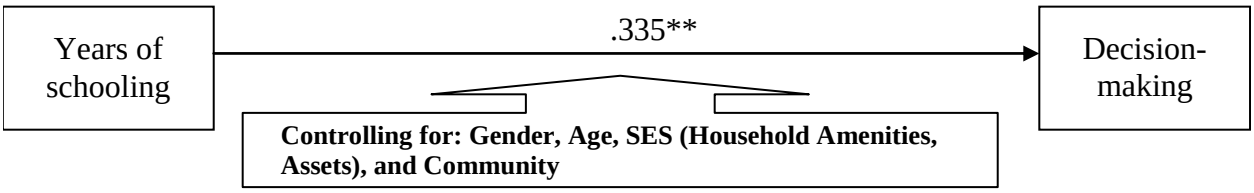

Figure **7-1:** Relationship between schooling and decision-making

As shown in Figure 7-1, even after the controlling for gender, age, SES, and community, schooling has a strong significant effect on decision-making with a standardized effect size of .335. These findings support the results of the initial logistic regression that indicated that decision-making moderated the relationship between schooling and condom usage. The following models will examine possible moderating factors in the relationship between schooling and decision-making by first modeling the hypothesis that numeric ability is moderating the relationship between schooling and decision-making and then model the effect of cognitive skills as a moderating effect between schooling and decision-making.

H3: Mathematic ability will mediate the relationship between schooling and decision-making?

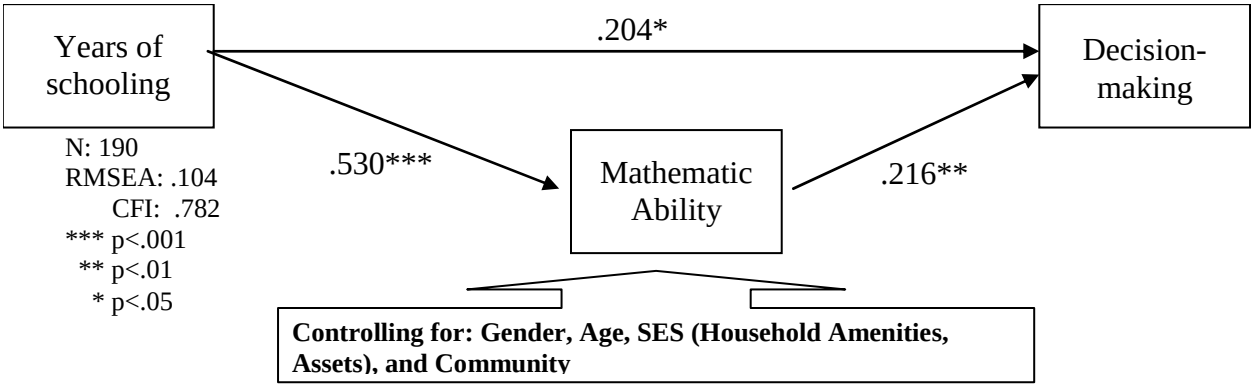

Figure **7-2:** Relationship between schooling and decision-making moderated by mathematic ability

Mathematic ability. To test the hypothesis of how mathematic ability moderates the relationship between schooling and decision-making, I regressed decision-making on schooling and mathematic ability while controlling for gender, age, SES, and community. Similar to studies conducted by Peters, et al (2006) and others, I find that schooling significantly increases

mathematic ability by .530 and that mathematic ability significantly increases decision-making ability by .216. Even after controlling for mathematic ability, schooling remains to be a strong and significant independent predictor (.217) of decision-making. The total effect of schooling on decision-making through mathematic ability is .318. Although mathematic ability moderates the relationship between schooling and decision-making it does not completely remove the independent effects of schooling

H4: Cognitive skills will mediate the relationship between schooling and decision-making?

To test my fourth hypothesis and examine whether the schooling and decision-making relationship is mediated by cognitive skills, I removed the mathematic ability variable from the model. I have run three different models to examine if cognitive skills mediate the relationship between schooling and decision-making, one for each measure of cognition independently and one for the construction of a latent variable "cognitive skills" that incorporates both cognitive measures.

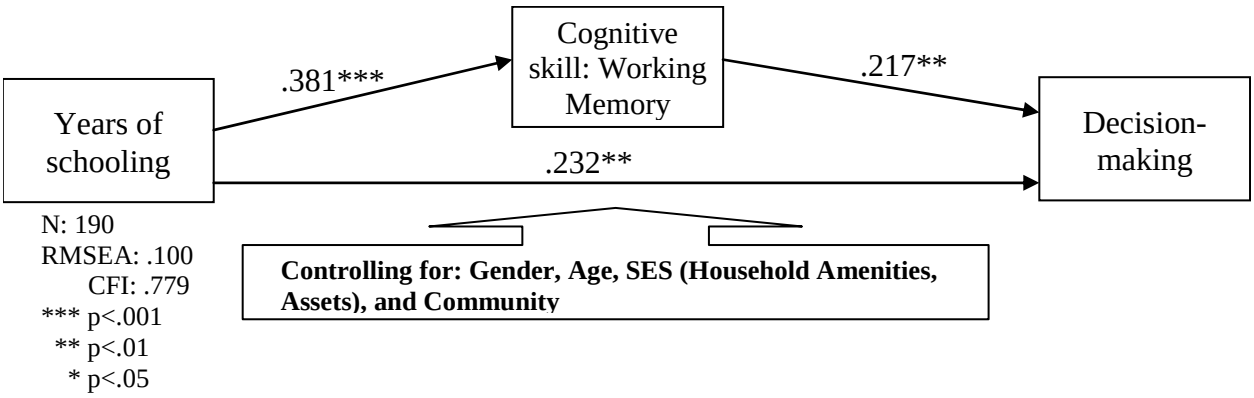

Figure **7-3:** Relationship between schooling and decision-making moderate by working memory

Working memory. Figure 7-3 presents the results of when I regressed decision-making on schooling and used the working memory cognitive skill as a moderating variable. Similar to

Figure 7-2, schooling significantly increases working memory by .381 and working memory significantly increases decision-making ability by .217. Even after controlling for working memory, schooling remains to be a strong and significant predictor (.232) of decision-making. The inclusion of working memory moderates the relationship between schooling and decision-making but does not mediate the relationship. The total effect of schooling on decision-making through working memory is .299, with .232 coming from schoolings direct effect on decision-making.

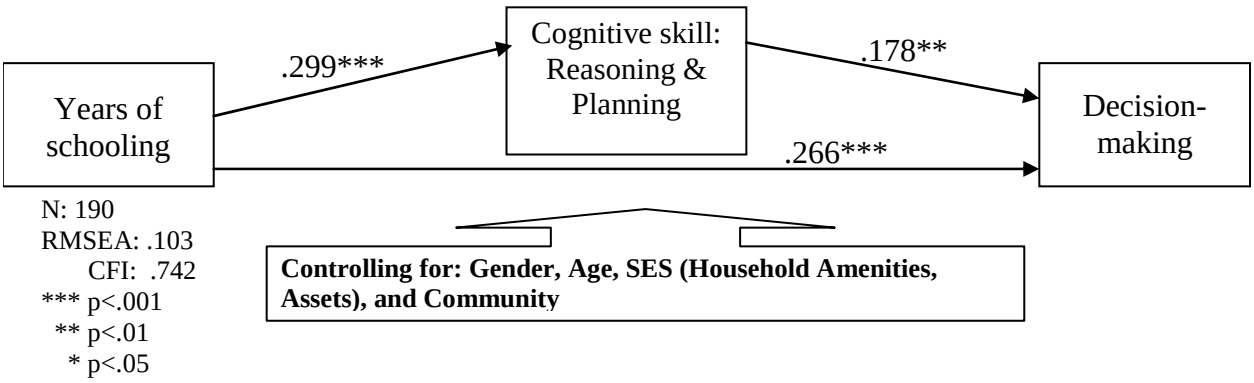

Figure **7-4:** Relationship between schooling and decision-making moderated by planning and strategy

Planning and strategy. Figure 7-4 presents the results of when I regressed decision-making on schooling and used the planning and strategy cognitive variable as a mediating variable. Similar to Figure 7-3, each additional year of schooling significantly increases planning and strategy skills by .299 while planning and strategy skills significantly increase decision-making ability by .178. Even after controlling for planning and strategy, schooling remains to be a strong and significant predictor (.266) of decision-making. Similar to Figure 7-3, the total effect of schooling on decision-making through cognition as measured by planning and strategy is .346. Planning and strategy do not mediate the relationship as schooling maintains a significant direct effect of .266 on decision-making. Both measures of cognitive skills independently support a moderating pathway between schooling and decision-making. However, none of the intervening

variables completely mediate the effect of schooling. As both cognitive skills are supposed to represent different aspects of a person's cognitive ability, I have created a latent construct "cognitive ability" and introduced it as an alternative intervening factor in the schooling and decision-making relationship.

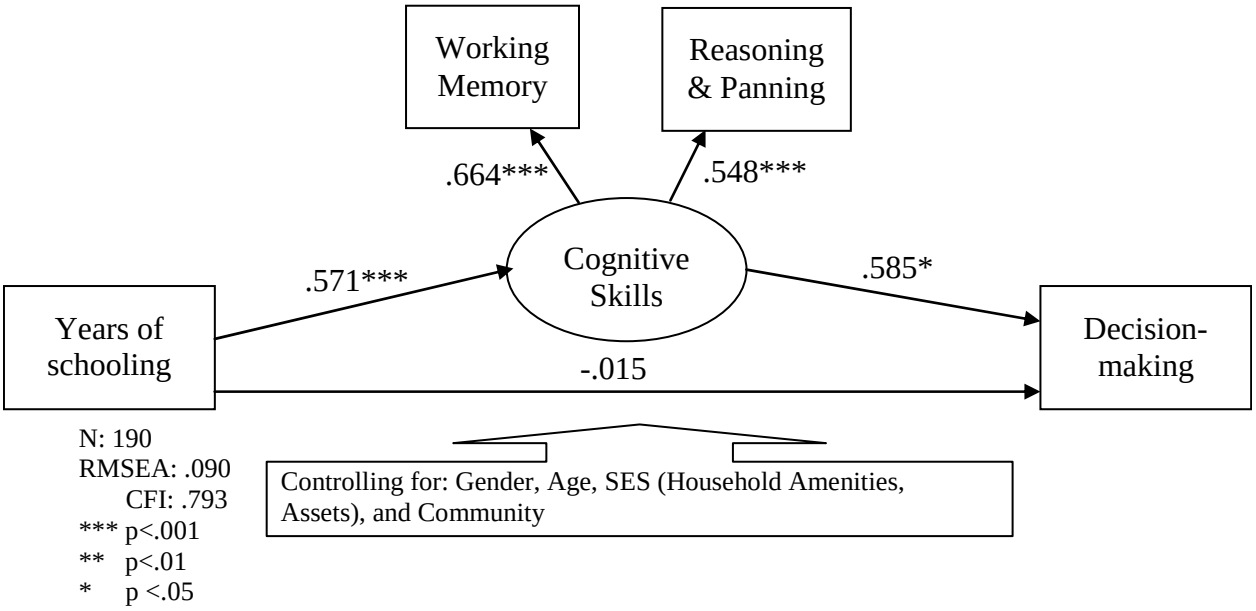

Figure **7-5:** Relationship between schooling and decision-making mediated by cognitive skills

Cognitive skills. In the SEM, both working memory and reasoning and planning have a strong fit in creating the cognitive skills latent variable. Schooling significantly increases cognitive skills by .571 and cognitive skills significantly increase decision-making ability by .585. Once "cognitive skills" is factored into the model, schooling loses its significance on decision-making. The introduction of the latent construct cognitive skills mediates the effect of schooling on decision-making. Schooling has lost its direct effect on decision-making but indirectly increases decision-making via cognitive skills. The indirect effect of schooling on decision-making is .334. The significant effect size of cognitive skills and the removal of schooling's direct effect on decision-making fails to reject my fourth hypothesis that cognitive

skills mediate the relationship between schooling and decision-making and in turn condom usage. As a result of these four independent analyses, I ran a combined model that included both the cognitive skills latent construct and mathematic ability to see how these worked together to mediate the relationship between schooling and decision-making.

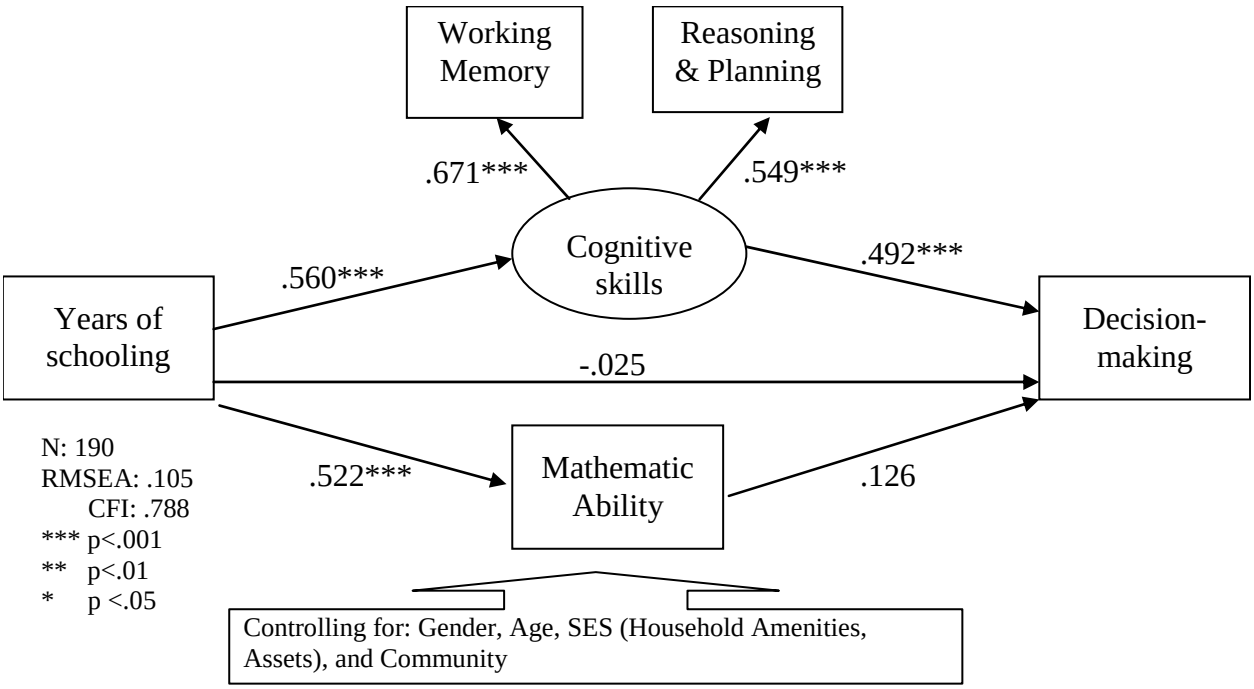

Figure **7-6:** Relationship between schooling and decision-making mediated by cognitive skills and mathematic ability

Cognitive skills and mathematics ability. The full SEM model that examines the relationship between schooling and decision-making is seen in Figure 7-6. In the full model I have included the latent construct of cognitive skills and mathematic ability. Schooling significantly increases mathematic ability by .522, however, mathematic ability no longer significantly relates to decision-making ability. Schooling continues to significantly increase cognitive skills by .560 and cognitive skills significantly increase decision-making ability by .492. Similar to the results seen in Figure 7.5, cognitive skills continues to mediate the direct effect of schooling on decision-making. As a result of including both mathematic ability and

cognitive skills I reject my third hypothesis that mathematic ability mediates the relationship between schooling and decision-making and fail to reject my hypothesis that cognitive skills mediating the schooling and decision-making relationship. In this final model schooling looses it direct effect on decision-making and looses its indirect effect via mathematic ability. In this model, schooling's effects are now entirely indirect through cognitive skills, creating an indirect effect of schooling on decision-making via cognitive skills of .275. These results indicate that mathematic ability moderates the relationship between schooling and decision-making but once cognitive skills are introduced into the model, the effect of mathematics ability on decision-making disappears.

Schooling, Decision-Making, and Condom Use

The effect of schooling on condom usage is moderated by decision-making and the relationship between decision-making and schooling is moderated by cognitive skills. These results introduce new insights into the previous theories connecting schooling and health. As seen in Chapter 6, facts and attitudes play a limited role in a person's behavior and do not account for the direct effects of schooling on engagement in behavior. As shown in this chapter, a person's decision-making ability moderates the relationship between schooling and engagement in health behaviors. These results indicate that schooling increases a person's decision-making capabilities via cognitive enhancement. These results indicate that schooling does both directly and indirectly enhance cognitive abilities, and that cognitive abilities lead to better decision-making which leads to healthier behaviors.

Chapter 8

Wrapping-up: Policy and Research Implications

This dissertation addressed the role of schooling in the HIV and AIDS pandemic. The results of the three studies presented in Chapters 5 through 7 provide new insights into the role of schooling in the HIV and AIDS pandemic. In this chapter I will first provide a discussion of the implications of the three findings chapters. After the discussion, I will provide both policy and research implications of these findings. At the end of this chapter I will discuss some of the limitations of this research along with the need for further research.

Discussion

HIV Infection

In Chapter 5 I present the results of the analysis of HIV infection in SSA on schooling by age cohort. The results indicate that after controlling for SES, gender, and place of residence, schooling is not related to HIV infection for the 35 and older cohort. The same trend is seen among the 25-34 age cohort schooling has shifted from a risk factor to a non significant factor for HIV infection in nine of the 11 countries while acting as a marginal risk factor in Malawi and a marginal protective factor against HIV infection in Rwanda. The biggest shift from past studies is seen in the 15-24 age cohort. For the 15-24 age cohort schooling is a significant protective factor against HIV infection in six of the 11countries and in no countries is schooling a risk factor.

These results are practically important as the 15-24 age cohort is the most at risk of new HIV infections.

There may be several reasons why schooling has a null effect on HIV infection in the 25-34 and the 35 and older age cohorts. First, the null effects among the oldest cohort could be due to the fact that by the time these DHS data were collected, many from this cohort who were infected earlier in the pandemic had died. And if, as predicted, schooling was a risk factor early on when there was not clear and widespread understanding of the disease, mortality rates would have been higher among the more educated, thus lowering the chance of finding schooling as a risk factor some twenty years into the disease for this age cohort. However, in several of these countries where schooling has no effect on HIV infection, AIDS rates are low enough and the population continues to have highly-educated individuals to assume that the null effect is only related to attrition from mortality. These unknown factors limit my ability to interpret the results for the 25-34 and 35 and older cohorts.

The null effects among the oldest age cohort might indicate that by early in the 21st Century there are no schooling effects among those who were sexually active before information about HIV became publicly available and that due to the lack of information, all sexually active individuals were at equal risk. Second, it is difficult to tease out precise period effects within cohorts, for example, schooling could reduce infections among the younger members of the middle age cohort and increase them among its older members. Another limitation is that gender differences are masked in this analysis and many null associations among the older cohorts could be related to these gender differences, which is a next step for this research but which fell outside the scope of this dissertation.

Although schooling is not related to HIV infection among the two older cohorts, these findings should not be discarded or ignored. In contrast to past studies that reported a strong relationship between schooling and HIV infection (as discussed in Chapter 2), these results

indicate that by 2003, once wealth and place of residence have been controlled for, schooling is no longer increasing a person's risk of HIV infection for individuals over the age of 25. And for the 15-24 age cohort, schooling is actually acting as a protective factor against HIV infection in six of the 11 SSA countries analyzed.

The 15-24 age cohort is the most at-risk group of new HIV infection and these findings indicate that schooling is an important component of reducing HIV infection in this high-risk group. This finding supports recent studies that have indicated that schooling is acting as more of a protective factor against HIV starting in the late 1990s and early 2000s (Hargreaves et al., 2008). Knowing that schooling is starting to provide its traditional protective role against negative health outcomes in the HIV and AIDS pandemic raises additional questions. Now that schooling is acting as a protective factor against HIV infection among the 15-24 age cohort, the way by which schooling is acting is not known or understood. This requires the need to understand how schooling is protecting individuals from HIV infection.

Sexual Behavior

To understand how schooling is protecting individuals from HIV infection, I empirically test theories that have been the predominant framework used to explain the relationship between schooling and HIV. The two predominant theories driving curricular interventions have centered on theories of information transfer and attitude change that lead to behavior change in three target behaviors: abstinence, being faithful to one sexual partner, and condom usage if a person has more than one sexual partner. These theories posit that schooling is only a proxy for access to information which leads to behavior change. Schooling is believed to give people more access to information and that increased information would reduce engagement in risky behavior, and increase protective behavior.

Analyses of how acquisition of facts and attitudes moderated the relationship between schooling and engagement in sexual behavior challenge the schooling as proxy for information argument. The acquisition of facts and positive attitudes only has a marginal effect on engagement in the three different sexual behaviors, whereas schooling has a persistent direct effect even after controlling for information and attitudes. Contrary to past assumptions, although schooling increased the acquisition of facts and positive attitudes, people's engagement in different sexual behaviors had more to do with their level of schooling than their acquisition of these facts and attitudes. For both age cohorts, schooling has both a direct and indirect effect on engagement in the ABC sexual behaviors, indicating that schooling works through the acquisition of facts and attitudes in addition to a direct schooling effect. Even with the inclusion of facts and attitudes, schooling continues to have a strong direct effect on engagement in abstinence, being faithful to one sexual partner, and condom usage. These findings reject the information-transfer hypothesis and the attitude change hypothesis often used to explain the role of schooling on engagement in these behaviors. These theories do not accurately account for the persistent direct effects of schooling on engagement on all three sexual behaviors.

Although facts and attitudes do relate moderately with behavior, the persistent direct effects of schooling reveal that when people have the same information, schooling actually reduces engagement in abstinence and fidelity to one sexual partner while significantly increasing condom usage for individuals with multiple sexual partners. These findings indicate that schooling may actually increase engagement in risky sexual behavior, yet this risk is tempered by protective strategies like using a condom if the person engages in higher risk sex such as having multiple sexual partners.

To examine alternative roles of schooling, I created a proxy for reasoning in the DHS data. Once reasoning was included into the model, the effect of facts and attitudes on engagement decreased as did the direct effect of schooling on behavior. These findings support an alternative

hypothesis that a person's ability to apply reasoning skills by discerning myths about HIV and providing information about STDs generally is enhanced by schooling and that this applied reasoning moderates the relationship between schooling and engagement in sexual behavior. These results indicate that schooling enables people to use information across settings and that the acquisition of facts and attitudes is not a sufficient explanation of the role of schools, but how schools enable a person to use the same information in a more effective way that results in behavior change. These findings indicate that schooling is acting above and beyond the acquisition of facts and attitudes and that a person's ability to use information depends on their level of schooling.

Decision-making

The ways in which schooling enables a person to use information that results in different health outcomes is a current gap in our understanding of the relationship between schooling and health outcomes. The ability to analyze how people with different levels of schooling use information and make health related decisions was addressed in Chapter 7 using the Ghana sample. The data collected in Ghana was specifically targeted at understanding the role of schooling on decision-making and a specific health outcome of condom usage. Similar to the findings of chapter 6, even in the Ghana sample, schooling is related to an increased use of condoms.

The analysis of condom usage on schooling indicated the significance of decision-making in moderating the relationship. Understanding the relationship between schooling and decision-making required me to bridge the numeracy and decision-making literature with theories that focus on the cognitive effect of schooling. I examined the schooling and decision-making relationship by examining how the introduction of basic mathematic ability and cognitive skills

moderate the relationship. Past studies of decision-making have found consistent effects of numeracy. Although I find effects of mathematic ability on moderating the relationship between schooling and decision-making, once cognitive skills were introduced into the model, the effect of mathematic ability no longer moderated the relationship between schooling and decision-making, whereas cognitive skills completely mediated the effect of schooling on decision-making.

These results introduce new insights into the previous theories connecting schooling and health. Although a certain amount of information is needed to help people understand health outcomes, facts and attitudes play a limited role in a person's behavior and do not explain the persistent direct effects of schooling on engagement in sexual behavior. A person's decision-making skills and ability to sort and interpret information is highly related to a person's experience with schooling. Schooling increases both cognitive and decision-making skills, which mediates the relationship between schooling and condom usage. These results indicate that schooling increases a person's decision-making capabilities via cognitive enhancement. These results indicate that schooling both directly and indirectly enhances cognitive abilities, and that cognitive abilities lead to better decision-making which leads to healthier behaviors.

Implications

Although this dissertation did not and could not examine all the potential mechanisms by which schooling impacts behaviors, there are important policy and research implications of the study for both HIV and AIDS policy but also education and health policy more broadly. Even with the need for further research studies that examine the role of schooling on health, there are several key policy implications that result from this study. This research has both policy and

research implications of how schooling is and can continue to work to protect populations from HIV infection in SSA, but also other health concerns in both SSA and other parts of the world.

Policy Implications

There are three key policy implications of this research. 1) Schooling needs to be seen as an actual tool and partner in the fight against HIV and AIDS, 2) Interventions are not a sufficient substitute for getting people into schools. 3) The right of an education needs be recognized as an important policy in the fight against HIV and AIDS.

Most countries have moved toward a multisectoral approach in which bi-, multi-lateral, government agencies and nongovernmental organizations (NGOs) are incorporated and integrated into one comprehensive response to the HIV and AIDS pandemic as opposed to each ministry or sector developing their own piecemeal response. The coordination and incorporation of different stakeholders and actors in the HIV and AIDS response reduces inefficiencies, redundancy from overlap, facilitates resource mobilization, partnerships, resource sharing, and ensures that all segments of society have access to HIV and AIDS information, resources, and services. Most developed countries, particularly in SSA have created a national coordinating body that acts as a bridge between different actors and ministries (Bodiang, 2001; Putzel, 2004; Rayna, 2003).

As a result different ministries and sectors incorporate an HIV and AIDS component into their missions and planning. Each ministry and sector is assessed to determine its comparative advantage and the most effective role the sector or ministry can participate in the fight against HIV and AIDS (Bodiang, 2001). Even with the move toward a national multisectoral response to HIV and AIDS, schooling has remained a marginal actor in the fight against HIV and AIDS. Although policy documents refer to schooling as a “Window of Hope” in the fight against HIV,

most policy talk focuses on schools ability to transfer information to a large captured audience before individuals engage in sexual behavior (Kelly, 2000).

Among governments and NGOs struggling against the HIV and AIDS pandemic, schooling has been relegated to the position of transferring information about HIV and AIDS to students. In the case of HIV and AIDS, it is believed that the acquisition of information about the modes of and barriers to transmission, such as abstinence, condoms, and volunteer counseling, translates directly into better decisions about risk and health (Nayga, 2001; Mirowsky & Ross, 2003). Inclusion of information on health issues such as human sexuality and birth control in school curricula are thought to be the chief way schooling influences health, and hence unschooled, or less schooled individuals do not receive this information as readily as their more educated peers.

The findings of this dissertation directly contradict this assumption that schooling merely transfers information. Schools need to be integrated into the multisectoral approaches of countries and be seen as providing a strong protective facet to the youth population above and beyond the acquisition of facts and attitudes. Since 2000, the international community has spent over US$44.5 billion dollars on HIV interventions and treatment in low and middle-income countries and in 2007, donors spent US$10 billion alone (UNAIDS, 2008). Of this funding, schools are typically overlooked as they are not seen as essential actors in the fight against HIV, but as a venue for NGOs and other groups to implement interventions. HIV funding has primarily been targeted towards treatment with prevention being under-researched and marginalized (Horton & Das, 2008).

It has been hoped that NGO-funded and operated HIV and AIDS programs implemented in schools would prevent HIV infection by providing a quasi-education effect among adults. Yet the heavy reliance on a simple information-transfer model of most of these programs make it doubtful that they are, or ever will become, an effective substitute for the kinds of reasoning skills

imparted by schooling. With the millions of dollars that have been spent on prevention programs by NGOs, there has been “no effective, reliable, and comprehensive monitoring or evaluation of HIV prevention programs” (Horton & Das, 2008, 422).

HIV interventions have been useful in spreading accurate information about condom-use and infection, but their simplified messages will not have a lasting and broad impact on helping the next generation develop effective everyday working theories of HIV risk (Collins, Bedford, Halabi, Baker, 2009). The curricula have had a heavy focus on transmitting information about basic facts regarding the modes and barriers to HIV transmission as they have focused on the ABCs of HIV. These interventions, although effective in transmitting information, are not sufficient enough to replace the effect of attending school. Yet interventions have been seen as instrumental in countries’ multisectoral response to HIV, relegating schools to mere venues for interventions.

Although HIV interventions are serving an important void, it is not a sufficient substitute for schooling. Sub-Saharan Africa is home to one-third of all out of school children and by 2015 is believed to account for 40% of all out of school children in the world (UNESCO, 2008). Even when children are attending schools in these countries, per-pupil funding has remained abysmally low with the largest segment of funding going towards teacher pay which has resulted in poor quality school structures, no textbooks, and very limited instructional materials. Even in countries that have been identified as having low school quality, schooling is still having a protective effect.

Countries have committed to providing free access for all children to at least six years of schooling. However, a lack of funding and resources to ensure that all children have access to school puts the effect of schooling as an effective prevention strategy in jeopardy of severe under utilization. A silent casualty of the HIV pandemic in SSA is the human toll in the education sector. The cost of free universal primary education in some countries has dramatically increased

as the HIV and AIDS pandemic has infected teachers, administrators, and potential teachers at high rates, devastating many nations' capacity to provide greater access to primary schooling (Kelly, 2000; Monasch, & Boerma, 2004; World Bank, 2002; World Bank, UNESCO, & UNAIDS, 2002). Furthermore, widespread AIDS-related student absenteeism to care for ill parents, siblings, and relatives, as well as a growing number of child-headed households limits children's ability to attend school. Access to primary education in SSA grew by 36% from 1999 to 2005, but 31 million children continue to have no access to schooling.

Without massive aid to assist the region in rebuilding the human capital needed to extend the already under-staffed schools, a real opportunity to protect the next generation against HIV will be missed. Schools need to be seen as more than just venues where NGOs implement HIV interventions. There is a need to shift the policy focus from schools as venues to how getting children into school can protect children from HIV infection above and beyond simple access to interventions. The education sector needs to be eligible for national HIV funding to pay for teacher salaries, and other schooling related costs and not solely for the purpose of implementing an intervention. Without massive aid to primary education, a large proportion of the next generation in SSA will miss out on the protective benefits of schooling against HIV infection and other health risks.

Separate from the emphasis on HIV interventions in schools, there has been an increased world-wide focus on getting all children into schools and completing at least six years of schooling since 2000. In connection with this push, there has been an increase in donor aid for basic education in low-income countries and in particular SSA since 2002. However, the overall donor assistance has been minimal when compared with HIV funding. Compared with the international funding for HIV and AIDS interventions and treatments of US$44.5 billion, the roughly US$3 billion annual aid for basic education in low-income nations worldwide reflects

only a third of what countries are putting towards interventions and treatments (UNESCO, 2007; UNAIDS, 2008).

Even with the US$3 billion committed towards increasing access to schooling there is considerable variation between countries with aid for primary schooling in SSA receiving less priority and funding than other regions of the world (UNESCO 2007). Inequality in the dispersion of funds has further exacerbated the problem as public spending on education goes towards wealthier, urban regions and advantaged groups disproportionately more than poorer, rural regions and disadvantaged groups (UNESCO, 2008).

Education as a human right has become a worldwide priority in recent years and is seen as crucial for countries in SSA to overcome the complex web of economic, political, and social problems. Schooling has been identified as building the skills in countries to solve economic, political and social problems, and this dissertation highlights the ability of schooling to help stem the equally complex health problem of the HIV and AIDS pandemic in the region. However, the focus has been primarily on the completion of primary education. The results indicate that although primary completion does provide protective benefits of schooling, it is not until you get to the completion of secondary school that you see the largest schooling effects on behavior. This indicates that although increasing access to primary education is important, policies need to be expanded to provide access to secondary education. National and international focus needs to expand to include the benefits of secondary education in the fight against HIV and AIDS.

Research Implications

In terms of research, the HIV and AIDS pandemic in SSA allows an opportunity to examine how schooling influences health. Although there is considerable research on schooling and health, only a tiny proportion of it attempts to identify the mechanisms at work behind the

relationship. In most western countries, the level of schooling is extremely high among the general population making analysis of the effect of schooling more difficult. Analyses have had to examine retrospective studies that examine changes in compulsory schooling laws in an effort to understand schooling's effect on health (Adams. 2002; Lleras-Muney, 2005; Oreopoulos, 2007). Communities in many developing countries vary in educational attainment more as a result of lack of access and inability to pay the cost of schooling as opposed to health and cognitive impairments that are reported in Western countries. This allows increased analysis of the role of schooling on a variety of health outcomes with less risk of endogenous factors confounding the effect of schooling. This dissertation is a first step that extends research on schooling and health into communities where schooling is still not a universal reality for the general population.

In addition, as of now, schooling's ability to increase cognitive skills and trains people to be better decision-makers is not understood. Speculations about increasing cognitive demand in the curricula are plausible explanations but there is an increased need to understand how schooling is enhancing cognitive skills and how these cognitive skills help a person to make better decisions around health. The ability of enhanced cognition skills that enables people with the same information to make better decisions is an important finding and indicates an important non-economic social benefit of schooling. The role of schooling in increasing better decision-making which leads to protective behaviors and reduced HIV infection among the 15-24 high-risk group cannot be under-stated.

Even as the significant effects of schooling are being reported past hypotheses that have downplayed the effect of schooling remain to direct much of the theories that attempt to explain the relationship between schooling and health. These hypotheses never focus specifically on what happens during the schooling process. Or in cases where the context of schooling is examined, it is only superficially examined to see what health related content was transmitted to students. Similarly, hypotheses that rely on human capital, enhanced psychological states, or the transfer of

information arguments ignore the actual schooling process leaving numerous gaps in understanding the relationship between schooling and health.

Human capital theory. There are several problems with human capital arguments about schooling effects on health. First, the logic tends to break down when applied to individuals with low to modest amounts of schooling that they received as children. Certainly there are foregone wages, and in the poor economies of SSA this is readily obvious for children who can be in the labor market, but it is a stretch to think that individuals with just a few years of schooling will strive to protect this relatively small investment by making better health decisions. Studies find that even modest amounts of formal schooling equip individuals with protective skills to achieve better health (Cutler, & Lleras-Muney, 2008; Mostafa and Ginneken, 2000). A second problem of human capital explanations is that the theories exclude anything that happens to students while at school, such as learning and thinking. Current human capital hypotheses attempt to force an image of the hyper-rationalized individual that makes decisions weighing all the costs and benefits in an effort to maximize their educational investment rather than considering how the schooling process might transform the individual to be more rational or how schooling enables a person to understand, sort, and interpret information as they make health decisions.

Psychological states hypothesis. Similar to the human capital arguments, the hypotheses that stress the enhanced psychological states that schooling develops in an individual is what is driving the positive health outcomes of schooling. These hypotheses argue that more educated individuals have formed habits that in various ways lead them to less risky behavior and more healthy lifestyles. Habits that result from attending schools include delayed gratification, self-efficacy, motivation, and emotional control. The reasoning behind these hypotheses, similar to the human capital hypothesis, asserts that schooling forms habits that result in delaying short-term physical, sexual, or emotional gratification that carry potential risks or damage long-term benefits of better health, higher income, and increased happiness. These hypotheses that examine the

enhanced psychological states of schooling do not address how schooling does this in such a short period of time for those with only a few years of schooling. Similarly the hypotheses do not examine what really is taking place in schools that are making people delay gratification, develop long-term goals, or self-efficacy.

Information-transfer hypothesis. As noted, the most common argument in the HIV pandemic about the role of schooling is school's ability to transfer information. Governments and NGOs have embraced this notion and have used it as a primary policy instrument in their struggling against the HIV and AIDS pandemic. Inclusion of information on health issues such as human sexuality and birth control in school curricula are thought to be the chief way schooling influences health, and hence unschooled, or less schooled individuals do not receive this information as readily as their more educated peers (Nayga, 2001; Mirowsky & Ross, 2003). A major limitation of this hypothesis is its inability to explain life-long schooling effects. Many people in the DHS survey were out of school before accurate information became available about the modes of HIV transmission, and particularly for individuals in the 35 and older cohort had left school well before HIV related information was available in schools, yet schooling continues to have a persistent effect on sexual behavior related to HIV infection. Furthermore, when information, reported as acquisition of facts and attitudes about HIV are controlled for schooling continues to have a stronger direct effect on engagement in behavior than the acquisition of facts and attitudes.

For the 15-24 age group, it is assumed that the transfer of information hypothesis is a better fit as they would have been in school when more accurate information about HIV became available. Even for the 15-24 age group, schooling continues to have a persistent direct effect above and beyond acquisition of facts and attitudes. This is partly explained that throughout SSA most schools have only recently put information about HIV and AIDS in classroom curricula—much too late to give these young educated adults an in-school information advantage.

Furthermore, in many places, this information is only found as part of the external curriculum of after-school clubs distributed to just a minority of all students (Jacob, et al, 2007). And, even in those countries that do provide information about HIV and AIDS in schools, it is usually only found in some schools while others lack this information in their curricula altogether. A major limitation of the information-transfer hypothesis is that it does not distinguish between a person's ability to have facts about the disease versus a person's ability to reason about the connections among these facts, his or her personal behaviors and the risk of infection.

Attempts to explain the schooling effect as a function of merely teaching information about the disease has not resulted in comparable effects seen through schooling. For example, attempts to reproduce the schooling effect through interventions and directly teaching facts about health risk have not been successful in duplicating the effects of schooling (de Walque et. al., 2005). The inability of interventions to replace the effect of schooling indicates that mere information is not sufficient to explain how schooling enables a person to use that information differently than someone without the same level of schooling.

The limitations of these past hypotheses coupled with the results of this study indicate that to understand underlying mechanisms driving the effect of schooling on health research needs to examine the "black box" of the schooling process, including the learning of non-health related academic subjects. This study demonstrated that schooling is directly related to reducing HIV infection, changing sexual behaviors, and increasing decision-making skills. I have presented findings that cognitive skills develop in the schooling process are related to increasing decision-making skills which in turn relate to behavior. However, this study does not reveal which aspect of schooling is increasing cognitive and decision-making skills.

A Need for further studies

Future research needs to focus on how schooling impacts both cognitive skills and decision-making and how these skills relate to health behavior. Numerous studies that report on the relationship between schooling and health have called for such an increased understanding of how schooling impacts thinking, reasoning, and problem solving and how these in turn impact health (e.g. Ross & Wu, 1995; Phelan et. al., 2004; Lleras-Muney, 2005). Schooling is often assumed to "teach one to think" but how schooling teaches "thinking" or makes a person a better decision-maker is unspecified, and the actual cognitive effect of schooling on thinking is often assumed to exist but is not actually examined. Understanding how the schooling influences an individual's thinking, attitudes, and behavior is a central question in need of further examination.

This study has built on a few recent studies that have attempted to understand the cognitive impact of schooling in terms of reasoning about everyday risk and decision-making skills that relate to health (Cutler & Lleras-Muney, 2008; Heckman, 2007). The mass schooling-decision-making hypothesis that I outlined in Chapter 3 argues that over the course of teaching academic material such as mathematics and reading, even in small amounts, schooling enhances fundamental cognitive capacities of individuals, such as executive functioning skills associated with reasoning and solving novel problems (Blair, Gamson, Thorne, & Baker, 2005). Thus in terms of everyday health risks, enhanced reasoning skills through basic mathematics and literacy enable individuals to make more-informed and reasoned decisions based on more accurate assessment of consequences of alternatives and risks (Bruine de Bruin, Parker, & Fischhoff, 2007; Peters et al., 2006). This dissertation has reported empirical support of schooling enhancing both cognitive and decision-making skills that related to improved health behavior.

Limitations. Although the findings of this study have important policy implications, this study has limitations that should be addressed in future studies. Due to limitations of time, and reliable instruments, this study did not examine additional potential paths in which schooling does

increase cognitive ability. In this dissertation I did not examine additional academic subjects nor did I examine the paths between mathematic ability and cognitive skills. I could not determine whether mathematic ability was driving cognitive skills or vice versa. Although the data allows additional theoretical modeling of potential pathways between mathematic ability, cognitive skills, and decision-making, future studies need to specifically test these theoretical paths. The limitation of not examining literacy and other core curricula of schools and how these relate to both cognitive and decision-making abilities reveal the need for increased studies into how schooling both enhances cognitive abilities and decision-making.

To understand the potential pathways between mathematics ability, cognitive skills and decision-making, future studies need to examine populations with similar educational backgrounds. This dissertation supports the notion that cognitive skills are mediating the relationship between schooling and decision-making, however, former studies that examined numeric ability and decision-making find consistent effects of mathematic ability for highly schooled populations. These studies did not account for cognitive skills and to test whether this finding is only an effect of a low-schooled population as compared to a high schooled populations, future studies need to examine highly-schooled population for both mathematic ability and cognitive skills.

Although, this dissertation draws into question the effect of mathematic ability on driving decision-making in low-schooled populations, it does not rule out mathematic ability, nor does it support the notion that mathematics is the key curricula to enhancing cognitive abilities. As this dissertation is not able to examine additional potential paths in which schooling does increase cognitive ability, these results reveal the need for increased studies into how schooling both enhances cognitive abilities and decision-making.

References

Adams, S. J. (2002). Educational attainment and health: Evidence from a sample of older adults. *Education Economics, 10*(1), 97-109.

Ainsworth, M., & Semali, I. (1998). Who is most likely to die of AIDS? Socioeconomic correlates of adult deaths in Kagera region, Tanzania. In M. Ainsworth, L. Fransen & M. Over (Eds.), *Confronting AIDS: Evidence from the developing world* (pp. 95-109). Washington DC: European Commission and the World Bank.

Ainsworth, M., & Teokul, W. (2000). Breaking the silence: Setting realistic priorities for AIDS control in less-developed countries. *The Lancet, 356*(9223), 55-60.

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision process, 50*, 179-211.

Alexander, K. L., Natriello, G., & Pallas, A. M. (1985). For whom the school bell tolls: The impact of dropping out on cognitive performance. *American Sociological Review, 50*(3), 409-420.

Al-Meshari, A., Chattopadhyay, S. K., Younes, B., & Hassonah, M. (1996). Trends in maternal mortality in Saudi Arabia. *International Journal of Gynecology & Obstetrics, 52*(1), 25-32.

Alwin, D. F., Cohen, R. L., & Newcomb, T. M. (1991). *Political attitudes over the life span: The Bennington women after fifty years*: University of Wisconsin Press.

Anheir, H., Glasius, M., & Kaldor, M. (Eds.). (2002). *Global civil society 2002*. London: Sage.

Anker, R., & Knowles, J. C. (1980). An empirical analysis of mortality differentials in Kenya at the macro and micro levels. *Economic Development and Cultural Change, 29*(1), 165-185.

Apter, A., Cheng, J., Small, D., Bennett, I., Albert, C., Fein, D., et al. (2006). Asthma numeracy skill and health literacy. *Journal of Asthma, 43*(9), 705-710.

Arendt, J. N. (2005). Does education cause better health? A panel data analysis using school reforms for identification. *Economics of Education Review, 24*(2), 149-160.

Axinn, W. G., & Barber, J. S. (2001). Mass Education and Fertility Transition. *American Sociological Review, 66*(4), 481-505.

Babai, R., Brecher, T., Stavy, R., & Tirosh, D. (2006). Intuitive interference in probabilistic reasoning. *International Journal of Science and Mathematics Education, 4*(4), 627-639.

Backlund, E., Sorlie, P. D., & Johnson, N. J. (1999). A comparison of the relationships of education and income with mortality: The national longitudinal mortality study. *Social Science & Medicine, 49*(10), 1373-1384.

Barker, D. J. P. (1995). The fetal and infant origins of disease. *European journal of clinical investigation, 25*(7), 457-463.

Baker, D., Collins, J. M., & Leon, J. (2009 forthcoming). Risk factor or social vaccine? The historical progression of the role of education in HIV and AIDS infection in sub-Saharan Africa. *Prospects*.

Baker, D., Knipe, H., Cummings, E., Collins, J. M. Gamson, D. Blair, C., & Leon, J. (Under Review). The Fall and Rise of American Primary School Mathematics: A Content Analysis and Cognitive Assessment of Textbooks from 1900 to 2000. (Submitted to *Journal for Research in Math Education*)

Baker, D., & LeTendre, G. K. (2005). *National differences, global similarities: World culture and the future of schooling*. Stanford, CA: Stanford University Press.

Baker, D. W., Parker, R. M., Williams, M. V., & Clark, W. S. (1998). Health literacy and the risk of hospital admission. *Journal of General Internal Medicine, 13*(12), 791-798.

Baker, D. W., Parker, R. M., Williams, M. V., Clark, S., & Nurss, J. R. (1997). The relationship of patient reading ability to self-reported health and use of services. *American Journal of Public Health, 87*(6), 1027-1030.

Barnett, T., & Blaikie, P. (1992). *AIDS in Africa: Its present and future impact*. New York: The Guilford Press.

Beck, E. J., Mays, N., Whiteside, A. W., & Zuniga, J. M. (Eds.). (2006). *The HIV pandemic: Local and global implications*. New York: Oxford University Press, USA.

Becker, H. R., Agopian, M. W., & Yeh, S. (1992). Impact evaluation of Drug Abuse Resistance Education (DARE). *Journal of Drug Education, 22*(4), 283-291.

Behrman, J. R., & Nevzer, S. (Eds.). (1997). *The social benefits of education*. Ann Arbor, MI: University of Michigan Press.

Behrman, J. R., & Rosenzweig, M. R. (2004). Returns to birthweight. *Review of Economics and Statistics, 86*(2), 586-601.

Benjamin, D. J., Brown, S. A., & Shapiro, J. M. (2006). Who is "behavioral"? Cognitive ability and anomalous preferences." UCLA Department of Economics Levine's Working Paper Series.

Berg, I. (1970). *Education and Jobs: The Great Training Robbery*. New York: Praeger

Berkley, S. F., Widy-Wirski, R., Okware, S. I., Downing, R., Linnan, M. J., White, K. E., et al. (1989). Risk factors associated with HIV infection in Uganda. *Journal of Infectious Diseases, 160*(1), 22-30.

Berkman, N. D., DeWalt, D. A., Pignone, M. P., Sheridan, S. L., Lohr, K. N., Lux, L., et al. (2004). *Literacy and health outcomes. Summary*. Rockville, MD: RTI International–University of North Carolina Evidence-based Practice Center.

Bhan, G., Bhandari, N., Taneja, S., Mazumder, S., & Bahl, R. (2005). The effect of maternal education on gender bias in care-seeking for common childhood illnesses. *Social Science & Medicine, 60*(4), 715-724.

Björkman, H. (2002). *HIV/AIDS and Poverty Reduction Strategies: Policy Note*. New York: UNDP.

Black, S. E., Devereux, P. J., & Salvanes, K. G. (2007). From the cradle to the labor market? The effect of birth weight on adult outcomes. *The Quarterly Journal of Economics, 122*(1), 409-439.

Blair, C., Gamson, D., Thorne, S., & Baker, D. (2005). Rising Mean IQ: Cognitive Demand of Mathematics Education for Young Children, Population Exposure to Formal Schooling, and the Neurobiology of the Prefrontal Cortex. *Intelligence* (33), 93-106.

Blair, C., Knipe, H., Cummings, E., Baker, D. P., Garrison, D., Eslinger, P., et al. (2007). A developmental neuroscience approach to the study of school readiness. In R. C. Pianta, M. J. Cox & K. L. Snow (Eds.), *School readiness and the transition to kindergarten in the era of accountability*. Baltimore: Paul H Brookes Publishing Co.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development, 78*(2), 647-663.

Bleakley, C. H. (2002). *Three empirical essays on investment in physical and human capital.* Massachusetts Institute of Technology, Cambridge.

Blomgren, J., Martikainen, P., Makela, P., & Valkonen, T. (2004). The effects of regional characteristics on alcohol-related mortality--a register-based multilevel analysis of 1.1

million men. *Social Science & Medicine, 58*(12), 2523-2535

Bloom, D. E. (2007). *Education, health, and development*. Cambridge, MA: American Academy of Arts & Sciences.

Bodiang, C. K. (2001). *The multisectoral approach: A focus on Africa*. Berne: Swiss Agency for Development and Co-operation.

Bollen, K. A. (1989). *Structural Equations with Latent Variables.* New York, NY: Wiley.

Bond, G. C.; Vincent, J. 1997. AIDS in Uganda: The first decade. In: Bond et al., eds. *AIDS in Africa and the Caribbean* pp. 85-98. Boulder, CO: Westview Press.

Bond Huie, S. A., Hummer, R. A., & Rogers, R. G. (2002). Individual and contextual risks of death among race and ethnic groups in the United States. *Journal of Health and Social Behavior, 43*(3), 359-381.

Boonstra, O. (1998). The impact of education on the demographic life course: The family reproduction process of literates and illiterates in the Netherlands at the end of the nineteenth century. *The History of the Family, 3*(3), 303-313.

Bradley, H., Bedada, A., Brahmbhatt, H., Kidanu, A., Gillespie, D., & Tsui, A. (2007). Educational attainment and HIV status among Ethiopian voluntary counseling and testing clients. *AIDS and Behavior, 11*(5), 736.

Brown, M. M. (2004). Addressing HIV/AIDS challenges head-on. *Choices Supplement* (July), 4-5.

Bruine de Bruin, W., Parker, A. M., & Fischhoff, B. (2007). Individual differences in adult decision-making competence. *Journal of Personality and Social Psychology, 92*(5), 938-956.

Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, switching, and working memory. *Developmental Neuropsychology, 19*(3), 273-293.

Caldwell, J. C. (1980). Mass Education as a Determinant of the Timing of Fertility Decline. *Population and Development Review, 6*(2), 225-255.

Caldwell, J. C., Caldwell, P., & Quiggin, P. (1989). The social context of AIDS in sub-Saharan Africa. *Population and Development Review, 15*(2), 185-234.

Campbell, C., & MacPhail, C. (2002). Peer education, gender and the development of critical consciousness: Participatory HIV prevention by South African youth. *Social Science & Medicine, 55*(2), 331-345.

Campbell, C., & Mzaidume, Z. (2001). Grassroots participation, peer education, and HIV prevention by sex workers in South Africa. *American Journal of Public Health, 91*(12), 1978-1986.

Caputo, R. 1988. Uganda: Land beyond sorrow. *National Geographic, April*, 468-491.

Caraël, M. 1995. Sexual behaviour. In: Cleland, J.; Ferry, B., eds. *Sexual behavior and AIDS in the developing world*, pp. 75-123. Bristol, PA: Taylor & Francis.

Case, A., Fertig, A., & Paxson, C. (2005). The lasting impact of childhood health and circumstance. *Journal of Health Economics, 24*(2), 365-389.

Castro Martin, T. (1995). Women's Education and Fertility: Results from 26 Demographic and Health Surveys. *Studies in Family Planning, 26*(4), 187-202.

Ceci, S. (1991). How much does schooling influence general intelligence and its cognitive components? A reassessment of the evidence. *Developmental Psychology, 27*(5), 703-722.

Ceci, S., & Williams, W. M. (1997). Schooling, intelligence, and income. *American Psychologist, 52*, 1051-1058.

Christenson, B. A., & Johnson, N. E. (1995). Educational Inequality in Adult Mortality: An Assessment with Death Certificate Data from Michigan. *Demography, 32*, 215-230.

Cohen, S. (2004). Beyond slogans: Lessons from Uganda's experience with ABC and HIV/AIDS.

Reproductive Health Matters, 132-135

Cole, M. (2003). *Cultural Psychology: A Once and Future Discipline*. Cambridge, Mass.: The Belknap Press of Harvard University Press.

Collins, J. M., Baker, D. B., Knipe, H., & Leon, J.J., & Peters, E. (2009). *Explaining the Education Effect and the Demography of Risk: Comparing Unschooled and Schooled on Everyday Reasoning and Decision-Making Skills*. Paper presented at the 2009 AERA Annual Meeting, San Diego, CA. April, 13.

Collins, J. M., Bedford, J., Halabi, S., & Baker, D. P. (2009, April 18). *Dissecting HIV/AIDS curricula: Limitations and critical weaknesses.* Paper presented at the Global Health and Innovation Summit, Yale University, New Haven, CT.

Conway, A. R. A., Kane, M. J., Bunting, M. F., Hambrick, D. Z., Wilheim, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and user's guide. *Psychonomic Bulletin and Review*.

Coombe, C., & Kelly, M. J. (2001). Education as a vehicle for combating HIV/AIDS. *Prospects, 31*(3), 438-445.

Crampin, A. C., Glynn, J. R., Ngwira, B. M. M., Mwaungulu, F. D., Pönnighaus, J. M., Warndorff, D. K., et al. (2003). Trends and measurement of HIV prevalence in northern Malawi. *AIDS, 17*(12), 1817-1825.

Crimmins, E. M., & Saito, Y. (2001). Trends in healthy life expectancy in the United States, 1970-1990: Gender, racial, and educational differences. *Social Science & Medicine, 52*(11), 1629-1641.

Crum, R. M., Helzer, J. M., & Anthony, J. C. (1993). Level of education and alcohol abuse and dependence in adulthood: A further inquiry. *American Journal of*

Cutler, D. M., & Lleras-Muney, A. (2008). Education and health: Evaluating theories and evidence. In R. F. Schoeni, J. S. House, G. A. Kaplan & H. Pollack (Eds.), *Making*

Americans healthier: Social and economic policy as health policy (pp. 29-60). New York: Russell Sage Foundation Publications.

Dailard, C. (2003). Understanding 'abstinence': Implications for individuals, programs and policies. *Guttmacher Report on Public Policy, 6*(5), 4–6.

Dallabetta, G. A., Miotti, P. G., Chiphangwi, J. D., Saah, A. J., Liomba, G., Odaka, N., et al. (1993). High socioeconomic status is a risk factor for human immunodeficiency virus type 1 (HIV-1) infection but not for sexually transmitted diseases in women in Malawi: Implications for HIV-1 control. *Journal of Infectious Diseases, 167*(1), 36-42.

Deaton, A., & Paxson, C. H. (1999). *Mortality, Education, Income, and Inequality among American Cohorts* (No. NBER Working Paper No. W7140): National Bureau of Economic Research.

Delis, D., Kaplan, E., & Kramer, J. (2001). *D-KEFS executive function system examiner's manual*. San Antonio, TX: The Psychological Corp.

De Neys, W. (2006). Dual processing in reasoning: Two systems but one reasoner. *Psychological Science, 17*(5), 428-433.

de Walque, D. (2004). How does the impact of an HIV/AIDS information campaign vary with educational attainment? Evidence from rural Uganda. *Policy Research Working Paper Series* 3289. Washington, DC: World Bank.

de Walque, D. (2005). Parental education and children's schooling outcomes: Is the effect nature, nurture, or both? Evidence from recomposed families in Rwanda. Washington, D.C.: World Bank.

de Walque, D. (2007). Does education affect smoking behaviors? Evidence using the Vietnam draft as an instrument for college education. *Journal of Health Economics, 26*(5), 877-895.

de Walque, D., Nakiyingi-Miiro, J. S., Busingye, J., & Whitworth, J. A. (2005). Changing

association between schooling levels and HIV-1 infection over 11 years in a rural population cohort in south-west Uganda. *Tropical Medicine and International Health, 10*(10), 993-1001.

DeWalt, D. A., Berkman, N. D., Sheridan, S., Lohr, K. N., & Pignone, M. P. (2004). Literacy and health outcomes. *Journal of General Internal Medicine, 19*(12), 1228-1239.

Dougherty, M. R. P., Gronlund, S. D., & Gettys, C. F. (2003). Memory as a fundamental heuristic for decision making. In S. L. Schneider & J. Shanteau (Eds.), *Emerging perspectives on judgment and decision research* (pp. 125-164). New York: Cambridge University Press.

Droomers, M., Schrijvers, C. T. M., & Mackenbach, J. P. (2004). Educational differences in starting excessive alcohol consumption: explanations from the longitudinal GLOBE study. *Social Science & Medicine, 58*, 2023-2033.

Droomers, M., Schrijvers, C. T. M., Stronks, K., van de Mheen, D., & Mackenbach, J. P. (1999). Educational Differences in Excessive Alcohol Consumption: The Role of Psychosocial and Material Stressors. *Preventive Medicine, 29*, 1-10.

Duncan, O. D. (1975). *Introduction to Structural Equation Models*. New York, NY: Academic Press.

Edwards, A., Elwyn, G., Wood, F., Atwell, C., Prior, L., & Houston, H. (2005). Shared decision making and risk communication in practice: A qualitative study of GPs' experiences. *The British Journal of General Practice, 55*(510), 6-13.

Elo, I. T., & Preston, S. H. (1996). Educational differentials in mortality: United States, 1979–1985. *Social Science & Medicine, 42*(1), 47-57.

Ennet, S. T., Tobler, N. S., Ringwalt, C. L., & Flewelling, R. L. (1994). How Effective Is Drug Abuse Resistance Education? A Meta-Analysis of Project DARE Outcome Evaluations. *American Journal of Public Health, 84*(9), 1394-1401.

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *The*

American Psychologist, 49(8), 709-724.

Eslinger, P. J., Flaherty-Craig, C. V., & Benton, A. L. (2004). Developmental outcomes after early prefrontal cortex damage. *Brain and Cognition, 55*(1), 84-103.

Estrada, C. A., Martin-Hryniewicz, M., Peek, B. T., Collins, C., & Byrd, J. C. (2004). Literacy and numeracy skills and anticoagulation control. *The American Journal of the Medical Sciences, 328*(2), 88-93.

Feinstein, J. S. (1993). The Relationship between Socioeconomic Status and Health: A Review of the Literature. *The Milbank Quarterly, 71*(2), 279-322.

Feldman, J. J., Makuc, D. M., Kleinman, J. C., & Cornoni-Huntley, J. (1989). National Trends in Educational Differentials in Mortality. *American Journal of Epidemiology, 129*, 919-933.

Filmer, D., & Pritchett, L. (1998). *The effect of household wealth on educational attainment: Demographic and health survey evidence*. Washington, DC: World Bank.

Flynn, J. R. (1984). The mean IQ of Americans: Massive gains 1932 to 1978. *Psychological Bulletin, 99*, 29-51.

Flynn, J. R. (1987). Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin, 101*, 171-191.

Foster, P. (2008). Education and social inequality in sub-Saharan Africa. *The Journal of Modern African Studies, 18*(02), 201-236.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives, 19*(4), 24-42.

Fylkesnes, K., Musonda, R. M., Kasumba, K., Ndhlovu, Z., Mluanda, F., Kaetano, L., et al. (1997). The HIV epidemic in Zambia: Socio-demographic prevalence patterns and indications of trends among childbearing women. *AIDS March, 11*(3), 339-345.

Garfein, R. S., Golub, E. T., Greenberg, A. E., Hagan, H., Hanson, D. L., Hudson, S. M., et al. (2007). A peer-education intervention to reduce injection risk behaviors for HIV and hepatitis c virus infection in young injection drug users. *AIDS, 21*(14), 1923-1932.

Gattellari, M., Butow, P. N., & Tattersall, M. H. N. (2001). Sharing decisions in cancer care. *Social Science & Medicine, 52*(12), 1865-1878.

Gazmararian, J. A., Kripalani, S., Miller, M. J., Echt, K. V., Ren, J., & Rask, K. (2006). Factors associated with medication refill adherence in cardiovascular-related diseases. *Journal of General Internal Medicine, 21*(12), 1215-1221

GSMF International. (NDa). *Drive protected: Commercial driver HIV/AIDS Programme, peer education training manual.* Accra: Ghana Social Marketing Foundation (GSMF) International.

GSMF International. (NDb). *Lifeshield: Protecting our workforce from HIV/AIDS, peer counselors training manual*. Accra: Ghana Social Marketing Foundation (GSMF) International.

Ghana Statistical Service. (2006). *Ghana in figures 2005*. Accra: Ghana Statistical Service

Ghana Statistical Service (GSS), Noguchi Memorial Institute for Medical Research (NMIMR), & ORC Macro. (2004). *Ghana demographic and health survey 2003*. Calverton, MD: GSS, NMIMR, and ORC Macro.

Glynn, J. R., Carael, M., Buve, A., Anagonou, S., Zekeng, L., Kahindo, M., et al. (2004). Does increased general schooling protect against HIV infection? A study in four African cities. *Tropical Medicine & International Health, 9*(1), 4-14.

Glynn, J. R., Crampin, A. C., Ngwira, B. M. M., Mwaungulu, F. D., Mwafulirwa, D. T., Floyd, S., et al. (2004). Trends in tuberculosis and the influence of HIV infection in northern Malawi, 1988-2001. *AIDS, 18*(10), 1459.

Glynn, J. R., Pönnighaus, J., Crampin, A. C., Sibande, F., Sichali, L., Nkhosa, P., et al. (2001). The development of the HIV epidemic in Karonga district, Malawi. *AIDS, 15*(15), 2025-2029.

Gigerenzer, G., & Goldstein, D. G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review, 103*(4), 650-669.

Girard, R. (1987). *Sida: Tristes chimères*. Paris: Grasset.

Goldman, D. P., & Smith, J. P. (2002). Can patient self-management help explain the SES health gradient? *PNAS, 99*(16), 10929-10934.

GOU/UAC/UNAIDS. (2000). *The national strategic framework for HIV/AIDS activities in Uganda: 2000/1-2005/6*. Kampala: Government of Uganda.

Gow, J. (2002). The HIV/AIDS epidemic in Africa: Implications for U.S. Policy. *Health Affairs, 21*(3), 57-69.

Gray, R. F. (1960). Sonjo bride-price and the question of African" wife purchase". *American Anthropologist, 62*(1), 34-57.

Green, E. C., Halperin, D. T., Nantulya, V., & Hogle, J. A. (2006). Uganda's HIV prevention success: The role of sexual behavior change and the national response. *AIDS and Behavior, 10*(4), 335-346.

Gregson, S., Garnett, G. P., Nyamukapa, C. A., Hallett, T. B., Lewis, J. J. C., Mason, P. R., et al. (2006). HIV decline associated with behavior change in eastern Zimbabwe. *Science, 311*(5761), 664-666.

Gregson, S., Waddell, H., & Chandiwana, S. (2001). School education and HIV control in sub-Saharan Africa: From discord to harmony? *Journal of International Development, 13*(4), 467-485.

Gregson, S., Zhuwau, T., Anderson, R. M., Chimbadzwa, T., & Chiwandiwa, S. K. (1995). Age and religion selection biases in HIV-1 prevalence data from antenatal clinics in Manicaland, Zimbabwe. *The Central African journal of medicine, 41*(11), 339.

Grmek, M., D. (1990). *History of AIDS: Emergence and origin of a modern pandemic* (R. Maulitz & J. Duffin, Trans.). Princeton, NJ: Princeton University Press.

Grosskurth, H., Mosha, F., Todd, J., Senkoro, K., Newell, J., Klokke, A., et al. (1995). A community trial of the impact of improved sexually transmitted disease treatment on the HIV epidemic in rural Tanzania. II: Baseline survey results. *AIDS, 9*(8), 927-934.

Grossman, M. (1972). *The Demand for Health: A Theoretical and Empirical Investigation*. New York, NY: National Bureau of Economic Research and Columbia University Press.

Grossman, M., & Kaestner, R. (1997). Effects of education on health. In J. R. Behrman & N. Stacey (Eds.), *The Social Benefits of Education*. Ann Arbor, Michigan: University of Michigan Press.

Grossman, M. (2004). The demand for health, 30 years later: A very personal retrospective and prospective reflection. *Journal of Health Economics, 23*(4), 629-636.

Hambrick, D. Z., & Engle, R. W. (2003). The role of working memory in problem solving. *The psychology of problem solving*, 176-206.

Hambrick, D. Z., & Oswald, F. L. (2005). Does domain knowledge moderate involvement of working memory capacity in higher-level cognition? A test of three models. *Journal of Memory and Language, 52*(3), 377-397.

Hargreaves, J. R., & Boler, T. (2006). *Girl power: The impact of girls' education on HIV and sexual behaviour*. Johannesburg, South Africa: ActionAid International.

Hargreaves, J. R., Bonell, C. P., Boler, T., Boccia, D., Birdthistle, I., Fletcher, A., et al. (2008). Systematic review exploring time trends in the association between educational attainment and risk of HIV infection in sub-Saharan Africa. *AIDS, 22*(3), 403-414.

Hargreaves, J. R., & Glynn, J. R. (2002). Educational attainment and HIV-1 infection in developing countries: A systematic review. T*ropical Medicine & International Health, 7*(6), 489-498.

Haub, C. (2007). *2007 world population data sheet*. Washington, DC: Population Reference Bureau.

Heckman, J. J. (2007). Economics of health and mortality special feature: The economics, technology, and neuroscience of human capability formation. *Proceedings of the National Academy of Sciences, 104*(33), 13250-13255.

Heyns, B. (1978). *Summer Learning and the Effects of Schooling*. New York: Academic

Hibbard, J. H., Peters, E., Dixon, A., & Tusler, M. (2007). Consumer competencies and the use of comparative quality information: It isn't just about literacy. *Medical Care Research and Review, 64*(4), 379-394.

Hiroto, D. S. (1974). Locus of control and learned helplessness. *Journal of Experimental Psychology, 102*(2), 187-193.

Horton, R., & Das, P. (2008). Putting prevention at the forefront of HIV/AIDS. *The Lancet, 372*(9637), 421-422.

Hunter, M. (2002). The materiality of everyday sex: Thinking beyond 'prostitution'. *African Studies, 61*(1), 99-120.

Hyde, K., Ekatan, A., Kiage, P., & Barasa, C. (2002). *The impact of HIV/AIDS informal schooling in Uganda: Summary report*. Brighton, UK: Centre for International Education.

Inkeles, A. (1969). Making men modern: On the causes and consequences of individual change in six developing countries. *American Journal of Sociology, 75*(2), 208-225.

Inkeles, A. (1975). Becoming modern: Individual change in six developing countries. *Ethos, 3*(2), 323-342.

Isiugo-Abanihe, U. C. (1994). Reproductive motivation and family-size preferences among Nigerian men. *Studies in Family Planning, 25*(3), 149-161.

Isiugo-Abanihe, U. C. (1995). Bridewealth, marriage and fertility in the east-central states of Nigeria. *Genus, 51*(3-4), 151-178.

Jacob, W. J., Morisky, D. E., Nsubugu, Y. K., & Hite, S. J. (2006). Evaluation of HIV/AIDS education programs in Uganda. In D. E. Morisky, W. J. Jacob, Y. K. Nsubugu & S. J. Hite (Eds.), *Overcoming aids: Lessons learned from Uganda*. Greenwich, CT: Information Age Publishing.

Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Perrig, W. J. (2008). Improving fluid intelligence with training on working memory. *Proceedings of the National Academy of Sciences, 105*(19), 6829-6833.

Jewkes, R., Vundule, C., Maforah, F., & Jordaan, E. (2001). Relationship dynamics and teenage pregnancy in South Africa. *Social Science & Medicine, 52*(5), 733-744.

Karim, Q. A., & Karim, S. S. A. (2002). The evolving HIV epidemic in South Africa. *International Journal of Epidemiology, 31*(1), 37-40

Kaufman, C. E., & Stavrou, S. E. (2004). 'bus fare please': The economics of sex and gifts among young people in urban South Africa. *Culture, Health & Sexuality, 6*(5), 377-391.

Kelly, M. J. (2000). *The encounter between HIV/AIDS and education*. Harare, Zimbabwe: UNESCO, Sub-Regional Office for Southern Africa.

Kenkel, D. S. (1991). Health Behavior, Health Knowledge, and Schooling. *The Journal of Political Economy, 99*(2), 287-305.

Kim, S. P., Knight, S. J., Tomori, C., Colella, K. M., Schoor, R. A., Shih, L., et al. (2001). Health literacy and shared decision making for prostate cancer patients with low socioeconomic status. *Cancer investigation, 19*(7), 684-691.

King, R. (1999). *Sexual behavioural change for HIV: Where have theories taken us?* Geneva:

UNAIDS.

Kinsman, J., Nakiyingi, J., Kamali, A., Carpenter, L., Quigley, M., Pool, R., et al. (2001). Evaluation of a comprehensive school-based aids education programme in rural Masaka, Uganda. *Health Education Research, 16*(1), 85-100.

Kirby, D. (2008). Changes in sexual behaviour leading to the decline in the prevalence of HIV in Uganda: Confirmation from multiple sources of evidence. *Sexually Transmitted Infections, 84*(Suppl 2), ii35-ii41.

Kirby, D., Short, L., Collins, J., Rugg, D., Kolbe, L., Howard, M., et al. (1994). School-based programs to reduce sexual risk behaviors: A review of effectiveness. *Public Health Reports, 109*(3), 339-360.

Kirunga, C., & Ntozi, J. (1997). Socio-economic determinants of HIV serostatus: A study in Rakai district, Uganda. *Health Transition Review, 7*(Supplement), 175-188.

Kitagawa, E. M., & Hauser, P. M. (1973). *Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*. Cambridge, Mass.: Harvard University Press.

Kline, R. B. (1998). *Principles And Practice Of Structural Equation Modeling* New York, NY: Guilford Press.

Klingberg, T., Fernell, E., Olesen, P. J., Johnson, M., Gustafsson, P., Dahlström, K., et al. (2005). Computerized training of working memory in children with ADHD-a randomized, controlled trial. *Journal of the American Academy of Child & Adolescent Psychiatry, 44*(2), 177-186.

Knipe, H. L., Collins, J. M., Baker, D. B., & Peters, E. (2008). *Education and Decision-Making around Health in Ghana and Peru.* Paper presented at the 52nd Annual Comparative and International Education Society, New York City, NY. March 17.

Laukamm-Josten, U., Mwizarubi, B. K., Outwater, A., Mwaijonga, C. L., Valadez, J. J., Nyamwaya, D., et al. (2000). Preventing HIV infection through peer education and

condom promotion among truck drivers and their sexual partners in Tanzania, 1990-1993. *AIDS Care, 12*(1), 27-40.

LeDoux, J. (2002). *Synaptic Self: How Our Brains Become Who We Are*. New York, NY: Viking.

Lleras-Muney, A. (2005). The Relationship between Education and Adult Mortality in the United States. *Review of Economic Studies, 72*(1), 189-221.

Lloyd, R. (2005). *The role of NGO self-regulation in increasing stakeholder accountability*. London, England: One World Trust.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin, 127*(2), 267-286.

Lom, M. M. (2001). Senegal's recipe for success: Early mobilization and political commitment keep HIV infections low. *Africa Recovery, 15*(1-2), 24-25, 29.

Luria, A. R. (1976). *Cognitive Development: Its Cultural and Social Foundation*. Cambridge, Mass.: Harvard University Press.

Martinez, M. E. (2000). *Education as the cultivation of intelligence*. Mahwah, NJ: Lawrence Erlbaum Associates.

McCaul, K. D., & Tulloch, H. E. (1999). Cancer screening decisions. *JNCI Monographs, 1999*(25), 52-58.

Meara, E. (2001). Why is health related to socioeconomic status? The case of pregnancy and low birth rate. *NBER Working Paper*.

Meda, N., Ndoye, I., Boup, S. M., Ndiayee, S., Niang, C., Sarr, F., et al. (1999). Low and stable HIV infection rates in Senegal: Natural course of the epidemic or evidence for success of prevention? *AIDS, 13*(11), 1397-1405.

Merson, M. H., O'Malley, J., Serwadda, D., & Apisuk, C. (2008). The history and challenge of HIV prevention. *The Lancet, 372*(9637), 475-488.

Meyer, J. W., Ramirez, F. O., & Soysal, Y. N. (1992). World expansion of mass education, 1870-

1980. *Sociology of Education, 65*(2), 128-149.

Michelo, C., Sandøy, I. F., & Fylkesnes, K. (2006). Marked HIV prevalence declines in higher educated young people: Evidence from population-based surveys (1995-2003) in Zambia. *AIDS, 20*(7), 1031-1038.

Mishra, V., Assche, S. B., Greener, R., Vaessen, M., Hong, R., Ghys, P. D., et al. (2007). HIV infection does not disproportionately affect the poorer in sub-Saharan Africa. *AIDS, 21*(Suppl 7), S17-S28.

Mishra, V., Vaessen, M., Boerma, J. T., Arnold, F., Way, A., Barrere, B., et al. (2006). HIV testing in national population-based surveys: Experience from the demographic and health surveys. *Bulletin of the World Health Organization, 84*, 537-545.

Mirowsky, J., & Ross, C. E. (2003). *Education, social status, and health*. New York: Aldine de Gruyer.

Mmbaga, E. J., Leyna, G. H., Mnyika, K. S., Hussain, A., & Klepp, K. I. (2007). Education attainment and the risk of HIV-1 infections in rural Kilimanjaro region of Tanzania, 1991-2005: A reversed association. *Sexually Transmitted Diseases, 34*(12), 947.

Monasch, R. M., & Boerma, J. T. (2004). Orphanhood and childcare patterns in sub-Saharan Africa: An analysis of national surveys from 40 countries. *AIDS, 18*(Supplement 2), S55-S65.

Mostafa, G., & van Ginneken, J. (2000). Trends in and determinants of mortality in the elderly population of Matlab, Bangladesh. *Social Science & Medicine, 50*(6), 763-771.

Murphy, E. M., Greene, M. E., Mihailovic, A., & Olupot-Olupot, P. (2006). Was the “ABC” approach (abstinence, being faithful, using condoms) responsible for Uganda's decline in HIV. *PLoS Medicine, 3*(9), e379.

Nayga, R. M. (2001). Effect of schooling on obesity: Is health Knowledge a Moderating Factor? *Education Economics 9*(2): 129-137.00

Neisser, U. (Ed.). (1998). *The Rising Curve: Long-Term Gains in IQ and Related Measures* (1st Edition ed.). Washington, D.C.: American Psychological Association.

Nelson, W., Stefanek, M., Peters, E., & McCaul, K. D. (2005). Basic and applied decision making in cancer control. *Health Psychology, 24*(4 Suppl), S3-8.

Nordtveit, B. H. (2005). *The Role of Civil Society Organizations in Developing Countries: A Case Study of Public-Private Partnerships in Senegal.* University of Maryland, College Park, MD.

Nyindo, M. (2005). Complementary factors contributing to the rapid spread of HIV-I in sub-Saharan Africa: A review. *East African Medical Journal, 82*(1), 40-46.

Oppong, J. R., & Agyei-Mensah, S. (2004). HIV/AIDS in west Africa: The case of Senegal, Ghana, and Nigeria. In E. Kalipeni, S. Craddock, J. R. Oppong & J. Ghosh (Eds.), *HIV/AIDS in Africa: Beyond epidemiology* (pp. 70–82). Malden, MA: Wiley-Blackwell.

Oreopoulos, P. (2007). Do dropouts drop out too soon? Wealth, health and happiness from compulsory schooling. *Journal of public Economics, 91*(11-12), 2213-2229.

Parascandola, M., Hawkins, J., & Danis, M. (2002). Patient autonomy and the challenge of clinical uncertainty. *Kennedy Institute of Ethics Journal, 12*(3), 245-264.

Patrick, M. E., Blair, C., & Maggs, J. L. (2006). Executive Function, Behavioral Approach, and Risk Behavior Among Female College Students. The Pennsylvania State University.

Peters, E., & Slovic, P. (2000). The springs of action: Affective and analytical information processing in choice. *Personality and Social Psychology Bulletin, 26*(12), 1465-1475.

Peters, E., Vastfjall, D., Slovic, P., Mertz, C. K., Mazzocco, K., & Dickert, S. (2006). Numeracy and Decision Making. *Psychological Science, 17*(5), 407-415.

Phelan, J. C., Link, B. G., Diez-Roux, A., Kawachi, I., & Levin, B. (2004). "Fundamental Causes" of Social Inequalities in Mortality: A Test of the Theory. *Journal of Health and Social Behavior, 45*(3), 265-286.

Posner, M. I., & Rothbart, M. K. (2005). Influencing brain networks: Implications for education. TRENDS in Cognitive Sciences, 9(3), 99-103.

Putzel, J. (2004). The global fight against AIDS: How adequate are the national commissions? *Journal of International Development, 16*(8).

Quigley, M., Munguti, K., Grosskurth, H., Todd, J., Mosha, F., Senkoro, K., et al. (1997). Sexual behaviour patterns and other risk factors for HIV infection in rural Tanzania: A case-control study. *AIDS, 11*(2), 237-248.

Raven, J., Raven, J. C., & Court, J. H. (2000). *Standard Progressive Matrices*. San Antonio, TX: Harcourt Associates.

Rayna, S. (2003). *Implementation of the integrated early childhood policy in Senegal*. Paris: UNESCO.

Revel, J.F. July 13, 1987. Sida: Les mots meurtriers. *Le Point,* 30-31.

Reyna, V. F. (2004). How People Make Decisions That Involve Risk: A Dual-Processes Approach. *Current Directions in Psychological Science, 13*(2), 60-66.

Reyna, V. F., Lloyd, F. J., & Brainerd, C. J. (2003). Memory, development, and rationality: An integrative theory of judgement and decision-making. In S. Schneider & J. Shanteau (Eds.), *Emerging perspectives on judgment and decision research* (pp. 201-245). New York, NY: Cambridge University Press.

Rice, B. D., Bätzing-Feigenbaum, J., Hosegood, V., Tanser, F., Hill, C., Barnighausen, T., et al. (2007). Population and antenatal-based HIV prevalence estimates in a high contracepting female population in rural South Africa. *BMC Public Health, 7*(1), 160-172.

Rogers, R. G., Hummer, R. A., & Nam, C. B. (2000). *Living and Dying in the USA: Behavioral, Health, and Social Differentials of Adult Mortality*. New York, NY: Academic Press.

Roseboom, T. J., Van der Meulen, J. H. P., Ravelli, A. C. J., Osmond, C., Barker, D. J. P., & Bleker, O. P. (2001). Effects of prenatal exposure to the Dutch famine on adult disease in later life: An overview. *Molecular and Cellular Endocrinology, 185*(1-2), 93-98.

Rosenbaum, D. P., Flewelling, R. L., Bailey, S. L., Ringwalt, C. L., & Wilkinson, D. L. (1994). Cops in the Classroom: A Longitudinal Evaluation of Drug Abuse Resistance Education (DARE). *Journal of Research in Crime and Delinquency, 31*(1), 3-31.

Ross, M. W., & Rosser, B. R. S. (1989). Education and AIDS risks: A review. *Health Education Research, 4*(3), 273-284.

Ross, C. E., & Wu, C.-L. (1995). Education, Age, and the Cumulative Advantage in Health. *Journal of Health and Social Behavior, 37*(1), 104-120.

Rothman, R. L., Housam, R., Weiss, H., Davis, D., Gregory, R., Gebretsadik, T. et al., (2006). Patient understanding of food labels: The role of literacy and numeracy. *American Journal of Preventive Medicine*, 31, 391-398.

Rothman, R., Montori, V., Cherrington, A., & Pignone, M. (2008). Perspective: The role of numeracy in health care. *Journal of Health Communication, 13*(6), 583-595.

Rushing, W. A. (1995). *The AIDS epidemic: Social dimensions of an infectious disease*. Boulder, CO: Westview Press.

Salm, S. J., & Falola, T. (2002). *Culture and customs of Ghana*. Westport, CT: Greenwood Press.

Schneider, H., & Stein, J. (2001). Implementing AIDS policy in post-apartheid South Africa. *Social Science & Medicine, 52*(5), 723-731.

Schoepf, B. G. (2003). Uganda: Lessons for AIDS control in Africa. *Review of African Political Economy*, 553-572.

Schofer, E., & Meyer, J. W. (2005). The world-wide expansion of higher education in the twentieth century. *American Sociological Review, 70*(6), 898-920.

Schultz, T. W. (1961). Investment in human capital. *The American Economic Review, 51*(1), 1-

17.

Schultz, T. W. (1971). *Investment in human capital. The role of education and of research*. New York: The Free Press.

Scott, T. L., Gazmararian, J. A., Williams, M. V., & Baker, D. W. (2002). Health literacy and preventive health care use among Medicare enrollees in a managed care organization. *Medical Care*, 40, 395-404.

Sen, A. K. (1999). *Development as freedom*. New York: Oxford University Press.

Sentell, T. L., & Halpin, H. A. (2006). Importance of adult literacy in understanding health disparities. Journal of General Internal Medicine, 21, 862-866.

Sepkowitz, K. A. (2001). AIDS-the first 20 years. *New England Journal of Medicine, 344*(23), 1764-1772.

Shavit, Y., & Featherman, D. L. (1988). Schooling, tracking, and teenage intelligence. *Sociology of Education, 61*(1), 42.

Shelton, J. D., Cassell, M. M., & Adetunji, J. (2005). Is poverty or wealth at the root of HIV? *The Lancet, 366*(9491), 1057-1058.

Shelton, J. D., Halperin, D. T., Nantulya, V., Potts, M., Gayle, H. D., & Holmes, K. K. (2004). Partner reduction is crucial for balanced "ABC" approach to HIV prevention. *British Medical Journal, 328*(7444), 891-893.

Silver, M. (1972). An Econometric Analysis of Spatial Variations in Mortality Rates by Age and Sex. In V. Fuchs (Ed.), *Essays in the Economics of Health and Medical Care*. New York, NY: Columbia University Press.

Simms, C., Salif Sow, P., & Sy, E. (2006). Senegal. In E. J. Beck, N. Mays, A. W. Whiteside & J. M. Zuniga (Eds.), *The HIV pandemic: Local and global implications* (pp. 228-239). New York: Oxford University Press, USA.

Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of*

Economics, 59, 99-118.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis, 24*(2), 311-322.

Slovic, P., & Peters, E. (2006). Risk Perception and Affect. *Current Directions in Psychological Science, 15*(6), 322-325.

Smith, J., Mushati, P., Kurwa, F., Mason, P., Gregson, S., & Lopman, B. (2007). Changing patterns of adult mortality as the HIV epidemic matures in Manicaland, eastern Zimbabwe. *AIDS, 21*(Supplement 6), S81-S86.

Spaeth, J. (1976). Cognitive complexity: A dimension underlying the socioeconomic achievement process. In W. H. Sewell, R. M. Hauaser & D. L. Featherman (Eds.), *Schooling and Achievement in American Society* (pp. 103-131). New York: Academic.

Spasojevic, J. (2003). Effects of education on adult health in Sweden: Results from a natural experiment. *PhD diss., Graduate Center, City University of New York.*

Stanovich, K. E. (1999). *Who is rational? Studies of individual differences in reasoning.* Mahwah, NJ: Lawrence Erlbaum Associates.

Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences*, 23, 645-726.

Sternberg, R. J. (2008). Increasing fluid intelligence is possible after all. *PNAS, 105*(19), 6791-6792.

Stevenson, H. (1982). Influences on schooling on cognitive development. In D. A. Wagner & H. Stevenson (Eds.), *Cultural Perspectives on Child Development*. San Francisco, Calif.: W.H. Freeman.

Swanson, H. L. (2001). Mathematical problem solving and working memory in children with learning disabilities: Both executive and phonological processes are important. *Journal of*

Experimental Child Psychology, 79, 294-321.

Swidler, A., & Watkins, S. C. (2007). Ties of dependence: AIDS and transactional sex in rural Malawi. *Studies in Family Planning, 38*(3), 147-162.

Taha, T. E., Dallabetta, G. A., Hoover, D. R., Chiphangwi, J. D., Mtimavalye, L. A. R., Liomba, G. N., et al. (1998). Trends of HIV-1 and sexually transmitted diseases among pregnant and postpartum women in urban Malawi. *Aids, 12*(2), 197-203.

TASO-WHO. (1995). *TASO Uganda: The inside story; participatory, evaluation of HIV/AIDS counselling, medical and social services, 1993-1994*. Kampala: The AIDS Support Organization (TASO) & The World Health Organization (WHO).

Turner, F. C., & Corbacho, A. L. (2000). New roles for the state. *International Social Science Journal, 52*(163), 109-120.

Tvedt, T. (2002). Development NGOs: Actors in a Global Civil Society or in a New International Social System?. *International Journal of Voluntary and Nonprofit Organization 13*(4), 363-375.

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211*(4481), 453-458.

Ubaidullah, M. (2004). Social vaccine for HIV prevention: A study on truck drivers in south India. *Social Work in Health Care, 39, 3*(4), 399-414.

UNAIDS. (2006). *AIDS epidemic update*. Geneva: Joint United Nations Program on HIV/AIDS (UNAIDS) and World Health Organization (WHO).

UNAIDS. (2007). *AIDS epidemic update*. Geneva: Joint United Nations Program on HIV/AIDS (UNAIDS) and World Health Organization (WHO).

UNAIDS. (2008). *Report on the global AIDS epidemic*. Geneva: Joint United Nations Program on HIV/AIDS (UNAIDS).

UNAIDS-IATT. (2002). *HIV/AIDS and education. A strategic approach*. Paris: UNESCO.

UNESCO. (2003-2004). *EFA Global Monitoring Report*. Paris: UNESCO.

UNESCO (2007). *EFA Global Monitoring Report*. Paris: UNESCO.

UNESCO (2008). *EFA Global Monitoring Report*. Paris: UNESCO

UNDP. (2002). *HIV/AIDS and poverty reduction strategies: Policy note*. New York: UNDP.

Vandemoortele, J., & Delamonica, E. (2000). The 'education vaccine' against HIV. *Current Issues in Comparative Education*, 3(1), 6-13.

von Neumann, J., & Morgenstern, O. (1947). *Theory of games and economic behavior* (2nd ed.). Princeton, NJ: Princeton University Press.

Waters, G., & Caplan, D. (2003). The reliability and stability of verbal working memory measures. *Behavior Research Methods, Instruments, & Computers, 35*(4), 550-564.

Wechsler, D. (1981). *The Wechsler Adult Intelligence Scale - Revised*. San Antonio, TX: Psychological Corporation.

Weinstein N.D. (1988). The precaution adoption process. Health Psychology, 7:355-386.

Wiley, D. E. (1976). Another hour, another day: Quantity of schooling, a potential path for policy. In W. H. Sewell, R. M. Hauser & D. L. Featherman (Eds.), *Schooling and Achievement in American Society* (pp. 225-265). New York: Academic.

Williams, M. V., Baker, D. W., Parker, R. M., & Nurss, J. R. (1998). Relationship of functional health literacy to patients' knowledge of their chronic disease. *Archives of Internal Medicine*, 158(166-172).

Willis, S. L., Tennstedt, S. L., Marsiske, M., Ball, K., Elias, J., Koepke, K. M., et al. (2006). Long-term effects of cognitive training on everyday functional outcomes in older adults. *JAMA, 296*(23), 2805-2814.

Wilson, D., & Halperin, D. T. (2008). "Know your epidemic, know your response": A useful approach, if we get it right. *The Lancet, 372*(9637), 423-426.

Wojcicki, J. M. (2004). Socioeconomic status as a risk factor for HIV infection in women in east, central and southern Africa: A systematic review. *Journal of biosocial science, 37*(01), 1-36.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III*. Rolling Meadows, IL: Riverside Publishing.

World Bank. (2002). *Education and HIV/AIDS: A window of hope*. Washington, DC: World Bank.

World Bank. (2003). *Education: The social vaccine to HIV/AIDS*. Washington, DC: World Bank.

World Bank. (2004). World Development Indicators Online Publication. Retrieved 02-07-07.

World Bank, UNESCO, & UNAIDS. (2002). Press release: In turning the tide against HIV/AIDS, education is key. Retrieved January 11, 2008, from http://portal.unesco.org/en/ev.php-URL_ID=7195&URL_DO=DO_TOPIC&URL_SECTION=201.html

Zelazo, P. D., & Muller, U. (2002). Executive function in typical and atypical development. In U. Goswami (Ed.), *Handbook of childhood cognitive development*. Oxford, UK: Blackwell Publishing Limited.

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2005 **Master of Education**, Department of Educational Leadership & Foundations, Brigham Young University, Provo, Utah

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Selected Publications

Jacob, W. J., & Collins, J.M. (2009 forthcoming). "HIV/AIDS and Education." In E. F. Provenzo, Jr (Ed.), *Encyclopedia of Social and Cultural Foundations of Education*. Thousand Oaks, CA: Sage.

Collins, J. M. (2009). "When schools fail to protect girls: School-related gender-based sexual violence in sub-Saharan Africa" In Heyneman, S.P. (ed). *Buying Your Way into Heaven: Education and Corruption in International Perspective*. Netherlands: Sense Publishers.

Baker, D. B., Collins, J. M., & Leon, J.J. (2009). Education and the HIV/AIDS Pandemic in sub-Saharan Africa: From Risk Factor to Social Vaccine? *Prospects*.

Collins, J. M. (2008). "Reconstructing Access in the Cambodian Education System." In D. B. Holsinger & W. J. Jacob (Eds.), International Handbook on Educational Inequality. Dordrecht, The Netherlands: Springer.

Coutinho, A., Ochai, R., Mugume, A. Kavuma, L., & Collins J. M. (2006). "The AIDS Support Organisation (TASO): Issues and Potential for Developing Countries." In Morisky, D. E., Jacob, W. J., Nsubugu, Y. K. & Hite, S. J. (Eds), Overcoming AIDS: Lessons Learned from Uganda. Charlotte, NC: Information Age Publishing, 125-150.

Holsinger, D.B., Collins, J.M., Burt, M., Darsow, B., Davis, R., & Hagman, A, & Clark, A. (2006). Education inequality in the Cambodian labor force: Measurement and policy implications. *Iskanja Vzgoja-Pre-Vzgoja, (24)*, 176-194.

Selected Professional Presentations

2009 Collins, J. M., Bedford, J, Halabi, S. & Baker, D. Dissecting HIV/AIDS Curricula: Limitations and Critical Weaknesses. Paper presented at the 2009 Global Health and Innovation Summit, New Haven, CT. April, 18, 2009.

2009 Collins, J. M., Baker, D. B., Knipe, H., & Leon, J.J., & Peters, E. Explaining the Education Effect and the Demography of Risk: Comparing Unschooled and Schooled on Everyday Reasoning and Decision-Making Skills. Paper presented at the 2009 AERA Annual Meeting, San Diego, CA. April, 13, 2009.

2009 Collins, J. M., Baker , D. B., Leon, J.J. & Halabi, S. Trends in knowledge, attitudes and behavior toward HIV and their relationship with education among women in Ghana. Paper presented at the 2009 53rd Annual Comparative and International Education Society, Charleston, SC. March 23, 2009.