STRUCTURAL AND INDIVIDUAL INFLUENCES ON

INFORMATION BEHAVIOR:

A NATIONAL STUDY OF ADOLESCENTS' USE OF PUBLIC LIBRARIES

by

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ABSTRACT

STRUCTURAL AND INDIVIDUAL INFLUENCES ON INFORMATION BEHAVIOR:

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This study proposed and tested a Person-In-Environment (PIE) framework to evaluate the relative

impact of social-structural and personal factors on an individual's information behavior. In contrast to

the focus on individual-level variables, the PIE framework integrates measures of an individual's

information and socio-economic environments at the family and neighborhood levels.

The PIE framework is applied to identify those factors influencing the use of public libraries by

12th-graders for schoolwork, non-schoolwork and Internet access. Drawing from the Education

Longitudinal Study (ELS), this study analyzed a national sample of more than 13,000 students. Data

from each of the respondents is mapped to his/her residential neighborhood, public library, and socio-

economic data using ArcGIS, a Geographic Information System. By integrating data from the ELS,

the Public Libraries Survey and the U.S. Census, this study provides a multivariate analysis of both

individual factors (such as demographics, academic motivation, and reading) and structural factors

(such as the accessibility of public libraries and neighborhood income levels). Structural Equation

Modeling is used to test the model.

The study reveals that there exists prevalent information inequality. There is unequal availability of

print and digital resources at the students' homes, schools, and neighborhood public libraries based on

socio-economic status, race/ethnicity, and gender. The research also finds that school information environment, frequency of school library use, and race/ethnicity are the top three factors affecting the students' frequency of public library use.

This study demonstrates that, even after controlling for individual differences, structural environment has a significant impact on an individual's use of information resources. It is thus paramount for information behavior research to incorporate measures of social-structural inequality. This study also has information policy implications; it shows that one cannot dismiss the lower level of information use as simply a matter of personal disposition. Structural inequality in information resources distribution can depress an individual's library use. More resources need to be devoted to schools and library systems in disadvantaged neighborhoods to facilitate their use and help rectify the information and digital divide.

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1. INTRODUCTION

1.1 Problem Statement

The new millennium sees an alarming pattern of prevalent inequities[1]. Wealth disparities are high in the United States (Davies, Sandstrom, Shorrocks, & Wolff, 2006; Mishel, Bernstein, & Allegretto, 2006; Zhu, 2007), and differential access to services based on socio-economic status (SES) is also evident (Van Doorslaer, Masseria, & Koolman, 2006). Information inequity, such as barriers in digital access (Fox & Livingston, 2007; Horrigan, 2007), no longer garners as much attention from the federal government[2] (Dickard & Schneider, 2002). There are evidences of disparities in access to non-digital information (Duke, 2000; Jue, Koontz, Magpantay, Lance, & Seidl, 1999; Neuman & Celano, 2001), but such inequities have received even less concern than the digital divide. The persistence of information inequity and the lack of resources to combat such inequity are worrisome.

With its keen concern in promoting a free and equitable flow of information, the Library and Information Science (LIS) discipline plays an important role in uncovering and rectifying information

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[1] In this paper, the term information equity is defined using Lievrouw and Farb's (2003) delineation; it is "the fair or reasonable distribution of information among individuals, groups, regions, categories, or other social units, such that those people have the opportunity to achieve whatever is important or meaningful to them in their lives. To the extent that information is unfairly distributed, people are denied such opportunities and information inequity exists" (2003, p. 503).

[2] Official reports on the issue of digital divide have shifted focus, and several federal programs have been eliminated. The earlier reports were concerned about those without access (i.e., the have-nots) (National Telecommunications and Information Administration [NTIA], 1995, 1998, 1999, 2000). While acknowledging that there are groups that have no access because of prohibitive cost or unavailability of services, recent reports focus extensively on the increase in Internet use (i.e., the haves) (NTIA, 2002, 2004). Funding has been discontinued for programs aimed at increasing access such as the *Technology Opportunities Program* and the *Community Technology Centers Program*. The U.S. is now ranked only 20th worldwide on the Digital Opportunity Index (a measure of digital opportunity, infrastructure, and utilization) (*World Information Society Report*, 2007).

inequities (International Federation of Library Associations and Institutions [IFLA], 2001; McCook & Geist, 1994; Norris, 2001). There are obstacles to achieving such goals, however. First, similar to recent trends, the LIS field also tends to focus on digital information inequities (i.e., the digital divide). Disparities in accessing non-digital information sources have not received enough attention. Second, while contributing to identifying barriers that hinder individuals' information seeking and use, the information behavior subfield has not incorporated structural inequity as a central component in the analysis of individual information behavior. Structural factors (defined, in this study, as factors that are (1) related to the basic, recurring pattern of the institutional (i.e., meso level) and societal environment where an individual lives; and (2) beyond the individual's immediate control) have not been well explored in the LIS research (Audunson, 1999; Vakkari, 1997). Few conceptual frameworks include both the individual and the structural aspects. Even applying existing frameworks can be challenging due to difficulties in operationalizing abstract concepts, and identifying suitable research design (Courtright, 2007; Hjørland, 1997; Vakkari, 1997). These research gaps limit the discipline's ability to uncover the extent of structural information inequities and reveal how it influences individual behavior.

Limited inclusion of structural factors is also evident in research of public library use. This needs to be rectified because evidence suggests that there are structural inequalities in both public library funding and resource provision (Sin, 2009), which may in turn affect library use (Hemmeter, 2006; Sin & Kim, 2008). While the public library is widely regarded as important in bridging the information divide, in reality it does not seem to receive sufficient support to fight this inequity (American Library Association [ALA], 2008; Davis, 2006, 2008). It would be nearly impossible for the public library to effectively tackle information inequity if their funding, infrastructure, and resource and service levels mirror the inequity in the broader society. Important work has been and is being done to research and facilitate Internet access in the public library (Bertot, McClure, Thomas, Barton, & McGilvray, 2007;

Gordon, Moore, & Gordon, 2003). However, one cannot afford to lose sight of potential structural inequity in public library services other than the Internet access. In addition, most public library studies have focused on the adult population.

While research shows that adolescents[3] are a major library user group, little research has been done to explore the factors behind their use of public libraries (D'Elia, Abbas, Bishop, Jacobs, & Rodger, 2007; Walter, 2003). Compared to adults, adolescents possess fewer physical, social, informational, and monetary resources to overcome structural inequities. More research is needed in this area.

1.2 Purpose and Method of the Study

The purpose of this study is twofold. First, it aims to address the conceptual and methodological gaps in integrating individual and structural factors when studying individuals' information behavior. Second, it aims to uncover patterns in unequal quality of information environment related to individual characteristics, and to identify the effects of such disparities on individuals' use of public libraries. In sum, this research will strive for both conceptual development and empirical investigation.

This author developed a *Person-In-Environment* [4] (PIE) framework to investigate the effects of structural and individual factors on individual behavior. The proposed framework consists of

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[3] The definition of *adolescent/young adult* varies across information studies. A survey of public libraries found that the most commonly used age range for defining the adolescent/young adult group is from 12 to 18 years of age (Heaviside, Farris, Dunn, & Fry, 1995). As this age range coincides with the definition of young adults by YALSA (Young Adult Library Services Association), this definition will be adopted for the current study.

[4] *Environment* in this study is defined as "the totality of circumstances surrounding an organism or group of organisms" ("Environment," 2000). Thus, *environment* refers not only to the physical and natural aspects of the surrounding, but also to the social, economic, informational, cultural, organizational, and other aspects.

individual, inter-personal, meso, societal, and information environment components. This study pays special attention to the structural factors in the individual's environment, especially those at the meso and societal levels, which are more difficult for the individual to control.

Pathways among the components are the study's focus. Of special interest are the relationships between: (1) structural factors including societal and meso level factors; (2) structural and individual factors; (3) structural factors and individual behavior; and (4) individual factors and individual behavior.

The model testing part of this study will also provide empirical evidence of the factors behind 12th-graders' use of public libraries. Based on the PIE framework, this author developed and tested a specific model of 12th-graders' library use. To capture the structural environment, the residential neighborhood was used as the unit of observation. As in some of the neighborhood effects studies (Durlauf, 2004; Jencks & Mayer, 1990; Sampson, Morenoff, & Gannon-Rowley, 2002), *residential neighborhood* is defined here as the zip code area where the participant resided at the time of the survey.

This study used the *secondary analysis of quantitative data* method. It analyzed quantitative data from a nationally representative sample of more than ten thousand high school seniors. The data was drawn from the base year survey and first follow-up survey of the *Education Longitudinal Study of 2002* (ELS) collected by the National Center for Education Statistics (NCES). Data on the public library resource and service environment came from the *Public Libraries Survey (*PLS), a survey previously collected by NCES and now collected by the Institute of Museum and Library Services (IMLS). Information on neighborhood socio-economic characteristics was drawn from *Census 2000*. The analysis was completed using structural equation modeling (SEM).

1.3 Research Questions

In relation to the study's goal of conceptual development, the broader research question is: Can the PIE conceptual model be applied to the study of individual information behavior? To address this broader question, the PIE model was empirically evaluated using high school seniors' use of public libraries as a test case. This empirical analysis addresses four research questions:

(1) Macro-meso linkage: What are the relationships between the structural factors, that is between the macro-societal factors (e.g., socio-economic environment) and meso-institutional factors (e.g., resource and service levels of the neighborhood public library)?

(2) Macro-meso-micro linkage: What are the relations between structural factors and individual characteristics?

(3) Macro/meso factors and micro behavior: What are the structural factors that are related to the individual's use of public libraries, and to what extent are they related?

(4) Micro factors and micro behavior: What are the individual characteristics that are related to the individual's use of public libraries, and to what extent are they related?

1.4 Significance

This study will further the development of information behavior research, particularly the *information behavior in context* research area. The information behavior field is acutely aware of the drawbacks of over-focus on individual factors (Courtright, 2007; Talja, Keso, & Pietilainen, 1999; Vakkari, 1997). The efforts to incorporate contextual factors, however, have been thwarted with conceptualization and operationalization issues. By proposing a conceptual framework incorporating structural aspects and a method to effectively apply such a framework, the study will be able to help address some of the research gaps. This will help expand the scope of information behavior studies from individual and group level research to a more holistic one that includes structural aspects as well.

The study also has practical implications in terms of policy recommendations. The PIE framework introduces structural factors as a core component, and emphasizes the correlation between individual factors and structural factors (i.e., structural disparities based on individual characteristics). This could give a central focus to the impact of structural factors. Studies show that the American public tends to attribute inequalities to individual characteristics and behavioral factors (e.g., will power, laziness), and overlook societal/structural problems (Bénabou & Tirole, 2006; Wright, 1993). This tendency is referred to as "fundamental attribution error" (Ross, 1977). By paying attention to the structural as well as individual factors in their research, LIS scholars can help counter this tendency. When formulating policy recommendations, such perspectives should help LIS researchers identify solutions that not only focus on issues related to individual characteristics, but also tackle broader issues such as structural barriers.

The study contributes to the extant research on public libraries, which has previously lacked large scale and representative studies of adolescent users. The nationally representative sample used in this study provides better generalizability of the results. Multivariate analysis was used to avoid problems relating to correlated independent variables and to provide a better assessment of the influence of each variable. More importantly, the inclusion of structural factors, a hitherto rarely incorporated dimension, will help identify possible structural problems in public library services. This finding will be useful in planning for more equitable services, which will be particularly beneficial to underserved groups.

2. LITERATURE REVIEW

This section will first identify the need to incorporate structural factors in the study of individual information behavior, through a brief examination of the current status of social and information inequities in the U.S. society, and in public library resources and services (hereafter, simply *resources*) specifically. It will then discuss how structural factors have been conceptualized and operationalized in information behavior studies. The research gaps in extant frameworks and empirical investigations will be identified. The review will then conclude with an evaluation of the conceptual frameworks and research designs of the public library research.

2.1 Status of Inequities in the United States

There is a pressing need to understand the influence of structural inequities on individual behavior, as social inequities continue to widen around the world and in the United States (Mishel et al., 2006; Zhu, 2007). The richest 2% of the world's population controls over 50% of the world's household wealth. Wealth inequality in the United States is particularly prominent. From a range of 0 to 1, with 1 indicating complete inequality, the Gini coefficient of the United States wealth distribution is as high as 0.8 (Davies et al., 2006). More than 37 million people were in poverty in the United States (U.S. Census Bureau, 2008b). In 2006, 17% of children aged 0-17 lived in poverty. The poverty rate is even higher for some ethnic minorities. While about 10% of Caucasian American children lived in poverty, the figure is at 27% for Hispanic and 33% for African American children (Federal Interagency Forum on Child and Family Statistics, 2008).

There is not only a large disparity in household wealth in the United States, but also prominent inequities in access to services based on socio-economic characteristics. For example, there is unequal access to health services (Krieger, Barbeau, & Soobader, 2005), to quality education (Talen, 2001; The

Education Trust, 2008), and to information infrastructure and resources (Doctor, 1992; Fox &

Livingston, 2007; Horrigan, 2007; Lievrouw & Farb, 2003). Individuals in lower income households

experience suboptimal physical and social living conditions, such as higher exposure to environmental

pollutants, health risks, violence, and crime (Bradley & Corwyn, 2002; G. W. Evans, 2004; McLoyd,

1998). The following section will examine inequities in the information environment, with special

reference to the information environment facing today's adolescent.

2.1.1 Inequities in the Information Environment

Social inequities affect individuals in all stages of life, and youth is no exception. Compared to adults,

youth might have even fewer resources to overcome structural inequities. Those living in

disadvantaged areas such as lower-income areas, urban inner-city and rural areas, are often found to

have fewer information resources of their own, in their family, and in their neighborhood (D'Elia et al.,

2007; Duke, 2000; Eamon, 2004; G. W. Evans, 2004; Jue et al., 1999; Lipsman, 1972; Neuman &

Celano, 2001; Roscigno, Tomaskovic-Devey, & Crowley, 2006).

In light of the scarcity of resources at home, the availability of educational and information resources

from schools or other social institutions is crucial. Unfortunately, the quality of schools itself also

varies markedly across the U.S. There are considerable funding disparities among and within states,

even within the same school districts. Schools in lower-income or rural areas on average receive less

revenue and spend less per student, when compared to their counterparts in higher-income or urban

districts. In terms of state and local funding, for example, schools in the highest poverty districts on

average receive $938 per student less than those in the most affluent districts (The Education Trust,

2008). Schools in these disadvantaged neighborhoods often have fewer resources available to students.

These include lower quantity and quality of textbooks and curriculum materials (Oakes & Saunders,

2004), less computer and Internet access (Corporation for Public Broadcasting, 2002; Gorski, 2005),

and school libraries with smaller print collections (Duke, 2000; Neuman & Celano, 2001). Similarly, other public facilities in these disadvantaged areas are also less well-funded (Warner, 2006). Rural areas, in particular, have public facilities that are sparsely-located, have less Information and Communications Technology (ICT) infrastructure, and fewer public access Internet points (Boris, 2005; Flatley, 2001; Grubesic & Murray, 2004).

2.1.2 Inequities in Public Library Resources

While the public library is widely considered as a prominent resource in addressing information inequity (IFLA, 2001; McCook & Geist, 1994; Norris, 2001), funding and resource levels vary across library branches. Such variations have long been documented. Louis R. Wilson's seminal publication, The Geography of Reading, presented the disparities in public libraries' availability, holdings, and revenues across the nation. In the work, Wilson suggested that factors such as variations in economic ability and geography (e.g., urbanization level) contributed to these inequalities (L. R. Wilson, 1938). Although efforts have been made to add more public libraries since then, similar disparities are still evident today. Budget constraints that public libraries experience today have worsened the situation. An American Library Association (ALA) study found that libraries serving populations below 25,000 and above 500,000 or those in the Midwest or the West especially, are experiencing significant budget cuts (Davis, 2006). The 2004 Public Libraries Survey shows that funding levels varied widely - from a low of $62 to a high of $1,529,746 total funding per thousand services capita. Even after controlling for variations in service population size and the state, a regression analysis of the funding level with census tract data reveals that public library systems in higher income neighborhoods or in urban areas received more funding per services capita than those systems in lower-income or rural neighborhoods (Sin, 2009).

Such funding disparities could be especially detrimental to disadvantaged neighborhoods. Systems in

low-income neighborhoods might not have the funding to maintain a sufficient number of outlets. Jue

and colleagues (1999) offer insights on differential physical access to public libraries based on the

neighborhood income. The study utilized the 1993 Federal State Cooperative System (FSCS) data and

the 1990 census data on poverty level. They found that public libraries are less likely to be in or serve

extreme poverty areas when compared to the poverty or low poverty areas.

Even when there is a public library outlet in the neighborhood, the resource levels might vary widely.

Some national level inferential studies suggest structural variations in services. Robert Williams

(1980), for example, found a positive relationship between several socio-economic variables of the

community (formal education, economic ability and occupational prestige at the community level) and

a composite index of the level of public library developments (including number of professional staff,

expenditures, number of books in the collection, and circulation figure)[5]. Sin's nation-wide study

indicates that such variations are still a common pattern across the United States. The study found that

in 13 resource categories (e.g., number of paid full-time employees, opening hours, print materials,

audio, video, etc.), libraries in urban neighborhoods had better per-capita resources than rural libraries

in all categories. Those in high-income neighborhoods had better per-capita resources than their lower-

income counterparts in all but one category – public access Internet terminals (Sin, 2008).

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[5] It should be noted that the composite index is not a pure measure of library resource and service
availability. This is because the index includes circulation figures, which is not solely a measure of resource
availability, but rather a measure of supply and demand (i.e., availability and use of services). However, the
study is still significant in showing the differences of service levels, as nationwide studies and inferential
testings of this topic are rare.

The aforementioned national studies did not specifically examine library services designed for the adolescent. Nevertheless, there is some evidence that disparities also exist in youth services provision. While the adolescent makes up a significant portion of library users, LIS scholars and professionals have expressed their concerns regarding the low priority that adolescent services and adolescent information needs receive from public libraries (Chelton, 1985; Harmon & Bradburn, 1988; Winston & Paone, 2001). According to the *Survey on Library Services for Children in Public Libraries* conducted by NCES in 1995, only about 11% of public libraries have a young adult librarian. The survey also shows that 11% of the libraries do not have a young adult collection or section. While the data provided did not allow for statistical analyses, the percentage tabulation data suggest that large libraries or those in suburban areas are more likely to have specialized staff and more materials and services for children and youth patrons (Heaviside et al., 1995). Similar large-scale survey has not been conducted until the Public Library Association's *Young Adult Services Survey* in 2007. This survey shows that more resources have been committed to youth materials and services since the mid-1990s. However, still only about half of public libraries have full-time staff dedicated to young adult services (Public Library Association, 2007).

In summary, the findings of the general national studies coincide with the findings of those focused on particular services - for example, youth services (Heaviside et al., 1995) and Internet access in the public library (Bertot et al., 2007). They also agree with findings from case studies of selected locations or library branches (Loreto & Tse, 1999; Neuman & Celano, 2001). Together, these findings suggest that structural inequities are prevalent in public library services. As disadvantaged areas would most benefit from the free services offered by the public library (Parker, 1974), such disparities in public library funding and resource levels should be a matter of great concern. While the digital divide has drawn the public's attention, society cannot afford to lose sight of the persistent differential access

to other information resources, nor ignore the potential influences of such structural inequities on individual behavior.

2.2 Conceptual Frameworks for Agency-Structure Integration

The rise in social and information inequities increases the urgency for the LIS discipline to reexamine the role of individual agency and social structure in influencing individual behavior. *Social structure* is the most basic, enduring, and orderly pattern in social life. *Individual agency* refers to the capabilities of an individual to act independently of the constraints exerted by the social structure (Abercrombie, Hill, & Turner, 1994; Calhoun, 2002). This section will review how individual agency and social structure are studied in social sciences (including the information research field). This will be followed by a discussion of gaps in extant studies.

2.2.1 Agency-Structure Integration in Social Sciences

Many social science disciplines have long attempted to tackle the agency-structure issue (Ritzer & Gindoff, 1994). Some scholars focus extensively on individual agency (e.g., symbolic interactionism, ethnomethodology, phenomenology) while others focus on studying social structure (e.g., structural functionalism). Sociologists refer to this as the micro-macro or agency-structure (occasionally subjectivism-objectivism, or individualism-holism) debate (Ritzer & Gindoff, 1994; Ritzer & Goodman, 2004). Psychologists also have a similar discussion, often referred to as the person-situation or person-environment debate (Hogan & Roberts, 2000).

There have been attempts to draw attention to both micro and macro factors, particular by scholars advocating an ecological perspectives. Roger Baker, for example, found the psychology discipline focused too much on individual characteristics. His *ecological psychology* advocates the study of the environmental setting to help understand variances in individual behavior (Barker, 1968). Urie

Bronfenbrenner's *ecology of human development* (1979) is based on the principle that development is a joint function of person and environment. It was not until the 1980s, however, that more scholars across various social science disciplines started to acknowledge the interrelated nature of individual agency and the social structure. Many scholars have now moved away from the idea of a dichotomy, and attempt to integrate both agency and structure in the understanding of human behavior (i.e., micro-macro or agency-structure integration).

Advancement in agency-structure integration can be observed in many grand social theories and empirical multilevel studies. Grand social theories such as Anthony Gidden's *structuration theory* and Pierre Bourdieu's *habitus* have gained wide interest. These social theories propose how active individuals come to reproduce the social structure, even when the structure is not to their advantage. Giddens suggested individuals tend to want to avoid anxiety. This contributes to the repetition of daily routines that sustain social structures. Bourdieu focused on how individuals, through their experience, internalize views and norms shared by members of their own social groups, which in turn contributes to their actions to reproduce social structures (Ritzer & Goodman, 2004). These grand theories have influenced the frameworks used for studying various social phenomena. In information behavior studies, for example, Rosenbaum's (1993; 1996) and Savolainen's (1995) frameworks were drawn from Giddens' and Bourdieu's theories, respectively. Most frameworks developed from grand theories focus on selected concepts only because they cannot cover all the elements that such theories encompass. As the concepts are very abstract in nature, however, it is difficult to study them empirically.

Scholars have also proposed mid-range approaches to bridge the agency-structure gaps. Particularly relevant to this study is the attention to institution, the *meso-level approach*, as advocated by Paul DiMaggio (1991). DiMaggio distinguished two linkages; one between individuals and the institution

(micro-meso), and the other between the institution and the broader social structure (meso-macro). On the micro-meso side, the institution cannot direct individuals' actions, but could legitimize and encourage certain types of individual behavior, for example, by establishing official policies or offering rewards. On the meso-macro side, the institution itself is not completely autonomous. It is influenced by (and could in turn reinforce) its relationship with other institutions and the broader societal conditions. The focus on the meso-level pinpoints the fact that, in addition to individuals, the institution is also the site where social structures are reproduced, or challenged. With the interest in the public library and its role in addressing information inequity, the current research will be guided by this meso-level perspective. Further discussion on this perspective can be found in section 3.2.2.

Empirical studies investigating both individual and structural factors also help contribute to agency-structure integration. Such empirical studies bring forth an important issue, the *unit of observation* (i.e., the entity that is observed and about which data is collected) concerning the structural factor. For example, if a study is interested in socio-economic status (SES) as a structural factor, SES data can be collected at various levels (e.g., regional, state, or neighborhood levels). Similarly, studies of institutions as discussed before can also be conducted at different levels (W. R. Scott, 2001). For example, one could study the public library institution in the world, in the U.S., in a U.S. geographical region, in a state, in a particular library system, or in a neighborhood library branch.

Of particular interest to this research are studies at the neighborhood level. The structural characteristics of neighborhoods have drawn much attention, as the neighborhoods represent the immediate environment in which people live their daily lives. Research at the levels closer to individuals such as the neighborhood level is more likely to reveal disparities than more distal levels (e.g., state level) (D. M. Smith, 1979). Studies that examine the influence of neighborhood-level factors on individual behaviors and outcomes are sometimes referred to as studies of "neighborhood

effects." Recognizing the interrelated relationship among individual, family, and neighborhood characteristics, neighborhood effect studies rarely analyze neighborhood-level factors only. Instead, both individual-level and neighborhood-level factors are usually included. Some studies also include family-level or school-level factors (Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000). Theoretical and methodological discussions and empirical studies surrounding agency-structure integration are now common in different fields such as sociology (Sampson et al., 2002), psychology (Leventhal & Brooks-Gunn, 2000; Shinn & Toohey, 2003), education (Duncan & Raudenbush, 1999) and health sciences (Roux, 2001).

2.2.2 Agency-Structure Integration in Information Behavior Studies

While many social scientists moved towards agency-structure integration in the 1980s, the LIS field, particularly the information behavior subfield, experienced a paradigm shift from the system-centered to the user-centered approach. The user-centered paradigm emphasizes users' individuality and recognizes that human information behavior is "situational." Dervin and Nilan (1986) characterized this new paradigm as "It sees users as beings who are constantly constructing, as beings who are free (within system constraints) to create from systems and situations whatever they choose" (p. 16). This characterization touches on both individual agency and system constraints. Perhaps as a reaction to the previous paradigm which focused on systems, however, it has been observed that most studies since the paradigm shift have focused extensively on the individual level (Bystrom, 1999; Courtright, 2007; Johnson, Case, Andrews, Allard, & Johnson, 2006; Solomon, 2002; Talja et al., 1999). The influences of structural factors on individual information behavior have not drawn much examination (Audunson, 1999; Dervin, 1999; Vakkari, 1997).

Around the mid-1990s, there was growing recognition that factors beyond the individual user needed more attention. This crystallized in interest in the "*context*" or contextual factors of information

behavior. The biennial *Information Seeking In Context* (ISIC) conference, first started in 1996, is

particularly prominent in aiding this development. The editors of the first ISIC conference proceedings

identified their view of *context*, "Our strong presupposition is that a wide variety of contextual

considerations (e.g., communities and organizations with their structures and cultures) constitute

frames of reference for the information behavior in individuals" (Vakkari, Savolainen, & Dervin,

1997, p. 8). From the standpoint of achieving individual-structural integration, this rising interest in

context is promising. At the moment, however, the field is still wrestling with what *context* actually

constitutes, how to integrate contextual factors in a coherent conceptual framework, and the research

methods suitable for such research (Courtright, 2007).

2.2.3 Potential Information Behavior Frameworks for Agency-Structure Integration

The following sections will examine how individual and contextual factors were conceptualized and

operationalized over the years. These frameworks provide the foundations to build this study's

conceptual framework (see section 3.3), and thus will be explored in more depth. Special attention will

be paid to frameworks that are relevant to the study of structural factors. Barriers in extant frameworks

will then be discussed in an effort to pave the way for further development in this research area.

While many information behavior studies in the 1960s and 1970s are now considered as positivistic,

system-oriented, and lacking interest in individuality and context, some earlier studies did pay

attention to individual differences and contextual factors (Talja & Hartel, 2007). A good example is

William Paisley's conceptual framework (Paisley, 1967). Paisley emphasized that users are situated at

the center of different work, social, political, and cultural systems. He stressed the need for

understanding how these systems influence users' information behavior. The framework is noteworthy

because of the wide-ranging layers of contextual factors included.[6] This framework offers evidence

that the LIS field has long been aware of the importance of individual characteristics and contextual

factors in information behavior - even during the period now generally considered to be overly

positivistic and system-centered. As Paisley developed this framework specifically for the study of

scientists and their work-related information behavior, the framework will need to be modified if it is

to be applied to the study of everyday life information seeking (ELIS).

T. D. Wilson's 1981 model also conceptualized the person as nested within the environment. Different

from Paisley's framework, Wilson's can be used to study information behavior outside of the work

environment. The model identified personal, interpersonal, and environmental factors (including work,

socio-cultural, political-economic, and physical environments) as influential to information needs and

information seeking behavior. In discussing the potential impact of the environment on work, for

example, Wilson identified issues such as the "differential stratification of resources" (p. 10). His

model also more explicitly recognized the interconnected relationships among all factors (T. D.

Wilson, 1981). This broad conceptual model is promising in framing a study that incorporates both

individual and structural factors. Unfortunately, the model has not been fully applied in subsequent

information behavior studies.

Robert Taylor's *Information Use Environments* (IUEs) is another oft-mentioned framework that

includes people and the environment they are situated in (Taylor, 1991). Four elements were identified

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[6] Paisley identified eight systems arranged in concentric circles. The outermost layer is the cultural system, followed by the political system, the membership group (e.g., a national association of the scientist's discipline), the reference group (e.g., colleagues from the same specialty), invisible college, a formal organization, a work team, and at the center of the circles is located the user (including factors concerning users' perception, cognition, affect, and motivation). Two systems, the legal/economic system and a formal information system are seen as cutting across the aforementioned eight layers.

in this framework; they are sets of people, problems, settings, and resolution of problems. Of particular interest to this research is the inclusion of "settings" as one of the four core elements. The study of *settings* includes topics such as the nature, structure, and attributes of the setting, and the availability and accessibility of information resources. Taylor's model, however, focuses on groups of people but not individuals. As such, individual-level demographics such as age and sex are considered less consequential in IUEs. Taylor also focused mostly on the professionals and the entrepreneurs in the work environment and organizational settings. He did express a hope that the framework would be used in studies of the general public. Several scholars have indeed used IUE in the study of everyday life information behavior. Agada (1999) applied IUE to study the information behavior of 20 inter-city gatekeepers in Harambee, an inner-city neighborhood in Milwaukee. Hersberger and colleagues (2006) used IUE in their pilot study of the information behavior of 15 abused and neglected children. However, in these applications, IUE was still used to examine the information behavior of the group as a whole, rather than to focus on individuals.

Rosenbaum's *Organizational Information Use Environment* (OIUE) is based on Taylor's IUE (Rosenbaum, 1993, 1996). OIUE is defined as the "component of organizational structure composed of rules and resources which affect information flow in the organization and which hold potential criteria used to value information, typical information-based problems faced by organizational members, and acceptable resolutions to those problems" (1996, p. 153). Similar to IUE, OIUE is work-environment and group oriented. It is worth mentioning here, however, that OIUE is based on Anthony Giddens' *structuration theory*, one of the prominent attempts to bridge the agency-structure gap. As *structuration theory* covers everyday practices, it is a bit surprising that the theory was not used to expand the concept of OIUE to include everyday life information behavior.

Chatman's conceptualization of a *small world* is also oriented towards group-level study. Different from IUE and OIUE, however, this framework is particularly suitable for the study of everyday life information behavior. The concept is based on sociological theories and developed through exemplary ethnographical works of aging women (Chatman, 1992), janitors (Chatman, 1991, 1996), and women in maximum-security prison (Chatman, 1999). In this framework, individuals in a *small world* are seen as sharing a cultural space, in which members share similar world-views and social norms. These shared norms and expectations shape the boundary of appropriate behavior, and thus have the potential to shape the members' information behavior as well. Because of the focus on marginalized groups, this concept is of particular interest to research of structural and information inequities. While Chatman also introduced the idea of "social types" to help study sub-groups, the interest remained in understanding the world-views of the group and the impact of these views on information behavior. Individual variations among group or sub-group members were not the focus of the framework.

Where everyday life information behavior is concerned, one could not bypass Savolainen's study (Savolainen, 1995). While Rosenbaum integrated Gidden's *structuration theory* to investigate information behavior in organizational settings, Savolainen used Pierre Bourdieu's concept of *habitus* to study everyday life information seeking (ELIS). Savolainen's framework is particular relevant to this study because of its explicit recognition of the role of structural factors, which is often less directly addressed in other frameworks. As he put it, the framework "prepares the ground for a substantial analysis of individual and structural factors of information seeking, as well as their intermediation" (1995, p. 260). However, the framework has two main drawbacks that hinder its application. First, as Savolainen discussed, the concept of *habitus* is very abstract and difficult to operationalize. As a result, he narrowed down the focus to the concepts of *way of life* and *mastery of*

life instead. Unfortunately, these concepts are still difficult to define.[7] Savolainen acknowledged these difficulties in the conclusion section: "the concepts with large extensions and heterogeneous intentions are problematic in that their exact operationalization is difficult; thus it may not be easy to specify which parts of ELIS are really determined by way of life and which would be explained better by other factors, such as current situation of life or the degree of difficulty of the problem being encountered" (p. 289). These difficulties in operationalization might have hindered the use of the framework. While this article popularized the term *everyday life information seeking (ELIS)*, few information behavior studies applied the framework or the concepts of *way of life* and *mastery of life*.

The second area worth examining is how structural factors were incorporated in the study – they were studied only indirectly. The focus of the framework was on exploring the link between *way of life/mastery of life* and ELIS. The link between structural factors and *way of life* itself was assumed but not explored. The empirical study, for example, focused on comparing two social classes (middle class and working class, more specifically, teachers and workers). This is based on the assumption that "they differ most markedly in regard to social and cultural capital acquired; this difference was expected to manifest itself in ways of life and styles of mastery of life, and through them in ELIS practices" (p. 269). The assumed link between structural factors/social class and *ways of life/mastery of life* could be an issue of contention. While structural factors may help shape an individual's way of life, one cannot easily identify exactly what structural factors influence an individual's way of life in what way, and the extent of such influences. In other words, even when the framework helps establish

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[7] For example, *way of life* was operationalized by "taking the following factors into account: the structure of time budget, described as a relation between working and leisure time, models of consumption of goods and services, and nature of hobbies" (Savolainen, 1995, p. 263). The operationalization seems less specific than desired.

the relationship between *way of life* and ELIS, there might not be sufficient evidence to infer the influences of structural factors on ELIS. An approach that allows one to test structural factors directly will be needed.

Allen (1997) and Allen & Kim (2001) offered a more seamless framework to study both individual characteristics and contextual factors directly. The *person-in-situation* model stands out as it emphasizes the interaction between individual and contextual factors. Based on the theoretical foundation of *interactionism*, the model highlights that individual differences and contextual factors could act concurrently to influence individual behavior. The interaction could be interpreted as a result of a person-situation fit, in which an individual with certain characteristics might fit better with certain types of situations than others, leading to differences in behavior. Another interpretation is that individuals could be flexible and change their behavior in order to adapt to different situations. The model is also the only framework reviewed here that is actually tested through inferential testing. The interaction effect between personal cognitive characteristics and task characteristics in the academic context was not statistically significant (Allen & Kim, 2001). However, this paper tested only the interaction of a subset of individual and contextual factors. For the individual-level characteristics, the focus was on cognitive variables. For contextual factors, the study focused on different academic tasks, but not on the broader situation or structural factors. When other individual variables (e.g., problem solving styles) were studied in different contexts, significant interactions were found (Kim & Allen, 2002). This finding shows that individual and contextual factors do interact. The implication for research design is that, in order to test for such interactions, individual and contextual factors should be analyzed together and not separately. It is hypothesized that person-situation interaction will also be detected when other individual or structural variables are tested; more studies of this kind should be encouraged.

Williamson (1998) drew on the ecological approach in her study of information behavior of older adults in Australia. As she explained, the ecological approach "focuses on the individual in a particular physical, social, and cultural environment" (p. 25). The ecological approach is popular in the study of contextual factors and is increasingly being used in fields such as education and health sciences (Arum, 2000; McLaren & Hawe, 2005). After analyzing the data from her naturalistic study, Williamson built an *ecological model of information use*. This model is a nested model, with an individual nested within various layers of information sources. Several categories of factors were identified, including personal characteristics, socio-economic circumstances, values, lifestyles, and physical environment. Worth highlighting is that while in general an ecological approach pays special attention to factors at different levels, Williamson's model focuses heavily on the individual-level factors. The socio-economic circumstances, values, and lifestyle factors in the model refer to individuals' social and cultural characteristics, and not the characteristics of the social and cultural environments. Structural factors are still not the central component in Williamson's model.

Fisher's *information ground* pays special attention to the environment in which information is exchanged. The concept is used to examine social settings (e.g., community clinics) that foster spontaneous information sharing (Fisher, Durrance, & Hinton, 2004; Fisher, Naumer, Durrance, Stromski, & Christiansen, 2005; Pettigrew, 1999). Fisher and her colleagues identified and grouped the characteristics of *information grounds* as people-related, place-related, and information-related. Place-related characteristics include location and permanence, privacy, and ambient noises, to name a few (Fisher, Landry, & Naumer, 2007). As an *information ground* is designed to explore a temporal setting, societal and structural factors are not a central component of this concept. Nevertheless, the inclusion of place-related characteristics is promising. It helps underline that, in addition to individual characteristics, the information environment can also influence information behavior in everyday life.

Recently, with a growing interest in contextual factors, more concepts focusing on the information

environment are emerging. These include: *information horizon* (Sonnenwald, 1999; Sonnenwald,

Wildemuth, & Harmon, 2001), *information field* and *information pathway* (Johnson, 1996; Johnson et

al., 2006)*. These concepts suggest that an individual is surrounded by an array of information

resources, and different individuals might have different information environments. Such concepts

have the potential to reveal disparities in source availability and accessibility. So far, the concepts have

been developed to study what sources are considered, preferred, or used for a particular task, or to

identify the sequence of source selection by the participant. That is, using a quantitative nomenclature,

these studies treat information environment as the dependent variable. The information environment

factor has not been used as an independent or mediating variable to help understand variations in

individual information behavior.

2.2.4 Gaps in Extant Frameworks

The status of research development related to the inclusion of structural factors in information

behavior studies can be summarized as follows:

(1) The potential influence of social structural factors on individual behavior is recognized. It was

   discussed as early as in the 1960s (e.g., Paisley, 1967), and recently discussed in studies of

   contextual factors (e.g., Savolainen, 1995; Vakkari, 1997). The interrelated nature of individual and

   contextual factors is also highlighted (e.g., Allen & Kim, 2001);

(2) Broad conceptual frameworks that include both individual and structural factors have been

   proposed. However, those frameworks were not always applied (e.g., Paisley, 1967; T. D. Wilson,

   1981); or when applied, they were difficult to operationalize (e.g., Savolainen, 1995);

(3) While receiving more attention in models related to work environment (e.g., Paisley, 1967; Taylor, 1991), institutions have rarely been examined in models focusing on everyday life information behavior;

(4) There are frameworks and concepts that have been applied more successfully, but their focus has been mainly on a whole group rather than individuals (e.g., Taylor, 1991; Chatman, 1991, 1992, 1996, 1999); and

(5) Structural factors have not been fully or directly explored in extant frameworks (e.g., Savolainen, 1995; Williamson, 1998), or they are yet to be used as explanatory or exploratory variables (e.g., in *information horizon*, *information field*, and *information pathways*).

There is much room for conceptual and methodological improvements towards individual-structural integration in information behavior research. As Hjørland stated, "it has been difficult to reach a synthesis that would put individual information needs, query formulations, search behavior, and so on, in a sociological perspective. The connecting link between the psychological and the sociological levels has been missing" (Hjørland, 1997, p. 120). This problem still plagues us today (Courtright, 2007). There are several characteristics of information behavior research that might have inadvertently hindered research development along this avenue. This will be explored in the following sections.

2.2.4.1 Ambiguous conceptualization

While the recent interest in *context* has broadened the scope of information behavior study, further development is hindered by the confusion over what the concept means. It is unclear what the term *context* actually constitutes. In her review, Dervin called the term "the unruly beast," and exclaimed that "there is no term that is more often used, less often defined, and when defined so variously as context" (1997, p. 14). She stated that "virtually every possible attribute of person, culture, situation, behavior, organization, or structure has been defined as context" (p. 14). Dervin herself did not define

the term in the review, but turned to an in-depth discussion of the "contextual approach." Sonnenwald (1999) and Allen & Kim (2001) have helped distinguish *context* from *situation* and *task*. Other than such rare conceptual refinements, the definitional ambiguity is still very much evident nowadays (Chang & Lee, 2001; Cool & Spink, 2002; Courtright, 2007). As the term - *context* - is so vaguely defined, studies of *information behavior in context* may, or may not, include structural factors. It appears that interest in the vaguely-defined *context* alone has not drawn and may not draw sufficient attention to structural problems. Concepts and frameworks specific to the incorporation of structural factors are needed to encourage research along this avenue.

2.2.4.2 Focus on participants' perceptions

This issue is concerned with how contextual factors are studied in extant studies. Scholars have observed that there is a strong inclination towards studying contextual (including structural) factors as perceived by the participants (i.e., *emic/*insider perspective) (Hjørland, 2004; Sandstrom & Sandstrom, 1995; Talja, 1997; Talja et al., 1999). Dervin and Nilan's influential article, which heralds the user-center paradigm, succinctly captured this inclination, stating that the paradigm "focuses on the user. It examines the system **only as seen by the user**" (1986, p. 16, emphasis mine).

Such preference for participants' interpretations, based on the epistemological stance that individuals construct their own meaning of the world, is not a problem in itself. However, the concern is that when the majority of the information behavior research takes a particular stance, our understanding of information behavior becomes crippled (Bates, 2005). Information behavior often involves an individual interacting with external information sources and systems. Since individuals have fragmented knowledge of the reality that exists external to their mind, their views might not fully reflect the conditions of the external world.

For investigations of information inequities, omitting *etic*/outsider measures would be problematic. Participants may not be aware of the existence, or the extent of, the inequities they are experiencing (Bhaskar, 1998; Hjørland, 2004). Through socialization, individuals might internalize the injustice they face. Individuals can be socialized to believe that distributive inequity is the result of faults in their own character, rather than recognizing that it may be the product of structural barriers (Prilleltensky & Gonick, 1996; Scheppke, 1994). In light of these, it seems reasonable to conclude that researchers cannot uncover all structural inequities by examining the participants' views alone, no matter how in-depth these examinations would be (Archer, 1998; Okin, 1994; Talja, 1997). Including *etic*/outsider and objective measures should help address the research gap and better identify potential inequities.

2.2.4.3 Lack of large-scale studies

Another barrier to further individual-structural integration is the lack of large-scale information behavior studies. The user-centered paradigm tends to favor qualitative methods (Dalrymple, 2001). In ELIS, many individual and contextual factors come into play and they are often interrelated (Savolainen, 2006). Qualitative methods excel in presenting such a complex picture as a whole. However, it could be difficult to disentangle the influence of different factors (Holstein & Gubrium, 2004). In addition, the sample size tends to be small in qualitative studies. Even quantitative studies on information behavior tend to be limited in scope and size, and their samples are not always representative. Large-scale studies of the public's information behavior, such as those conducted in the 1980s (Chen & Burger, 1985; Chen & Hernon, 1982; Dervin, 1984) are not as common nowadays. This limits the generalizability of the findings (Sonnenwald & Iivonen, 1999). Furthermore, most studies focus on a particular group or a particular geographical location. Because they surveyed individuals in an environment with a restricted range of variability, it could be harder to discern the effects of the structural factors in individual behaviors. This could underestimate the influences of

structural factors (Duncan & Raudenbush, 1999). A possible remedy is to conduct a comparative

study, such as comparing different groups in the same environment, and same groups in different

environments. It is observed, however, that while comparative studies in organizational settings are

often found, they are not common in the ELIS setting (Courtright, 2007).

2.3 Public Library Studies

With the discussion of the information behavior theoretical frameworks concluded, the review will

now turn to the topic of the empirical analysis- factors influencing the use of public libraries by

adolescents. Because research in this area is rare (Walter, 2003), this review will also cover research of

the library use by adults. The section will start with a brief review of what we know about adolescents

and public library use. It will then evaluate how individual and structural factors are conceptualized in

public library research. The categories of variables used in such research will be discussed. The focus

of this section will be on public library use. Research on specific information seeking behavior or

information retrieval related to the public library (e.g. reference interviews, OPAC searches) is beyond

the scope of this review, and will not be included.

2.3.1 Adolescent Use of Public Libraries

There is a rather long history of research on the use of public libraries. One of the earliest large-scale

studies is the *Public Library Inquiry*, commissioned in 1946 (Berelson, 1949; Campbell & Metzner,

1950). Unfortunately, in terms of adolescents' public library use, the long history of research did not

help generate as much knowledge as desired (D'Elia et al., 2007). Most of the extant library user

studies surveyed only the adult populations. Even for the adult population that has been frequently

studied, findings have been conflicting (Lange, 1988; Zweizig & Dervin, 1977). The positive

correlation between education attainment and public library use is perhaps the only one on which most

scholars agree. For the adolescent's public library use which has been rarely studied, conclusive

evidence is even scarcer. This lack of research on the adolescent's public library use reflects the general trend in information behavior research. It is found that the research on youth tends to focus on their school-related information behavior, or on their use of electronic resources (Fisher, Marcoux, Meyers, & Landry, 2007; Shenton, 2004; Walter, 2003). Several scholars in the field have made repeated calls for more studies to address this research gap (Agosto & Hughes-Hassell, 2006; Todd, 2003; Walter, 2003).

What has been found about the adolescent's public library use so far is that, when only library users are concerned, youth is one of the major user groups (Berelson, 1949; C. H. Kim & Little, 1987; Leckie & Given, 2005; Lipsman, 1972). It is suggested that, on average, about a quarter of library users are adolescent (Heaviside et al., 1995). Among the few public library surveys that include both adolescents and adults, two studies suggest that adolescents might be more likely than adults to be public library users (Campbell & Metzner, 1950; C. H. Kim & Little, 1987).

There is a dearth of research concerning what factors distinguish public library users from non-users within the adolescent population (i.e., within-group differences). The percentage of the nation's adolescents using public libraries is uncertain (D'Elia et al., 2007). The *Public Library Inquiry* around the 1950s suggested that about 36% of children between 11 and 15 years of age, and about 34% of young adults between 16 and 20 years of age used the public libraries (Berelson, 1949; Campbell & Metzner, 1950). But recent and nationally representative research of adolescent public library use is lacking. Vavrek (2004) surveyed more than a thousand teens (aged 12-17) about their uses and views of public libraries. The study used a nationwide, but not nationally representative sample. Findings indicated that 77% of the respondents had used the services of a public library/bookmobile in the past year.

D'Elia and his colleagues studied grade 5 to 12 students in the Buffalo-Niagara region of western New York State. Among the respondents in high school, 69.4% of the respondents visited the public library in that academic year (D'Elia et al., 2007). This survey included 4,032 middle school and high school students, which is a large sample compared to most other public library studies. The authors cautioned readers about generalizing these findings too broadly, however. The survey response rate was 37.8%, and non-response analysis was not conducted. This study is still worth noting, as it sheds light on differences within the adolescent group. The study tested the variations in use/non-use among the participants with several chi-square analyses. It was found that youth with the following characteristics tended to use the public library less: male, of Hispanic ancestry, African American, of mixed racial ancestry, living in urban area, attending public schools, having a lower than "C" overall grade level, or having parents with lower educational attainment level. The current study could offer an opportunity to test whether this is a pattern prevalent across the United States, and how much individual characteristics or structural factors contribute to such a pattern.

2.3.2 Conceptual Frameworks of Public Library Studies

Studies of public library use are often more practically oriented than conceptually oriented. Conceptual frameworks are not always explicitly outlined (Zweizig, 1973). However, the paradigm shift toward a user-centered approach could be observed in the public library studies. The frameworks and designs of public library studies share many characteristics of the information behavior research discussed above.

The paradigm shift is most evident in Zweizig's dissertation on the predictors of public library use (1973). According to Zweizig, previous public library studies focused too much on the library system itself. He advocated a used-oriented perspective that helps examine the role of public libraries in the life of the adult. His conceptual framework outlined the information environment of an individual. An

individual is placed in the center of the model, nested within the family, social group and community, and broader information environment (which includes multiple information channels such as radios, TVs, public libraries, and government agencies). This nested model with the individual at the center is reminiscent of Paisley's nested model. Later frameworks, such as T. D. Wilson's and Williamson's discussed in section 2.2.3, also used a nested model. The focus on the information environment (rather than, for example, the socio-cultural environment), and the idea that there is an array of resources for an individual to choose from, are also found in later concepts such as *information horizon* and *information field*. Zweizig's study also shared the common characteristic of information behavior research, which is the focus on individual-level variables. While environmental entities such as social group, community, and mass media were included in the conceptual model, these entities were not measured at the group or community level.

D'Elia's (1980) model of public library use behavior is notable because of its hierarchical nature. He postulated that individual characteristics provide the predisposition to the use of public libraries, but the decision to use is affected by a series of factors concerning the individual's relation to the public library. The factors include: (1) individual awareness of the availability of public library services; (2) individual perception of the physical accessibility of the public library, (3) individual perception of the level of difficulty in using these public library services; and (4) individual use of a competing, non-public library in the environment. Worth highlighting is that while the model gives more prominent attention to contextual factors due to its hierarchical nature, the model reflects the general preference for examining contextual factors as perceived by the individual, as discussed in section 2.2.4.2.

While D'Elia emphasizes the need for more model building, testing, and refining, there has not been much new conceptual development in the study of individual public library use. Most of the subsequent studies are empirical ones focused on individual-level characteristics and the individual's

relationship to the public library. There are, however, two recent studies at the household level that also introduce variables at the county/state level. Although the studies are not of individuals' public library use, they have implications for the conceptual development of this study, and shall be reviewed below.

Based on data from the *1996 National Household Education Survey*, Hemmeter (2006) examined the potential effects of large bookstores on the use of public libraries. The independent variables were measured at various levels, including seven at household level (e.g. household income), one at zip code level (e.g., median income in the same zip code area), five at county level describing the information environment (e.g., number of large bookstores in county, library books per county capita), and one at state level (e.g., percentage of household with Internet access in state). The study found five out of the seven factors at higher levels to be statistically significant in the household use of public libraries. Sin & Kim (2008) examined the household use and non-use of public libraries with data from the *Current Population Survey of October 2002*. The study included six public library characteristics at the state level (e.g., per service capita library collection expenditures at the state level), along with thirty-seven household characteristics. Among the six public library service variables tested, three were found to be significant.

While both studies focus more on an empirical investigation than conceptual development, the statistically significant findings suggest that incorporating factors at higher levels (i.e., zip code area/county/state) could be fruitful. More conceptual development and empirical testing along this avenue should be encouraged. There are a few areas that could be further refined: (1) It will be helpful to refine the *unit of analysis* (i.e., the entity to be analyzed). Both studies examined public library use at the household-level; this could be improved to individual-level for better understanding of the relationship between individuals and environments; (2) Researchers could refine the *unit of*

observation (i.e., the entity to be observed or measured) of the contextual variables. Sin & Kim used state level contextual factors, while Hemmeter used a mixture of zip code, county, and state level variables. If data permitted, more variables measured at a lower level, such as zip code area or census tracts, would allow more detailed analyses (Hyman, 1972); and (3) Future study could incorporate different types of contextual variables. In addition to variables about the information environment, studies could also include socio-economic contextual factors, such as those reflecting social inequities (e.g., income at the neighborhood level). The categories of variable investigated in extant public library use studies will be discussed in the next section.

2.3.3 Variables in the Public Library Studies

2.3.3.1 Dependent variables

The *frequency of use* is the most commonly used dependent variable in public library studies. Earlier studies have selected the possession of a library card as a measure. But this measure is now considered as less suitable because having a library card does not necessarily mean that an individual has used the services of the library (Zweizig, 1973). Individuals could also use some services of the public library without holding a library card (Campbell & Metzner, 1950). Instead of measuring only the frequency of use, Zweizig recommended the use of multiple measures to form a composite index representing the library use. He suggested including what he termed as "*intensity of use*." This measure indicates whether an individual uses the public library for a variety of purposes (Zweizig, 1973). Marchant (1994) also examined whether public libraries were used for pursuing specific interests. D'Elia introduced additional measures of public library use, which include: average number of items borrowed per visit, average duration of each visit, the number of different services used each visit, and the perceived importance of use (D'Elia, 1980). These measures and composite indexes have not been used often, however.

2.3.3.2 Independent variables

There is quite a variety of independent variables studied in the extant literatures. To facilitate

examination, these variables are grouped into several broader categories. Table 1 presents the

categories and gives examples of the variables in each category. Tables 2 to 4 identify what categories

of variables are investigated in the more prominent public library use studies.

Table 1

Public Library Studies: Independent Variables

Category	Examples
Ascribed characteristics	Age Sex Race/ethnicity
Socio-economic status	Education attainment Income Occupation
Family-related characteristics	Family size Marital status Number of children in household
Psychological	Achievement motivation Dogmatism/open-mindedness Locus of control Sense of personal competence/efficacy
Life style	Community involvement Involvement in cultural activities Membership in formal organizations Political activity/political orientation
Media and source use	Amount of book reading Amount of television use News source Use of other libraries
Relationship to the library	Distance to the library Knowledge of the library Perception/attitude e.g., perceived ease of use
Home information environment	Number of books in the home Has a home computer Has Internet access at home
Geographical	Geographical region Size of community Urban versus rural residence

Table 2

Studies of Public Library Use at the Individual Level

Study		Research design		Individual-level variable								Community-level
		National	Multi-variate	Ascribed char.	SES	Family-related	Psy.	Life style	Media use	Relation to library	Home info. env't	Geog.
Campbell & Metzner	1950	✓		✓	✓	✓			✓	✓		✓
Rees & Paisley	1968		✓	✓	✓	✓	✓	✓				
Knight & Nourse	1969	✓		✓	✓	✓			✓			✓
C. Evans	1970			✓	✓	✓				✓		
Lipsman	1972		✓	✓	✓	✓		✓	✓	✓		
Kronus	1973		✓	✓	✓	✓	✓					
Zweizig	1973		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gallup Org.	1976	✓		✓	✓	✓				✓		✓
Gallup Org.	1978	✓		✓	✓	✓			✓	✓		✓
Carpenter	1979			✓	✓	✓		✓	✓			
Madden	1979	✓		✓	✓	✓	✓	✓	✓			✓
D'Elia	1980		✓	✓	✓	✓	✓	✓	✓	✓	✓	
Chen & Hernon	1982			✓	✓							✓
Powell	1984		✓	✓			✓	✓				
Powell et al.	1984	✓	✓	✓	✓	✓		✓	✓			✓
Chen & Burger	1985		✓	✓	✓							✓
Lange	1988	✓	✓	✓	✓	✓		✓	✓	✓		✓
Westin & Finger	1991	✓		✓	✓	✓		✓	✓	✓	✓	✓
Marchant	1994		✓	✓	✓			✓		✓		
Morrill	2003			✓	✓			✓	✓	✓		✓
D'Elia et al.	2007			✓	✓				✓	✓	✓	✓
Estabrook et al.	2007	✓		✓	✓	✓			✓	✓	✓	✓

Table 3
Studies of Public Library Use at the Household Level

Study		Research design		Household-level variable							Community-level		
		National	Multi-variate	Ascribed char.	Household SES	Family-related	Life style	Relation to library	Psy.	Home info. env't	Geog.	Public library info. env't	Neighbor-hood SES
Hemmeter	2006	✓	✓	✓	✓	✓		✓			✓	✓	✓
Sin & Kim	2008	✓	✓	✓	✓	✓	✓	✓			✓	✓	

Table 4
Studies of Public Library Use at the Community Level

Study		Research design		Community-level variable								
		National	Multi-variate	Ascribed char.	Neighbor-hood SES	Family-related	Life style	Relation to library	Psy.	Home info. env't	Geog.	Public library info. env't
Parker & Paisley	1965			✓	✓	✓	✓				✓	
Kim & Shin	1977			✓	✓	✓						✓
Getz	1980	✓		✓	✓							✓
Williams	1980	✓	✓	✓	✓	✓	✓			✓	✓	
Kim & Little	1987		✓	✓	✓			✓				
Japzon & Gong	2005		✓	✓	✓		✓					
Glorieuxa, Kuppens & Vandebroeck	2007	✓	✓	✓	✓							✓

A review of the variables indicates that, similar to other information behavior studies, most research focused on individual-level variables. These include studies of individual ascribed characteristics, family-related characteristics, socio-economic backgrounds, psychological characteristics, life style variables, media and source uses, and relationship to the library. When information environment variables are concerned, most variables are still measured at the individual level. These include individual possession of books or computers. Measures of public library resources or information environment characteristics at the community/county/state levels - such as those included in the household level studies by Hemmeter (2006) and Sin & Kim (2008) - are rarely used in individual public library use studies. Similarly, inter-personal/social network variables are measured as related to the individual (e.g., number of formal organizations an individual participates in), instead of measures of the social network itself at a higher level (e.g., number of formal organizations in the community).

Not all public library studies ignore community or higher level characteristics completely. Some studies included the geographic region where the participant resides. One variable at the community level that is sometimes included is the *type of community*. Some studies include a categorical variable about the rural- urban category (Lange, 1988; Powell, Taylor, & McMillen, 1984; Westin & Finger, 1991), or in rare cases, about the size of the community (Campbell & Metzner, 1950). These variables are often found to be significant. The inclusion of such variables in library use studies reflects the recognition that regional or community environment could be related to individual use of public libraries. In the absence of detailed variables about the environment at the community or higher level, the community type variable might serve as a substitute. However, the precise relations between a community type and the various community environment variables have not been well established. As such, this *type of community* variable is at best an imprecise representation of the community characteristics. Since data at the community level are actually available, it is time to directly test the influence of different community-level variables on individual behavior.

Because most individual-level studies do not include independent variables at higher levels, this review also includes studies examining public library use at the household (Hemmeter, 2006; Sin & Kim, 2008) and the community levels (Japzon & Gong, 2005; Parker & Paisley, 1965; R. W. Williams, 1980) in order to help identify potential variables. The review suggests that the independent variables included in these studies are quite similar to those used in individual use study. As presented in Table 3 and Table 4, these variables can still be classified using the categories identified earlier in Table 1. The main difference is that the variables are operationalized differently. For example, as measures of race/ethnicity, individual level studies can use the respondents' race/ethnicity. The race/ethnicity variable at the household level can be derived in different ways (Dale, Fieldhouse, & Holdsworth, 2000), such as using the race/ethnicity of the householder (as in Sin & Kim, 2008), or the oldest family member (as in Hemmeter, 2006). Studies at the community level can measure the proportion of different race/ethnic groups in the community, or include indexes such as the racial segregation index used in Japzon & Gong (2005).

2.3.4 Gaps in Research Design

Despite the long history of research on public library use, there is less agreement concerning the factors affecting library use than one would expect. Other than the effect of education, extant studies often disagree on the significance and direction of effect of most variables.[8] The differences in

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[8] For example, income or occupation is often found to be significant in univariate study (e.g. Westin & Finger, 1991), but others such as Kronus (1973) and Zweizig and Dervin (1977) indicated that this is probably due to their correlations with education attainment. Gender is found to be significant in predicting library use in studies by D'Elia (1980), Marchant (1994), Powell et al. (1984), and Zweizig (1973), but not in C. Evans (1970), Kronus (1973), Lipsman (1972) or Rees & Paisley (1968). Distance to the library is found to be significant in Campbell & Metzner (1950) and Lange (1988), but not in Marchant, (1994) and Zweizig (1973).

findings could be partly attributed to the differences and limitations in the study design and data analysis methods. In addition to the lack of variables measured at higher levels as discussed above, several limitations in research design can also be found: (1) the exclusion of non-users; (2) the preference for univariate, "variable-by-variable" approach; and (3) the lack of study with representative samples.

Many public library studies surveyed only the users. Without data of the non-users, however, it could be difficult to identify the factors behind use. Zweizig (1973) has cautioned that attempts to infer non-users' characteristics based solely on user data could be erroneous.[9] Although the problem of user-only studies is widely acknowledged, studies including non-users are still rare. This could be due to the logistics and cost involved in reaching non-users. A possible rectification is to compare the user-only data to the statistics of the general population. Unfortunately, this is not often done either.

Public library studies seldom use inferential testing or multivariate analysis. Many studies present user and non-user characteristics in a percentage form without statistical testing (Westin & Finger, 1991). Most still use the "variable-by-variable" approach in which the effect of different variables on library use is examined one at a time. Such a univariate approach is problematic, as it has long been pinpointed that many of the characteristics (e.g., education attainment and income) are correlated (Kronus, 1973; Zweizig, 1973). The variable-by-variable approach would not be able to control for these spurious effects, which might lead to an inaccurate understanding of factors behind use/non-use.

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[9] To give a hypothetical example, a survey of only library users might show that there are more adults than adolescents using the public library. Nevertheless, one could not infer that adults are more likely than adolescents to be library users. The findings could be because there are simply more adults than adolescents in the population.

There are studies that have overcome these limitations and offered more sophisticated analyses of individual library use (e.g., D'Elia, 1980; C. Evans, 1970; Kronus, 1973; Lipsman, 1972; Marchant, 1994; Powell et al., 1984; Rees & Paisley, 1968; Zweizig, 1973). However, most of these studies focused on the population of a specific geographical area, and the findings cannot be generalized to the nation. The lower variability in respondents' characteristics or in the structural environment could lead to findings with a lower statistical or substantial significance, when compared to findings from studies of a more diverse population and environment (Duncan & Raudenbush, 1999).

In an attempt to address the aforementioned gaps, this research will apply a multivariate approach to study the public library use by a nationally representative sample of 12th-graders. The following chapter will discuss the conceptual framework and research design of this study.

3. METHODS

This chapter describes the study's research framework and methodology. The chapter is divided into four sections. First, it begins by detailing the study's research questions. The second section briefly discusses *Critical Realism,* the philosophical stance that guided this research, and the guiding theoretical perspective that emphasizes the meso/institutional level. The third section focuses on the conceptual framework. It includes discussions on the *Person-In-Environment* (PIE) framework proposed by this author and the specific framework this author developed for the empirical study of 12th-graders' public library use. The concluding section presents the study's research method.

3.1 Research Questions

This study has two objectives: to develop the PIE conceptual framework, and to test the framework empirically. The broader research question is: "Can the PIE conceptual model be applied to the study of individual information behavior?" To address this, the PIE model was evaluated using high school seniors' public library use as a test case. The empirical analysis of high school senior's public libraries use aimed to address four research questions:

(1) Macro-meso linkage: What are the relationships between the structural factors, that is between the macro-societal factors (e.g., socio-economic environment) and meso-institutional factors (e.g., resource and service levels of the neighborhood public library)?

(2) Macro-meso-micro linkage: What are the relations between structural factors and individual characteristics?

(3) Macro/meso factors and micro behavior: What are the structural factors that are related to the individual's use of public libraries, and to what extent are they related?

(4) Micro factors and micro behavior: What are the individual characteristics that are related to the individual's use of public libraries, and to what extent are they related?

3.2 Philosophical and Theoretical Perspectives

3.2.1 Philosophical Perspective

This section provides a brief examination of the philosophical stance guiding this research. This study

is informed by *Critical Realism* (CR). CR was first developed by British philosopher Roy Bhaskar in

the 1970s. It has interested scholars in various disciplines, including sociology (Archer, 1998), human

geography (Yeung, 1997), education (D. Scott, 2005), and social work (Houston, 2001). In the LIS

field, CR has been introduced to the studies of information systems (Dobson, 2002; Mingers, 2004)

and information behavior (Wikgren, 2005).

The prominent characteristic of CR is that it espouses a *realist ontology* and a *relativist/subjectivist*

epistemology. As such, from an epistemological point of view, CR is similar to *social constructivism*, a

popular stance in information behavior studies (Vakkari, 1997). Both CR and social constructivism

consider that *knowledge* is relative and subjective, and that it is influenced by historical, cultural, and

social contexts (i.e., relativist/subjectivist's epistemology). CR, however, explicitly identifies its

ontological stance. CR considers it as a drawback that most stances address only the issue of what we

know or can know (epistemology) but do not attempt to address the question of what is (ontology)

(Bhaskar, 1998).

In terms of ontology, CR distinguishes things that are considered to exist independently of mind, and

those that are not. Physical objects and certain social structures and mechanisms are considered to

have an ontological existence, regardless of individuals' knowledge and perception of them, or

individuals' ability to know and perceive them. These objects are called "intransitive objects of

knowledge." On the other hand, different from *scientific realism*, which considers theoretical entities

postulated in scientific theory as real (or true), CR does not consider theoretical constructs ("transitive

objects of knowledge") as mind-independent. While *intransitive objects* are independent from mind,

people's *knowledge* about these *intransitive objects* is not completely independent. Such knowledge is socially-conditioned, value-laden, and fallible.

Since people's - including researchers' - knowledge about the *intransitive objects* could be incomplete and fallible, research guided by CR does not focus on predicting events, but rather on understanding and explaining the generative mechanism behind events. CR is termed *critical* because of its emancipatory and transformative dimensions. It argues that social science disciplines are not and should not be value-free. Due to fragmented and fallible knowledge of the world, individuals are not always aware of the social structure or mechanism affecting them, even when part of the structure is oppressive to them. CR advocates that social science research should help identify and expose such structural issues, and thus contribute to social changes and improvements.

CR is particularly appropriate for this study. CR has been developed to bridge the agency and structure gap (Bhaskar, 1998), which is also a central theme of this study. On one hand, CR's relativist/subjectivist epistemology recognizes individuality. On the other hand, it underscores the importance of structural issues by emphasizing that different social structures do exist independently from individuals' minds. CR scholars advocate identifying potentially oppressive structures by investigating beyond what participants know or perceive (Archer, 1998). The view dovetails with this study's concern about over-reliance on participants' views and perceptions. The emancipatory aspect of CR also fits this study well. By interrogating the impact of structural factors on individual information behavior, this study intends to draw attention to the problem of social and information inequities.

3.2.2 Theoretical Perspective

This study follows the perspective proposed by DiMaggio that institution (the meso-level) is an important part in studying agency-structure integration (DiMaggio, 1991). Individuals' public library use behavior, the focus of this research, involves individuals that either interact, or do not interact, with an institution - the public library. In general, the public library is regarded as important in addressing the information equity issue. Nevertheless, this study aims to underscore that, as an institution, the public library is itself affected by the broader societal environment (the meso-macro linkage). These societal influences could aid or hinder efforts towards information equity. Such influences may be demonstrated in various ways: for example, the ability and willingness of the government and the public to fund the public library, and the societal values concerning free access and censorship. Societal conditions can influence the public library's philosophy, mission, norms, organizational structure, and operating mechanism. These public library characteristics would in turn influence how individuals interact with the library (the meso-micro linkage). While there are concerted efforts to narrow the information divide, the public library's characteristics, such as the reliance on local government funding, might not always be conducive to such efforts. Because of the complex relations in micro-meso and meso-macro levels, research on individuals' information behavior (the micro) should also be sensitive to the potential influence of the information institutions (the meso), and the society (the macro).

For this study, the examination of the macro level will focus on the socio-economic aspects, as they have been found to have a more direct impact on the functioning of the public library (Liu, 1993; Sin, 2008; R. W. Williams, 1980; L. R. Wilson, 1938). How subtle aspects of the society, including societal norms and values, influence and interact with the institution will not be tested in this study. Societal norms and values are topics worth investigation in future studies. While meso-macro linkage other than the economic aspect, such as how social values affect library and information institutions, is

rarely tested in information behavior research, much insight on the linkage can be found in historical

or critical research in LIS (Garrison, 2003; Pawley, 1998, 2006; Robbins, 2000; Wiegand, 1989). Such

studies shed light on how the LIS professions and the public library's values, norms and operations

perpetuate or challenge social structures. Future public library use research could look to these studies

to identify salient societal and institutional factors for inclusion in their analyses.

3.3 Conceptual Framework

This author developed a new theoretical framework, the *Person-In-Environment* (PIE) framework, to

study individuals' information behavior. The foundation of this framework can be traced to the

information behavior frameworks discussed in section 2.2.3. The PIE framework is also informed by

the interest in meso-level and the empirical investigations in information behavior and neighborhood

effects.

3.3.1 General PIE Framework

From a theoretical standpoint, the PIE framework follows the imperatives of the user-centered

approach in recognizing individuality in information behavior. In this framework, the individual, and

not the group, is selected as the unit of analysis, to highlight individual differences. The inclusion of

environment-related variables reflects the attention to contextual factors advocated in the recent

information behavior in context research. In this study, e*nvironment* is defined as "the totality of

circumstances surrounding an organism or group of organisms" ("Environment," 2000). As such,

environment is more than the physical environment; it also includes cultural, social, economical,

political, and information environment. The ambiguous nature of *context* is discussed in section

2.2.4.1, and this study aims to draw special attention to a type of contextual factors - those of the

environment surrounding an individual. Of special interest are the structural factors at the

meso/institution and societal levels that cannot be easily controlled by the individual. When applying

the PIE framework, the environment can be studied at various levels (e.g., neighborhood, city, state) depending on the research interest.

The model in its generalized form is presented in Fig. 1. The basic layers are similar to Wilson's model (1981). The main difference is the addition of the institutional and neighborhood layers to distinguish it from the macro/societal layer. This addition is guided by DiMaggio's meso-level perspective (DiMaggio, 1991). The PIE framework also includes an information environment component. This is drawn from the models of Paisley (1967) and Zweizig (1973), and from the recent concepts of *information horizon* and *information field*. This component is added in order to draw an attention to, and to evaluate the influences of, information inequity.

Another main difference lies in the relationship between the structural environment and the individual factors. The relationship has not been specified in most extant models (e.g., Paisley, 1967; Zweizig, 1973), or is shown as uni-directional, mainly with environmental factors influencing individuals (e.g., T. D. Wilson, 1981; Savolainen, 1995). In this study, the relation between individuals and the environment is conceptualized as bi-directional. This is to acknowledge the current consensus that while the environment constrains/facilitates individuals' behavior, individuals can also alter the environment surrounding them.

In the PIE framework, the person and environment are seen as jointly influencing individual behavior, which is similar to the view of the *person-in-situation* approach (Allen, 1997; Allen & Kim, 2001; Kim & Allen, 2002). As such, individual and environmental factors should be studied simultaneously. Different from the *person-in-situation* approach which focuses on the interaction effect, however, the PIE framework aims to highlight the various pathways among the variables. These pathways are: (1) structural factors including societal and meso level factors; (2) structural factors (particularly those at

46
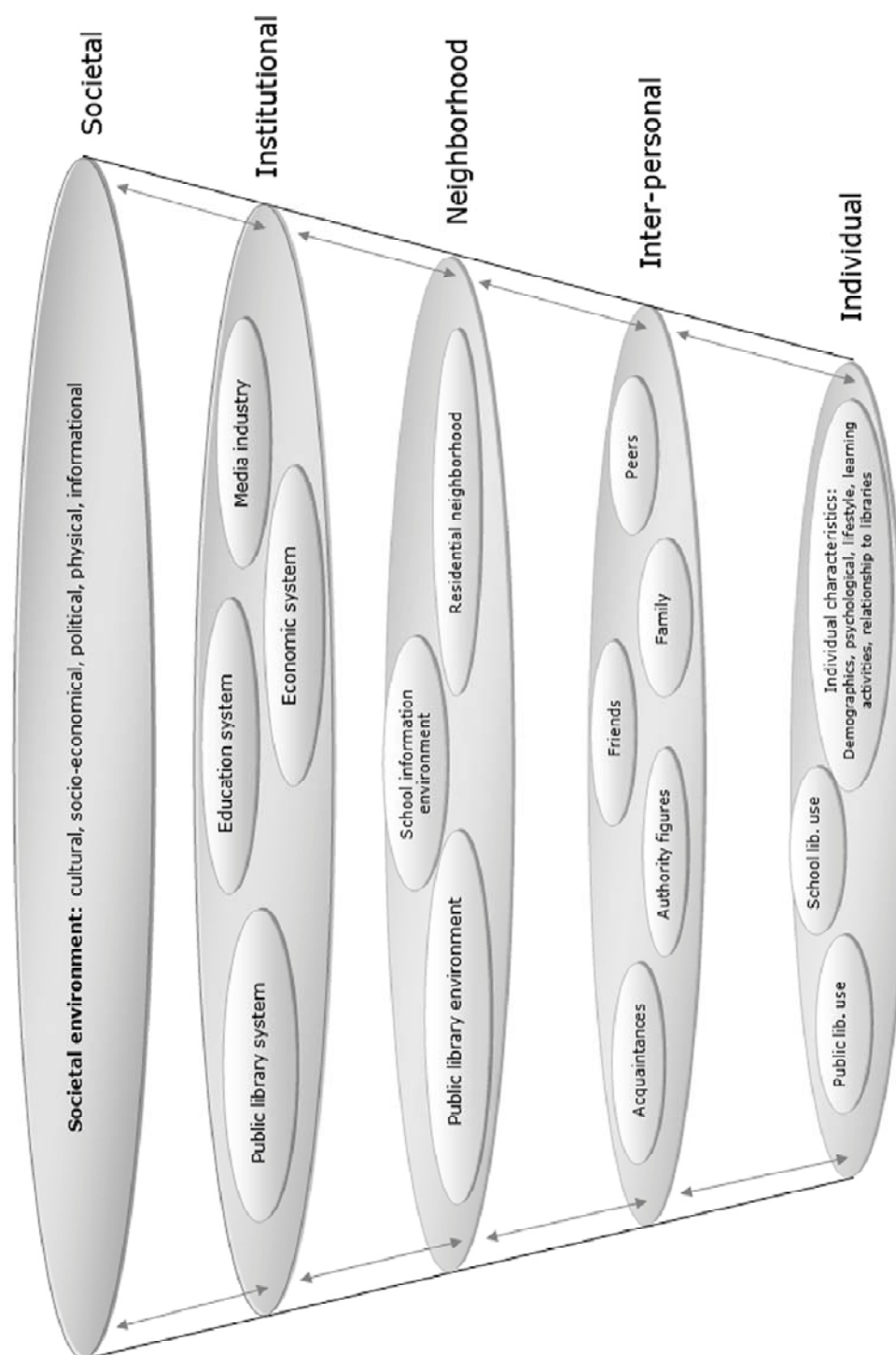
Figure 1. General PIE framework (with example components).

the societal and meso levels) and individual factors; (3) structural factors and individual behavior; and

(4) individual factors and individual behavior. Evidence of the relationships between the structural

environment, individuals, and their behaviors can be extracted from different frameworks and

empirical studies discussed in chapter 2. Some of the examples are presented in Table 5. This research

is an attempt to consolidate these separated pieces into an integrated conceptual framework.

Table 5

Pathways among the Variables: Example Studies

Macro - Meso linkage

- **National inferential studies of public library service variations:**
    Jue et al., 1999; Sin, 2008; Williams, 1980
- **National studies of specific public library services:**
    Bertot et al., 2007; Heaviside et al., 1995
- **Case studies of public libraries:**
    Loreto and Tse, 1999; Neuman and Celano, 2001; Smith & Constantino, 1997
- **Studies about school information environment:**
    Duke, 2000; Gorski, 2005; Neuman & Celano, 2001; Oakes & Saunders, 2004

Macro - Meso - Micro linkage

- **Inequity studies: Child and youth development:**
    G. W. Evans, 2004; McLyod, 1998
- **Inequity studies: Health-related:**
    Van Doorslaer, Masseria & Koolman, 2000; Williams & Collins, 1995
- **Information inequity studies: Computer and Internet:**
    D'Elia et al., 2007; Eamon, 2004; Fox & Livingston, 2007; Horrigan, 2007
- **Information inequity studies: Print materials:**
    Campbell & Metzner, 1950; McQuillan & Au, 2001

Macro/Meso factors - Micro behavior

- **Information behavior conceptual frameworks:**
    Paisley, 1967; Savolainen, 1995; Williamson, 1998; T. D. Wilson, 1981
- **Neighborhood effects studies:**
    Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000; Sampson, Morenoff, &
    Gannon-Rowley, 2002; Shinn & Toohey, 2003

Micro factors - Micro behavior

- **Majority of Information behavior frameworks**
- **Majority of public library studies**

3.3.2 PIE Framework for Adolescent Public Library Use

To test the PIE framework, this researcher developed a more specific model for the study of public library use by high school seniors (Fig. 2, Fig. 3). This framework included the major categories of variables found to be significant in existing public library studies.

Family-related variables such as marital status are not included in this model because of the study's focus on adolescents. To capture the structural environment, the *residential neighborhood* was used as the unit of observation. *Residential neighborhood* is defined here as the zip code area where the participant resided at the time of the survey. As reviewed in section 2.2.1, neighborhood is important because it is the place where individuals go about their daily lives. In addition, this neighborhood level also reflects more fine-grained and diverse environments, compared to higher (more aggregated) levels. For the study of public libraries in the U.S., neighborhood is preferred as the level at which to observe structural variations. This is because the public libraries in this nation have a decentralized governance structure that often contributes to differences across local library systems. For most public library systems, the local government is their major funding source. The absence of national prescriptive standards also contributes to more local variations ("Public library standards," 2007). The decentralized governance structure gives local public library professionals and local officials more autonomy in providing services to meet the needs of their community. At the same time, the decentralized structure also leads to disparities in public libraries' resources due to the varying ability and willingness of local governments to provide funding for the libraries (Bennett, 1980; Warner, 2006). Because of these local variations, studying the public library at a lower, less-aggregated level is preferred.
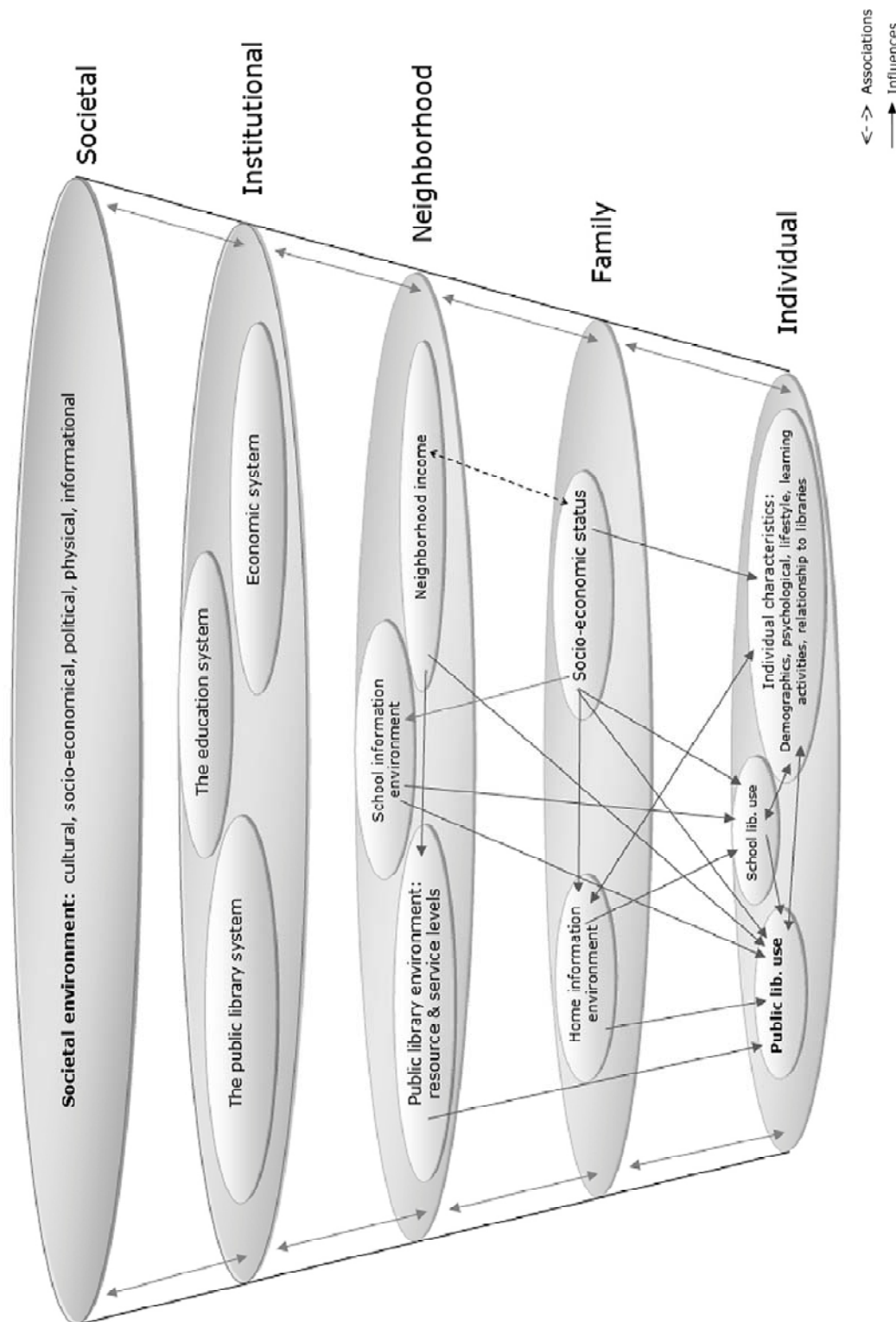
Figure 2. PIE framework for the study of adolescents' public library use.
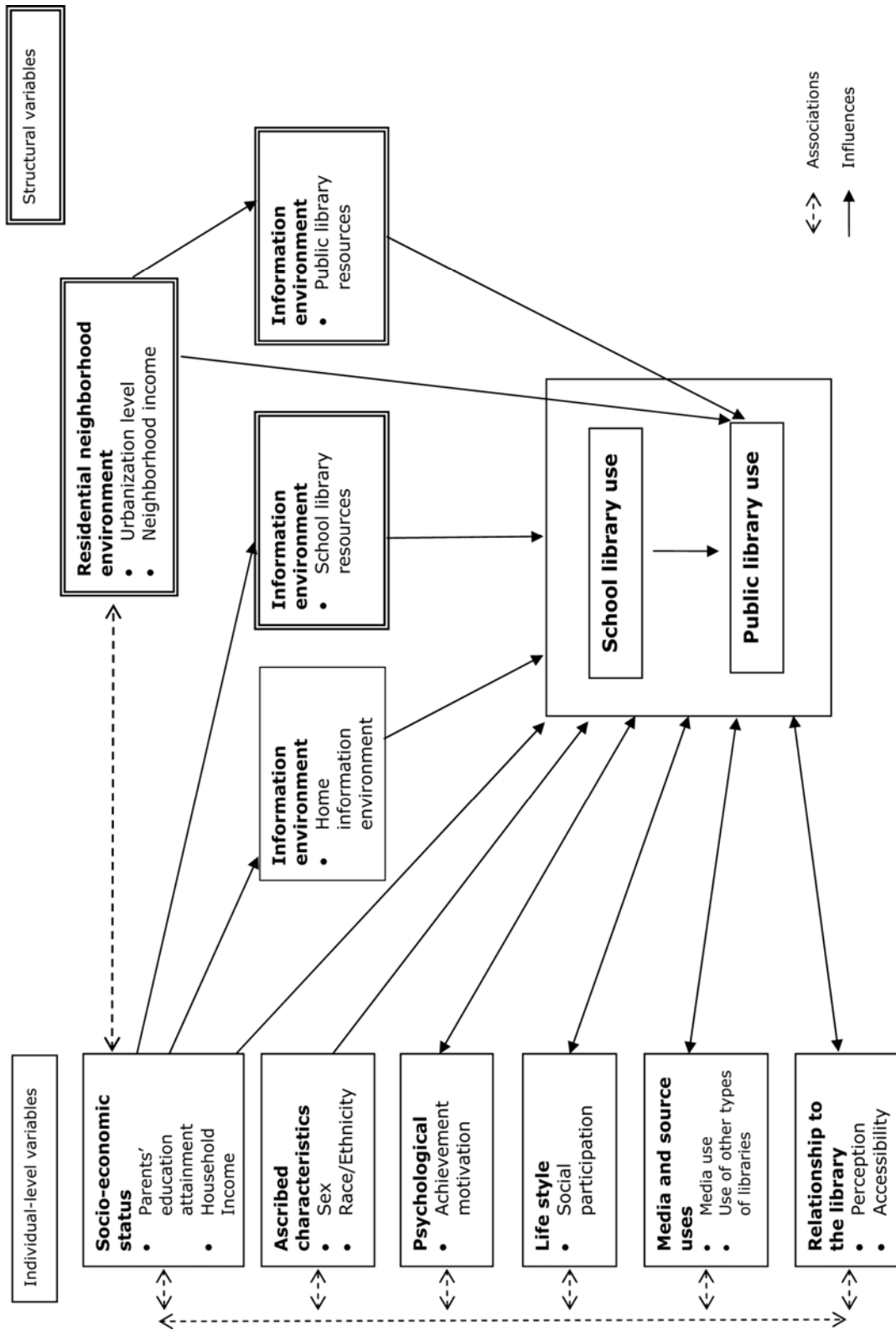
Figure 3. PIE framework for the study of adolescents' public library use.

The following subsections identify the main components in the initial model and summarize the key findings concerning the variables' relationship to public library use. Because public library studies of the adolescent are rare, findings from studies of adults are also included. Recognizing the complexity of social phenomenon, it is expected that the components will be related to each other in varying extent. The following descriptions will only focus on those relations that are prominent and central to the study's interest. To avoid repetitions, relations between pairs of components that have been discussed in the earlier paragraph will not be repeated in the later paragraph.

3.3.2.1 Independent variables: individual-level variables

3.3.2.1.1 Ascribed characteristics

This category includes age, sex, and race/ethnicity, which are characteristics that are relatively fixed. These variables, particularly the first two are frequently studied. Nevertheless, findings for all three remain conflicting. Because of the focus on the 12th-graders, which has a narrow age range, respondent's age was not tested in this study.

Sex[10]

A common perception is that women are more likely than men to be library users (ALA, 2006; Westin & Finger, 1991). The results from statistical analyses, however, are contradictory (Zweizig & Dervin, 1977). A recent survey of 97 adolescent library users in two public libraries found no significant gender difference in the respondents' frequency of library use (Agosto, Paone, & Ipock, 2007). A

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[10] Generally speaking, most library use studies test the variable "sex" instead of "gender." That is, the primary focus is on the respondent's biological category (i.e., male or female), as opposed to the socially-constructed psychological, behavioral and cultural attributes associated with sex (e.g., masculinity, femininity). In practice, the term "gender" is often used in place of "sex" in these studies. This study's focus is on the respondent's biological category (i.e., sex). For the ease of discussion, the terms "gender" and "sex" are also used interchangeably in this paper.

large-scale study of more than 4,000 students that included both users and non-users, on the other hand, found that a lower percentage of young male than young females are public library users (D'Elia et al., 2007); young females are also more likely to be frequent library users (Kimball, Abbas, Bishop, & D'Elia, 2007). As the study used a univariate statistical analysis, this difference may be confounded by other variables.

Race/ethnicity

Early studies in general considered the race/ethnicity variable unimportant (Kronus, 1973; Zweizig & Dervin, 1977). It should be noted that most library studies tend to have rather small and homogenous samples. Even with nationally representative samples, unless some minority groups are over-sampled, groups such as Asian Americans and Native Americans are not represented (e.g., Westin & Finger, 1991). These add to the difficulties in fully examining the influence of race/ethnicity. Recent multivariate analyses of large nationally representative data have revealed the race/ethnicity to be statistically significant; *ceteris paribus*, Caucasian households are more likely than those of other ethnic groups to be library users (Hemmeter, 2006; Sin & Kim, 2008). Public library literature focusing on specific groups also gave insights into the barriers facing ethnic minorities (Boyd, 1994; Burke, 2007). The aforementioned study by D'Elia and colleagues found that young African Americans, young Hispanics, and young people with a mixed ancestry are less likely to be library users. In terms of frequency of visit, however, students of Hispanic ancestry who did visit the library tended to visit the library frequently. Young Asians were also frequent library users (D'Elia et al., 2007). Again, it is uncertain if this is affected by other confounding variables.

While findings on race/ethnicity and public library use have been conflicting, race/ethnicity is often found correlated with other significant variables such as socio-economic status (U.S. Census Bureau, 2008a), which in turn are correlated with neighborhood income, and various information

environments. Because of the interest in structural and information inequities, the race/ethnicity variable is of interest to this study.

3.3.2.1.2 Socio-economic status (SES)

The most common indicators of SES are education attainment (i.e., highest level of education achieved), income, and occupation. In studies of children/youth, parents' education attainment, family income and parents' occupation are often used to represent the children's SES (Sirin, 2005; White, 1982). For public library studies, all three indictors have been adopted, but the education attainment and income are more frequently included than the occupation. Thus, this study focuses on the parents' education attainment and the family income.

Education attainment

Education attainment is often found to have significant positive relationship with library use. It is considered to be one of the strongest predictors of public library use (Zweizig & Dervin, 1977). This is the one variable that has been frequently included and has yielded rather consistent results across studies. For young adults' public library use, a univariate study suggests similar positive relationship (D'Elia et al., 2007).

Income

Income used to be viewed as a strong predictor indicating a positive relation with public library use. Because of the correlation between education attainment and income, however, the influence of income alone has been cast into doubt (Kronus, 1973; Zweizig & Dervin, 1977). There is general agreement that income is not as influential as previously thought. However, there is no agreement on whether it is still statistically significant after holding education and other factors constant. Adding to this confusion is that income seems to exhibit a curvilinear relationship with public library use, which

is not always taken into account in statistical analyses. Studies that did not assume the linear relationship between income and library use often found that people in the middle class are more likely to be public library users than those in either end of the income continuum (Campbell & Metzner, 1950; C. Evans, 1970; Japzon & Gong, 2005).

SES and information environment

Students in higher SES families are likely to have more information resources at home (Campbell & Metzner, 1950; McQuillan & Au, 2001; Sin & Kim, 2008; Teachman, 1987). Individual or family SES is often correlated with the neighborhood SES due to the self-selection into a neighborhood or residential segregation. By extension, higher SES students are more likely to be living in, or attending schools in, higher SES neighborhoods that tend to have better school and public library information environments. The relationship between neighborhood SES and information environment will be discussed in section 3.3.2.2.1.

3.3.2.1.3 Psychological variables

This category includes variables about an individual's affective, behavioral, or cognitive characteristics. Compared to the general information behavior literature, psychological variables are less frequently tested in public library studies. A few studies have shed light on this area. Zweizig (1973) found a positive relationship between open-mindedness and public library use. Locus of control has been tested in Zweizig (1973) and Powell (1984), but the results were not significant. Achievement motivation - which examines an individual's aspiration to learn, attain mastery, and strive for success - is found to be significant in Rees & Paisley (1968). Similarly, Kronus (1973) found a positive relationship between educational motivation and public library use. Because of the significant findings and the concept's relevancy to the educational setting, achievement motivation was examined in this study. In relation to other variables, studies indicate that the adolescent's

achievement motivation shows a positive relation with family SES. It is suggested that higher SES

parents might have more physical resources available, be more involved in the children's education,

and have higher expectations for their children, which could encourage the adolescent's achievement

motivation (Campbell & Metzner, 1950; Trusty, 1998; P. Wilson & Wilson, 1992).

3.3.2.1.4 Life style variable

Social participation

Variables in this group measure the respondent's level of participation in group and social activities.

These include the amount of volunteering, community involvement, participation in cultural events,

and participation in religious activities. There is a general consensus that a positive relation exists

between active participation in social activities and the use of the public libraries (Bolton, 1982;

D'Elia, 1980; Madden, 1979; Westin & Finger, 1991; Zweizig, 1973).

3.3.2.1.5 Media and source use

Media use

This category examines the respondent's use of different media. In general, findings indicate a

significant positive relation between media use and public library use (Zweizig, 1973). A positive

correlation between book reading and public library use is frequently found (Campbell & Metzner,

1950; Zweizig, 1973; Zweizig & Dervin, 1977). In Zweizig's study (1973), the amount of book

reading is found to be an even stronger predictor than education attainment. Findings concerning

magazine or newspaper reading are less consistent, however. Regarding other media, television and

radio use are not found to be related to public library use. The influence of Internet use is still

inconclusive. In terms of use of public libraries, most found a higher percentage of respondents who

have better access to (or those who use) the Internet are public library users than those respondents

who have less or no access to (or those who do not use) the Internet (D'Elia et al., 2007; D'Elia,

Jörgensen, Woelfel, & Rodger, 2002; Estabrook, Witt, & Rainie, 2007; Westin & Finger, 1991). In terms of the frequency of public library use, however, it is suggested that youngsters with Internet access at home visit the library less frequently than those without access at home (D'Elia et al., 2007). As these studies of Internet use and public library use are univariate studies, it is uncertain whether the results are confounded by other variables.

Use of other types of libraries

This variable is a component in D'Elia's hierarchical conceptual model (1980). His study with multiple regression analyses found a positive relation between use of other libraries and use of the public library. Sin & Kim (2008) also found positive relations at the household level. The relation between public library use and the use of school library media centers is particularly strong. *Ceteris paribus*, households with members using school library are 1.78 times more likely to be public library users than those who are not.

3.3.2.1.6 Relationship to the library

This category focuses on the relations between individuals and the library. These variables are measured at the individual level; and are to be distinguished from the characteristics of the library environment itself, which are measured at a higher unit of observation (e.g., at the neighborhood, or library system level). This category is the focus of D'Elia's hierarchical model (1980). Variables in this group include: an individual's knowledge or perception of the library, or the accessibility of the library to the individual. More knowledge and better perception of the library is found to be positively related to the use of public libraries (Zweizig, 1973). Accessibility is often measured by the distance to the closest library. Findings on the relationship between the accessibility and the use of public libraries have not been consistent. More recent, national household-level studies have revealed a rather strong relationship, however (Hemmeter, 2006; Sin & Kim, 2008). It is speculated that as information is

increasingly accessible via sources and media outside of the library such as the Internet (OCLC, 2004),

accessibility of the library might have become a more important factor in the decision of use/non-use

(Sin & Kim, 2008).

3.3.2.1.7 Home information environment

This variable examines the availability of information sources in the participant's household. For

measuring home information environment, the size of the household's book collection is often used

(D'Elia, 1980; McQuillan & Au, 2001; Zweizig, 1973). Most studies found a positive relationship

between the amount of print resources at home and public library use. Nevertheless, a study of 24 high

school students found the relationship not statistically significant (McQuillan & Au, 2001). Home

information environment is often positively related to individual SES and neighborhood SES

(Campbell & Metzner, 1950; Constantino, 2005; Roscigno et al., 2006; C. Smith & Constantino,

1997).

3.3.2.2 Independent variables: structural variables

3.3.2.2.1 Broader information environment

This category focuses on the availability and the characteristics of information sources in the

neighborhood. This study centers on the public library environment, and touches on the school library

media center. The relation between source availability and information behavior is direct. That is, if a

source is not available, the individual simply cannot use it. For source characteristics, measures such

as expenditure level, staff size, collection size and service level are often used (Matthews, 2004).

While the relationship between library resource levels and individual's use of academic libraries has

been tested (Whitmire, 2002), library resource levels were rarely considered in studies on individual's

use of public libraries. The effect of public library resource levels was tested only in a few studies at

the household or community level. Not all measures are found significant in these studies; but in

general, findings suggest that a better public library information environment is associated with a

higher rate of library use at the household or community level (Getz, 1980; Glorieux, Kuppens, &

Vandebroeck, 2007; C. Kim & Shin, 1977; Sin & Kim, 2008).

Information environment is found related to the neighborhood SES and individual SES, as discussed in

chapter 2 and in section 3.3.2.1.2. To recap, neighborhood SES is often positively related to the public

library environment (Loreto & Tse, 1999; Neuman & Celano, 2001; Sin, 2008; C. Smith &

Constantino, 1997) and school library media center environment (Constantino, 2005; Duke, 2000;

Neuman & Celano, 2001). The information environment also varies with the urbanization level. Rural

areas tend to have less ICT infrastructure than urban or suburban areas. Broadband Internet access is

not available in some rural areas, for example (Boris, 2005; Grubesic & Murray, 2004). Public

libraries in rural areas were also found to have received less funding and offered less services than

those in urban areas (Sin, 2009).

3.3.2.2.2 Neighborhood environment

Level of urbanization

Few public library studies include neighborhood environment variables. Those who did often

examined the urbanization level of the respondent's place of residence (e.g., Lange, 1988; Powell et

al., 1984; Westin & Finger, 1991). The results suggest that respondents living in a suburban area are

more likely to be public library users, followed by those living in an urban area and those in a rural

area.

Neighborhood income level

In terms of the neighborhood environment, this study focused on neighborhood income. This is

because previous studies have often found that neighborhood income level has a significant impact on

children/youth's behavior and outcomes. Studies using other measures, such as racial/ethnic

heterogeneity or residential stability, have not shown consistent results (Leventhal & Brooks-Gunn,

2000). The relationship between the neighborhood income and public library use has been found to be

positive in studies at the community level (Japzon & Gong, 2005) and the household level (Hemmeter,

2006). The relationship between the neighborhood income and public library use at the individual-

level is rarely tested.

3.3.2.3 Outcome variable: use of public libraries

As examined in section 2.3.3.1, the use of multiple indicators has been recommended in measuring

public library use (D'Elia, 1980; Zweizig, 1973). Following the recommendation, the outcome variable

in this study (the use of the public library) reflects both the *frequency of use* and the *intensity of use*

(using the public library for different purposes) as proposed by Zweizig (1973). This study examines

the frequency with which students used public library for schoolwork, non-schoolwork, and accessing

the Internet.

3.4 Research Design

Secondary analyses of quantitative data and structural equation modeling (SEM) were used to test the

PIE framework of 12th-graders' public library use. This section discusses the following: (1) the

secondary analysis method; (2) data source selection, survey population and sampling, and data

preparation procedures; and (3) data analysis and model testing method - the SEM approach, including

variable operationalization and measurement issues such as validity and reliability.

3.4.1 Secondary Analysis of Quantitative Data

Secondary analysis of quantitative data is sometimes called secondary analysis of survey data.

(Hereafter, the method will be referred to as *secondary analysis*). Hakim defined secondary analysis as

"any further analysis of an existing dataset which represents interpretations, conclusions, or

knowledge additional to, or different from, those presented in the first report on the inquiry as a whole

and its main results" (1982, p. 1). Secondary analysis is a well-established method that has seen

extensive uses among social scientists since early 1960s (Hyman, 1972).

The secondary analysis method was selected for this study as a response to the research gaps in extant

studies. As discussed previously, a major limitation of most extant public library use studies is a non-

representative sample, which undermines the generalization of findings. A nation-wide study is also

preferred in the effort to include a more diverse group of participants and to reflect a wider range of

structural aspects. The amount of manpower, time, and cost involved in a national, representative

survey is considerable. Even the rare nationally representative public library studies, for example,

often involve a smaller sample size seldom exceeding 2,500 respondents (e.g., Westin & Finger,

1991). Existing datasets, particularly those from government agencies, offer a more extensive and

representative sample that might otherwise not be available to researchers if data were to be collected

by the researchers themselves through surveys or observations (Dale, Arber, & Procter, 1988; Hyman,

1972). In addition, secondary analysis is also found to be very versatile. It is suitable for a variety of

research designs, including the design used for this study (i.e., a study designed to investigate

contextual effects through the analyses of individual- and macro-level variables) (Kiecolt & Nathan,

1985).

3.4.2 Data Source Selection

3.4.2.1 Selection of data sets

Identifying data sets with relevant variables measured at a suitable level is crucial to secondary

analysis. For this study, the *Education Longitudinal Study of 2002* (ELS) was selected as the main data

set. ELS was selected because it includes questions concerning use of the public library by individual

participants, and because it comes from a reputable source with established statistical standards (Seastrom, 2002).

The criterion concerning the unit of observation is most important to this study. Data of public library use are often aggregated at higher levels, such as state, library system, or library branch levels. In rare cases, data are available at household level. It would not be appropriate to try to infer individuals' library use from data aggregated at higher levels. This would be an ecological fallacy, which occurs when one draws conclusions about individuals based solely on the analysis of groups or systems (Babbie, 2001). To understand individuals' library use behavior, obtaining data with individual level use is critical, and ELS is one of the rare data sets that satisfies this criterion. In addition to the individual level use data, ELS 2002 also includes variables about participants' families and schools. Last but not least, this data set offers a nationally representative sample of more than ten thousand participants. This helps address the research gap concerning generalization discussed in section 2.2.4.3.

Two data sets were used to provide data at the neighborhood levels - the *Census 2000* data for neighborhood socio-economic characteristics, and the *Public Libraries Survey* (PLS) for neighborhood public library characteristics. They were selected because both are official surveys with an established history and a wide usage in research. Another important criterion is that the two surveys include location variables that allow them to be merged with the ELS data. The Census 2000 and PLS data are available from the Census Bureau and the NCES web site respectively. Information about these data sets, particularly their populations and sampling methods, is presented in the next section. The steps in preparation and merging these datasets will be the focus of section 3.4.3.

3.4.2.2 Description of data sets: population and sampling method

Education Longitudinal Study of 2002 (ELS) is a survey from the National Center for Education

Statistics (NCES) of the United States Department of Education. ELS is designed to examine the

transition of young people from high school to post-secondary education or work. It focuses on factors

related to the educational process and outcomes. The survey was first conducted in 2002 (base year

survey), with a first follow-up survey in 2004 and a second follow-up survey in 2006. This study used

the data from the base year and the first follow-up survey. Following NCES's Restricted Use Data

requirement, all ELS sample size numbers shown in this paper have been rounded to the nearest ten.

The base year survey consists of a nationally representative sample of high school sophomores in the

spring term of the 2001-2 school year. ELS used a two-stage sample selection design. In the first stage,

schools were selected with probability proportional to size (PPS). Among approximately 1,220 eligible

schools, 750 participated in the survey. The weighted school response rate is 67.8%. In the second

stage, sophomores were randomly selected from each participating school. Approximately 30 students

were selected per school. Out of about 17,590 eligible students, about 15,360 participated in the study

(87% weighted response rate). These 15,360 respondents (*the sophomore cohort*) are representative of

the target population which is sophomores in the spring of 2001-2. The first follow-up surveyed

respondents from the base year survey again in 2004, when most of them were 12th-graders (*the senior

cohort*). Some respondents were no longer in school and were therefore provided with a different

questionnaire. This study focuses on the subset of about 13,200 respondents who completed both the

base year survey (as 10th-graders) and the follow up survey (as 12th-graders).

The *Census 2000* data, specifically summary file 1 (SF1) and summary file 3 (SF3) provide socio-

economic characteristics at the neighborhood level. SF1 includes basic data collected from all people

and housing units. SF3 provides more detailed social, economic, and housing characteristics, with data

collected from a sample of the population. SF3 sampled the occupants of about 19 million housing units (an average sampling rate of about 1-in-6). The data are weighted to represent the total population (U.S. Census Bureau, 2002). Both SF1 and SF3 are available in various levels of geographical aggregation. To achieve a finer grain analysis, census data were obtained at the census tract levels. *Census tracts* are small and relatively stable geographic entities of about 2,500 to 8,000 persons. These tracts are delineated to include populations that are relatively homogenous in demographics (U.S. Census Bureau. Geography Division, 2005b). There are a total of 65,443 census tracts in the U.S. (U.S. Census Bureau. Geography Division, 2005a). These data are acquired through the Census Bureau's *American FactFinder* web site.

The *Public Libraries Survey* (PLS) is an annual survey of public libraries. It was part of the *Library Statistic Program* started in 1989. NCES was authorized to collect these data under the *Education Sciences Reform Act of 2002*. PLS is now collected by the IMLS. The data set includes statistics of a library's revenue and expenditures, service population size, and collection and service levels. The reporting unit of PLS is the administrative entity. Under one public library administrative entity, there can be multiple library outlets. PLS collects statistics at the administrative entity level, and not at the individual outlet level. (Hereafter, this administrative entity will be referred to as the *public library system*, or simply *public library*. The library outlet will be identified specifically as *public library outlet*). The PLS survey frame includes all public libraries identified by state library agencies in the 50 states, the District of Columbia, and the outlying areas of Guam, the Northern Mariana Islands, and the U.S. Virgin Islands. For the 2004 fiscal year, 9,000 libraries of the 9,207 public libraries in the survey frame responded.[11] The unit response rate was 97.7%. Imputations were made for non-responses; more

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[11] NCES defined respondents as the public libraries who provided response to the survey item *population of the legal service area* and also to at least three of the five following items: total paid employees, total operating revenue, total operating expenditures, print materials, and total circulation.

information about the imputation methods can be found in the document accompanying the data file

(Kroe et al., 2006). The public-use data file is available for download at the NCES web site.

3.4.3 Data Preparation

3.4.3.1 Selecting a subset

Selecting a data subset is necessary for ELS and for PLS. As noted above, this study includes data

from approximately 13,200 respondents who were in the sophomore cohorts in 2002, and were in the

senior cohorts in 2004. This subset was selected from the ELS data using the *G10COHRT* and the

G12COHRT flag. For PLS, most statistics at a library system level were found in the *Public Library*

Data File. Some library systems have more than one library outlet, and the addresses of these were

drawn from the *Public Library Outlet Data File*. The two files were merged using the variable *library*

identification code in both files. As in previous analyses of PLS (e.g., Jue et al., 1999), mobile libraries

were not included in this study due to the variability in their service locations and schedules. Only data

from stationary library outlets were used for this study. The resulting data subset for this analysis

includes a total of 16,532 stationary library outlets belonging to 9,189 stationary library systems.

3.4.3.2 Merging datasets

3.4.3.2.1 Merging ELS and Census 2000

ArcGIS, a Geographic Information System, was used to merge the ELS and Census 2000 data. The

ELS respondent's residential neighborhood is indicated by the residential zip code variable. The

Census 2000 data, on the other hand, no longer provide data at the zip code level. Instead, data are

provided at the ZCTA level. ZCTA is a generalized area representation of the ZIP code area developed

by the Census Bureau. ZCTA was not used in this study because there are cases where the ZCTA code

and the zip code do not match, and the Census Bureau does not provide any crosswalk to identify the

relationship between the two codes (U.S. Census Bureau. Geography Division, 2001). This study

instead used data from a more refined aggregation level - the census tract level - to interpolate the characteristics of the zip code area.

Using ArcGIS, the digital map of zip code areas was overlaid with the map of the census tracts acquired from the Census Bureau website. The INTERSECT command in ArcGIS was used to identify which census tract lies fully or partly within a zip code area. Interpolation of the socio-economic data was then conducted through the much-used *area weighting* method (Goodchild & Lam, 1980). This process involves calculating the size of each zip code area, and the size of the census tract within the zip code area. The proportion of zip code area each tract occupies can then be calculated. This proportion can then be used as weight when interpolating the socioeconomic data of the zip code area.[12] After the census variables were interpolated for the zip code areas, the Census data were merged with the ELS data using the zip code as the link.

3.4.3.2.2 Merging ELS and PLS

ELS and PLS were linked to identify the public library environment in the students' neighborhoods. ArcGIS was used to conduct this operation. The steps were as follows: (1) The location of each public library outlet was identified on the digital map using a geocoding process. Geocoding is the process of identifying the latitude and longitude of a place based on its street address. (2) The centroid (i.e., geometric center) of each neighborhood was identified. Although the easiest method to do this is to use ArcGIS to calculate the centroid of each zip code area, the nature of the zip code areas meant this

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[12] To give a hypothetical example, zip code area 12345 intersects two tracts (tract A and tract B). Let 80% of zip code 12345 be made up of tract A and 20% of the zip code area belong to tract B. If tract A has an income of $40,000 and tract B has an income of $35,000, the interpolated income for zip code 12345 will be $39,000 (80%*$40,000+20%*$35,000).

risked imprecision: the geometric center of a zip area is not necessarily a populated place[13]. This is

particularly true for rural areas and those in the Mountain or Western states, where zip code areas tend

to be physically large. To better estimate where the students resided, the *populated place areas* data

was utilized (Environmental Systems Research Institute, 2006). This helped identify which areas

within each zip code are populated. These areas were then used to calculate the centroid. (3) The

neighborhood library was located. This is done using ArcGIS's NEAR function. This identified the

public library closest to each centroid and recorded the distance between these two locations. (4) ELS

and PLS data were merged. Once the ID of the nearest neighborhood library was established, the

student data from ELS could then be merged with the PLS data using this ID. Where there was more

than one populated place in the zip code, the public library resource variables were chosen from the

outlet with the best resource level. This was based on the rationale that when multiple outlets are

present in a student's neighborhood, the student could visit the outlet with better services, even though

that might not be the closest one.

3.4.4 Data Analysis Method: Structural Equation Modeling

Structural equation modeling (SEM) is a multivariate statistical technique that can be considered as a

combination of factor analysis, regression, and path analysis. An important characteristic of SEM is its

focus on latent variables. Latent variables are the variables that are not directly observed or measured.

They are measured indirectly through *indicators* (i.e., observed variables). SEM consists of two parts,

the *measurement model* and the *structural model*. The measurement model involves specifying the

relation between the indicators and the latent variable they represent. It helps assess measurement

issues such as validity and reliability. The analysis of the measurement model is a variant of

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[13] The U.S. Geological Survey defines a populated place as a "place or area with clustered or scattered
buildings and a permanent human population (city, settlement, town, village)." (USGS)

Confirmatory Factor Analysis (CFA). The structural model part involves specifying and testing the

relationship among the latent variables. This part is similar to path analysis, but with latent variables

(Kline, 2005). The SEM analysis was conducted using the software program LISREL.

SEM is particularly suitable for testing and refining conceptual models, which fits with the purpose of

the study. Several characteristics of SEM make it appealing to this study: (1) SEM focuses on

measurement issues. As discussed in the literature review section, information behavior research faces

difficulties in applying their conceptual frameworks. The dearth of studies incorporating contextual

factors also means less solid evidence in terms of selecting variables for this study. SEM with its

measurement model part would better address the need for validating and refining the variable

operationalization. (2) SEM does not focus solely on the relationship between the independent and

dependent variables. The relationships among all latent variables can be examined, and represented

visually through the path diagram. This aligns with the study's research questions, as this research

aims to examine the relationship between the predictor variables (e.g., individual characteristics and

structural environment factors) in addition to the effects of individual or structural variables on

information behavior. (3) Unlike other methods such as regression, SEM does not assume that

predictor variables are measured perfectly. The possibility of having measurement errors in the

predictor variables is acknowledged and explicitly modeled in SEM. This fits with the

acknowledgment that measures are often, at best, approximations of reality, as discussed in section

3.2.1 concerning Critical Realism; and (4) SEM has advantages of having more flexible assumptions

over multiple regression, especially when multicollinearity (i.e., when predictor variables are highly

correlated) is suspected. Because of the interrelated nature of individual and structural variables, the

ability of SEM to incorporate these correlated predictor variables is useful for this study.

The oft-used *modeling development strategy* was adopted to apply SEM in this study. This involves using SEM to test the conceptual model. Based on the initial results, the researcher then makes modifications and reanalyzes the model. Thus, SEM serves both exploratory and confirmatory purposes.

More specifically, this study developed and tested the SEM models using the stages suggested by Hair, Anderson, Tatham, & Black (1998) and Kline (2005) as follows: (1) Based on the conceptual framework developed in section 3.3.2, and the candidate variables proposed in Table 6, an initial measurement model was specified. (2) Data were screened and transformed to tackle potential assumption violations. (3) The initial measurement model was tested to assess the reliability and validity of the measures. The measurement model and the selection of variables were modified accordingly, and the revised model was again evaluated. Following the two-step modeling process recommended by researchers, development of the structural model began only after the measurement model had been evaluated. (4) An initial structural model, based on the previous measurement model was specified and evaluated. Alternative models were built to test the changes in the model fit. The goal was to identify a parsimonious structural model with as simple a structure as possible that still maintains a good model fit.

The following sections address the first two stages. First, development of the initial measurement model is examined in 3.4.4.1. This includes discussion of variable operationalization and the reliability and validity measures. Second, data screening and transformation procedures are presented in section 3.4.4.2. This covers issues of sample size, missing data, and measurement levels. Results from the testing and respecification of the measurement and structural models (stages 3 and 4) are present in chapter 4. Interpretation of the results is discussed in chapter 5.

3.4.4.1 Development of the initial measurement model

3.4.4.1.1 Variable operationalization

As the conceptual framework for studying high school seniors' public libraries use is already outlined

in section 3.3.2, this section will focus on the variable operationalization. The observed and latent

variables selected for the initial model are presented in Table 6.

Table 6

Initial Measurement Model: Latent and Observed Variables

Latent Variable	Observed variable	Source
Sex	Sex	ELS
Race/ethnicity	Race/ethnicity	ELS
SES	Mother's education level	ELS
	Father's education level	ELS
	Family income	ELS
Achievement motivation	Importance of getting good education	ELS
	Importance of good grades to student	ELS
	Education is important to get a job later	ELS
Social participation	Participated in school service clubs	ELS
	Participated in community service	ELS
Learning activities	How often takes music, art, language class	ELS
	Hours/week spent reading outside of school	ELS
Perception of school library	School library staff helpful with finding research resources	ELS
	School library staff helpful with using databases	ELS
Home information environment	Family has a computer in 2002	ELS
	Family has Internet access in 2002	ELS
	Family has a computer in 2004	ELS
	Family has more than 50 books	ELS
School information environment	School has computers	ELS
	Library has automated book circulation system	ELS
	General articles / news databases available	ELS
Public library environment	MLIS librarian per service capita	PLS
	Collection expenditure per service capita	PLS
	Total income per service capita	PLS
Public library accessibility	Median distance to closest public library	PLS
	Number of library branch per square mile	PLS
Urbanization level	Urbanization level	U.S. Census
Neighborhood income	Median household income	U.S. Census
	Per capita income	U.S. Census
	Median real estate taxes	U.S. Census

Table 6 (cont'd)

Latent Variable	Observed variable	Source
School library use - schoolwork	For assignments	ELS
	For in-school projects	ELS
	For homework	ELS
	For research papers	ELS
School library use - non-schoolwork	For leisure reading	ELS
	To read magazines/newspapers	ELS
	For interests outside of school	ELS
School library use - Internet	Internet access	ELS
Public library use - schoolwork	For assignments	ELS
	For in-school projects	ELS
	For homework	ELS
	For research papers	ELS
Public library use - non-schoolwork	For leisure reading	ELS
	To read magazines/newspapers	ELS
	For interests outside of school	ELS
Public library use - Internet	Internet access	ELS

3.4.4.1.2 Single indicator variable

Multiple indicators are selected to represent a latent variable whenever possible to allow for the estimation of measurement errors. In the initial model there are five single-indicator variables. The study assumes that there are no measurement errors for the variables Sex and Race/ethnicity. For the other single-indicator variables (namely Urbanization level, School library use - Internet, and Public library use - Internet) it is recognized that measurement errors are likely to exist. Instead of treating the measures as perfectly reliable, a more preferable option is to estimate the measurement error (Hair et al., 1998). In this study, a conservative value is used to estimate the measurement error. The error variance is estimated as 0.1 times of the observed variable's variance ($0.1s^2_x$) while the factor loading/lambda is estimated as 0.95 times of the variable's standard deviation ($0.95s_x$), as recommended in the literature (Anderson & Gerbing, 1988).

3.4.4.1.3 Reliability and validity

While extant literature informs the selection of most variables, the variable operationalization is introductory in nature, particularly for the contextual variables measured at higher levels. This interest in measurement issues in part leads to the selection of the SEM. An integral part of the SEM is the development of the *measurements models*, which specifies and assesses how well the observed variables (i.e., indicators) reflect the theoretical constructs (i.e., latent variables). The following section will identify the reliability and validity measures used in this study.

Reliability is concerned with the extent to which measures are consistent. SEM explicitly takes into account the presence of measurement errors. Representing a construct with multiple indicators is preferred over the use of a single indicator; the latter is more likely to be affected by random error which lowers its reliability (Pedhazur & Schmelkin, 1991; Zeller & Carmines, 1980). This recommendation was followed in the study whenever possible. To evaluate the reliability of an individual observed variable, R-squared (R^2), also called the squared multiple correlation, was used. Construct Reliability (CR)[14] and Average Variance Extracted (AVE)[15] were used to evaluate the reliability of each latent variable (Fornell & Larcker, 1981; Hair et al., 1998).

In terms of validity, various aspects of validity have been identified in the literature. While there is no universal consensus on the definitions and groupings of these aspects, they have been traditionally

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[14] Construct Reliability = (sum of standardized loading)^2 / [(sum of standardized loading)^2 + sum of indicator measurement error], where the measurement error of each indicator is 1 minus the square of the indicator's standardized loading.

[15] Average Variance Extracted = (sum of squared standardized loading) / (sum of squared standardized loading + sum of indicator measurement error), where the measurement error of each indicator is 1 minus the square of the indicator's standardized loading.

grouped into three broad categories: content, criterion, and construct. Content validity focuses on assessing whether the content of the measures represent a specific domain. Criterion-related assessment focuses on the extent to which a measure successfully predicts a criterion. Construct validity is concerned with how well one can make inferences about theoretical constructs based on observed variables (Pedhazur & Schmelkin, 1991). Among the three categories of validity, construct validity is considered the most useful and important for studies aiming at theoretical/conceptual development (Boomsma, 2000; Carmines & Zeller, 1979). Thus, this study will focus on construct validation, specifically on *convergent validity* and *discriminant validity*.

Convergent validity addresses whether measures that are supposed to be theoretically related are indeed observed to be related. Convergent validity will be demonstrated by showing that the indicators of a latent variable correlate at least moderately with each other. AVE above 0.5 are considered as indications of convergent validity (Fornell & Larcker, 1981). Discriminant validity is concerned with whether indicators of different constructs are indeed observed to be different. Discriminate validity will be demonstrated when the variables that are measuring different constructs do not correlate too highly (Kline, 2005).

Based on extant recommendations, in this study, the criteria used for item selection are: $R^2 >= 0.5$; $CR > 0.7$; $AVE > 0.5$ (Fornell & Larcker, 1981; Hair et al., 1998).

3.4.4.1.4 Model-fit indices
Many measures have been introduced to evaluate the fit of SEM models. The recommended practice is to provide a set of indices to evaluate model fit and model parsimony, and also to compare alternative models (Hair et al., 1998; Schumacker & Lomax, 2004). This study used the following types of

measures: (1) Chi-square value and p-value; (2) Adjusted Goodness of Fit Index (AGFI); (3) Non-Normed Fit Index (NNFI); (4) Root Mean Square Error of Approximation (RMSEA); (5) Expected Cross-Validation Index (ECVI) and (6) Akaike Information Criterion (AIC). The indices and their recommended values are listed in Table 7.

Table 7

Mode-Fit Indices

Index	Recommended level
Chi-square	p > 0.05
AGFI	> 0.9
NNFI	> 0.9
RMESA	<= 0.05
ECVI	Model with smaller ECVI is preferred
AIC	Model with smaller AIC is preferred

3.4.4.2 Data screening and transformation

3.4.4.2.1 Sample size

SEM requires a large sample size. As a bare minimum, at least 100 subjects are needed (Kline, 2005). For a study with non-normal data, Bentler and Chou (1987) suggested at least 10 subjects per variable. The sample size in this study (i.e., more than 13,000) well exceeds the recommended requirement.

3.4.4.2.2 Missing data

The datasets used in this study include missing data. Various methods can be used to handle missing data: available case methods (e.g., deleting cases with missing observations); single imputation methods (e.g., replacing missing data with the mean); model-based imputation (e.g., imputing missing scores based on the distribution of the data with sophisticated estimating mechanisms); or special estimation methods such as Full Information Maximum Likelihood (FIML) (Kline, 2005).

When the amount of missing data is large, the model-based imputation method is considered more suitable than available case methods or single imputation (Schumacker & Lomax, 2004). While available case methods, such as listwise deletion, are the least complicated methods, it would result in a significant reduction in sample size. For this study, for example, the sample size dropped significantly to approximately 8,560 when listwise deletion was used. Listwise deletion will also lead to a biased estimation when data are not *Missing Completely at Random* (MCAR). MCAR means that the probability an observation is missing is not related to the value of the missing variable itself, or the value of other observed variables in the analysis. MCAR is rarer than *Missing at Random* (MAR). MAR means that the probability an observation is missing is random, after controlling for other observed variables. That is, the pattern of missing data is related to other observed variables in the study; thus one can estimate the missing value based on the available data. Compared to listwise deletion, pairwise deletion will not lead to as great a reduction in sample size. Pairwise deletion is generally not recommended for SEM, however, as it could cause computational problems (Kline, 2005).

The *Missing Value Analysis* of SPSS was used to test this study's missing data pattern. *Little's MCAR test*, a chi-square test used to test the MCAR assumption, yielded a statistically significant result ($\chi^2 = 29,213.23$, df $= 24,082$, p < 0.001). This indicates that the data were not *Missing Completely at Random*. Based on the results of the separate variance t-tests, the missing data patterns were related to the observed variable Race/ethnicity. Missing data were more commonly found in responses from non-Caucasian students than their counterparts. Because the data were not MCAR, model-based imputation was selected over listwise deletion. This study used PRELIS's Multiple Imputation, the Markov Chain Monte Carlo (MCMC) option for missing data estimation (Toit & Toit, 2001).

3.4.4.2.3 Measurement scale and model estimation method

This study includes both continuous and non-continuous variables. Following the recommended

practice for SEM studies with non-continuous data, PRELIS was used to create a matrix of

polychoric/polyserial correlations. An asymptotic variance-covariance matrix was also generated in

PRELIS to be used with the Weighted-least squares (WLS) method in estimating the SEM models

(Joreskog & Sorbom, 1996b). Generally, the most commonly-used method is the Maximum likelihood

(ML) estimation. For non-normal data, however, the WLS estimation method will generate more

accurate chi-square statistics and standard error measures. Thus, WLS was used for this study. The

drawback of WLS is that it requires a larger sample size (Schumacker & Lomax, 2004). As this study

included more than 10,000 samples, the large sample size requirement did not pose a problem.

4. RESULTS

4.1 Initial Measurement Model

The initial measurement model presented in Chapter 3 was tested with LISREL 8.7 using the WLS

estimation method (Joreskog & Sorbom, 1996a). The LISREL command in SIMPLIS syntax is

available in Appendix A. This section reports the following: (1) the model fit indices and the reliability

and validity measures of the initial measurement model; (2) the measurement model respecification

process; and (3) the various measures of the final measurement model.

4.1.1 Model Fits

Table 8 presents the overall fit of the initial measurement model. All but the chi-square test met the

recommended level. Because the chi-square test is sensitive to sample size, this result was as expected.

Data with a large sample size, such as those with more than 200 respondents, tend to have significant

chi-square test results that suggest the theoretical model did not fit well with the sample matrix (Kline,

2005). Given that this study has more than 13,000 samples, a significant chi-square statistic was

anticipated. As other overall fit indices met the recommended levels, it is concluded that this initial

measurement model is an acceptable fit for the sample data (Hair et al., 1998).

Table 8

Overall Fit of the Initial Measurement Model

Index	Recommended level	Initial measurement model
Chi-square	$p > 0.05$	16108.60 ($p < 0.001$)
AGFI	> 0.9	0.98
NNFI	> 0.9	0.96
RMESA	$<= 0.05$	0.04
ECVI	Model with smaller ECVI is preferred	1.26
AIC	Model with smaller AIC is preferred	16624.60

4.1.2 Reliability and Validity

This sections focus on the loading, reliability, and validity of each variable. To recap, the evaluation criteria are: item reliability, $R^2 >= 0.5$; Construct Reliability > 0.7; Average Variance Extracted (AVE) > 0.5. The results are presented in Table 9. Items that did not meet the criteria are highlighted in bold.

Table 9

Factor Loadings, Reliability and Validity of Initial Measurement Model

Latent variable	Observed variable	Standardized loading	Item reliability R^2	Construct Reliability	AVE
SES	Mother's education level	0.71	0.51	0.75	0.50
	Father's education level	0.71	0.50		
	Family income	**0.69**	**0.48**		
Sex	Sex	1.00	1.00	1.00	1.00
Race/ethnicity	Race/ethnicity	1.00	1.00	1.00	1.00
Achievement motivation	Importance of getting good education	0.87	0.76	0.85	0.65
	Importance of good grades to student	0.82	0.66		
	Education is important to get a job later	0.72	0.52		
Learning activities	How often takes music, art, language class	**0.45**	**0.20**	**0.30**	**0.18**
	Hours/week spent reading outside of school	**0.39**	**0.15**		
Social participation	Participated in school service clubs	0.77	0.59	0.73	0.58
	Participated in community service	0.75	0.56		
Perception of school library	Staff helpful with finding research resources	0.96	0.92	0.94	0.88
	Staff helpful with using databases	0.92	0.84		
Home information environment	Family has a computer in 2002	0.94	0.88	0.91	0.73
	Family has Internet access in 2002	0.97	0.95		
	Family has a computer in 2004	0.88	0.77		
	Family has more than 50 books	**0.58**	**0.33**		
School information environment	School has computers	1.00	1.00	0.91	0.77
	Library has automated book circulation system	0.75	0.56		
	General articles / news databases available	0.87	0.75		

Table 9 (cont'd)

Latent variable	Observed variable	Standardized loading	Item reliability R^2	Construct Reliability	AVE
Public library environment	MLIS librarian per service capita	0.82	0.68	0.93	0.83
	Collection expenditure per service capita	0.92	0.85		
	Total income per service capita	0.98	0.95		
Public library accessibility	Median distance to closest public library	0.80	0.63	0.81	0.68
	Number of library branch per square mile	0.85	0.72		
Urbanization level	Urbanization level	0.95	0.90	0.90	0.90
Neighborhood income	Median household income	0.80	0.64	0.80	0.56
	Per capita income	0.75	0.56		
	Median real estate taxes	0.70	0.49		
School library use - schoolwork	For assignments	0.92	0.84	0.95	0.82
	For in-school projects	0.92	0.85		
	For homework	0.87	0.76		
	For research papers	0.92	0.84		
School library use - non-schoolwork	For leisure reading	0.89	0.80	0.93	0.81
	To read magazines/newspapers	0.89	0.80		
	For interests outside of school	0.92	0.84		
School library use - Internet	Internet access	0.93	0.87	0.87	0.87
Public library use - schoolwork	For assignments	0.94	0.89	0.96	0.85
	For in-school projects	0.93	0.87		
	For homework	0.89	0.79		
	For research papers	0.92	0.85		
Public library use - non-schoolwork	For leisure reading	0.93	0.86	0.95	0.86
	To read magazines/newspapers	0.92	0.85		
	For interests outside of school	0.93	0.86		
Public library use - Internet	Internet access	0.95	0.91	0.90	0.90

4.2 Measurement Model Respecifications

Based on the results, several changes were made to improve the measurement model. First, for the

latent variables Learning activities and Home information environment, the factor loadings of some of

the indicators were significantly lower than the recommended criteria. This suggests that the observed

variables may represent different theoretical constructs. In later models, the home information environment variable was reformulated into two latent variables, one representing home computer/Internet resources, and the other representing home print resources. The learning activities variable was also separated into a variable for learning and another for reading.

Second, the model was respecified so that potential correlations between variables' measurement errors (i.e., error covariance) could be tested. In general, it is assumed that measurement errors of the observed variables are not correlated, thus, they are not tested. Nevertheless, these errors may be correlated in certain cases, for example, when the observed variables are recorded using the same measurement method, or when similar wordings are used in the questionnaire (Schumacker & Lomax, 2004). The Modification Indices (MI) provided by LISREL can help identify potentially correlated measurement errors. After reviewing the LISREL results of the initial measurement model, the error covariance of the following variables were tested: (1) between the observed variables Father's education and Mother's education; (2) between the observed variables Collection expenditure per service capita and Total income per service capita; (3) among the latent variables representing the three types of public library uses (i.e., for schoolwork, for non-schoolwork, and for using the Internet); and (4) among the latent variables representing the three types of school library uses.

4.3 Final Measurement Model

A final measurement model was selected after numerous iterations of model respecification and testing. The LISREL syntax of this model is presented in Appendix B. This finalized measurement model yielded the following model fit indices (Table 10). The indices of the initial measurement model are also listed below for easier comparison.

Table 10

Overall Fit of the Final Measurement Model

Index	Recommended level	Initial measurement model	Final measurement model
Chi-square	p > 0.05	16,108.60 (p < 0.001)	14,640.44 (p < 0.001)
AGFI	> 0.9	0.98	0.98
NNFI	> 0.9	0.96	0.96
RMESA	<= 0.05	0.038	0.037
ECVI	Model with smaller ECVI is preferred	1.26	1.15
AIC	Model with smaller AIC is preferred	16,624.60	15,232.44

Again, all but the chi-square test met the recommended level. Based on ECVI and AIC, which are

indices used for model comparison, the final measurement model has a better fit than the initial model.

This respecified model was thus selected as the basis to develop the structural model. The factor

loadings of the variables and their reliability and validity measures for the final measurement model

are presented in Table 11.

Table 11

Factor Loadings, Reliability and Validity of Final Measurement Model

Latent variable	Observed variable	Standard-ized loading	Item reliability R^2	Construct Reliability	AVE
SES	Mother's education level	**0.63**	**0.39**	0.71	**0.45**
	Father's education level	**0.62**	**0.38**		
	Family income	0.76	0.58		
Sex	Sex	1.00	1.00	1.00	1.00
Race/ ethnicity	Race/ethnicity	1.00	1.00	1.00	1.00
Achievement motivation	Importance of getting good education	0.88	0.77	0.85	0.65
	Importance of good grades to student	0.81	0.66		
	Education is important to get a job later	0.72	0.52		
Learning	How often takes music, art, language class	0.95	0.90	0.90	0.90
Reading	Hours/week spent reading outside of school	0.97	0.94	0.94	0.94

Table 11 (cont'd)

Latent variable	Observed variable	Standard-ized loading	Item reliability R^2	Construct Reliability	AVE
Social participation	Participated in school service clubs	0.77	0.59	0.74	0.59
	Participated in community service	0.76	0.57		
Perception of school library	Staff helpful with finding research resources	0.96	0.93	0.93	0.86
	Staff helpful with using databases	0.91	0.84		
Home computer/ Internet resources	Family has a computer in 2002	0.94	0.88	0.95	0.87
	Family has Internet access in 2002	0.98	0.96		
	Family has a computer in 2004	0.88	0.78		
Home print resources	Family has more than 50 books	0.99	0.99	0.98	0.98
School information environment	School has computers	0.92	0.84	0.89	0.72
	Library has automated book circulation system	0.75	0.56		
	General articles / news databases available	0.87	0.75		
Public library environment	MLIS librarian per service capita	0.90	0.82	0.89	0.74
	Collection expenditure per service capita	0.81	0.66		
	Total income per service capita	0.86	0.74		
Public library accessibility	Median distance to closest public library	0.80	0.64	0.81	0.68
	Number of library branch per square mile	0.85	0.72		
Urbanization level	Urbanization level	0.95	0.90	0.90	0.90
Neighborhood income	Median household income	0.82	0.67	0.81	0.59
	Per capita income	0.76	0.57		
	Median real estate taxes	0.71	0.51		
School library use - schoolwork	For assignments	0.92	0.84	0.95	0.82
	For in-school projects	0.92	0.85		
	For homework	0.87	0.76		
	For research papers	0.91	0.83		
School library use - non-schoolwork	For leisure reading	0.90	0.81	0.93	0.82
	To read magazines/newspapers	0.89	0.80		
	For interests outside of school	0.92	0.84		
School library use - Internet	Internet access	0.93	0.87	0.87	0.87

Table 11 (cont'd)

Latent variable	Observed variable	Standard-ized loading	Item reliability R^2	Construct Reliability	AVE
Public library use - schoolwork	For assignments	0.94	0.89	0.96	0.85
	For in-school projects	0.93	0.87		
	For homework	0.89	0.79		
	For research papers	0.92	0.85		
Public library use - non-schoolwork	For leisure reading	0.92	0.85	0.95	0.86
	To read magazines/newspapers	0.93	0.86		
	For interests outside of school	0.93	0.87		
Public library use - Internet	Internet access	0.95	0.91	0.90	0.90

The observed variables Father's education and Mother's education, and the corresponding latent variable SES, were the only variables that fell below the reliability and validity criteria. After controlling for potentially correlated measurement errors between mother and father's education, the item reliability, R^2, for Mother's education dropped to 0.39 and Father's education dropped to 0.38. They are lower than the recommended level of 0.5. The AVE for the latent variable SES is 0.45, which is also lower than the recommended 0.5 level.

A possible option is to drop the education-related observed variables and use only family income level to represent SES. In the literature, however, a student's SES is commonly represented by multiple indicators, including mother's education, father's education, and family income (Sirin, 2005; White, 1982). The fact that these three variables are commonly used together as indicators of SES lends strength to the measure's validity, particularly in terms of face validity. In addition, if only family income were used, a drawback is that one would not be able to calculate the variable's reliability; instead, the reliability measure would have to be estimated by the researcher. A test of a measurement model with family income as the only indicator for SES resulted in a lower level of model fit. In light

of this, in the final model, SES was represented by all three observed indicators: Mother's education,

Father's education, and Family income. Table 12 presents the descriptive statistics of the selected

variables.

Table 12

Descriptive Statistics of Selected Variables

Latent variable	Observed variable	Min.	Max.	Mean	S.D.
	Mother's education level	1.00	8.00	3.85	2.02
SES	Father's education level	1.00	8.00	4.01	2.21
	Family income	1.00	13.00	9.22	2.37
	Importance of getting good education	1.00	3.00	2.85	0.38
Achievement motivation	Importance of good grades to student	1.00	4.00	3.43	0.70
	Education is important to get a job later	1.00	4.00	3.62	0.56
Learning activities	How often takes music, art, language class	1.00	4.00	1.61	1.01
Reading outside school	Hours/week spent reading outside of school	0.00	5.00	0.94	0.80
Social participation	Participated in school service clubs	0.00	1.00	0.14	0.35
	Participated in community service	0.00	1.00	0.23	0.42
Perception of school library	Staff helpful with finding research resources	0.00	4.00	2.86	1.04
	Staff helpful with using databases	0.00	4.00	2.57	1.05
Home computer / Internet resources	Family has a computer in 2002	0.00	1.00	0.91	0.29
	Family has Internet access in 2002	0.00	1.00	0.86	0.35
	Family has a computer in 2004	0.00	1.00	0.93	0.26
Home print resources	Family has more than 50 books	0.00	1.00	0.86	0.35
	School has computers	0.00	1.00	0.99	0.08
School information environment	Library has automated book circulation system	0.00	1.00	0.91	0.29
	General articles / news databases available	0.00	1.00	0.92	0.27
	MLIS librarian per service capita	1.00	5.00	2.99	1.39
Public library environment	Collection expenditure per service capita	1.00	5.00	2.99	1.39
	Total income per service capita	1.00	5.00	3.00	1.39
Public library accessibility	Median distance to closest public library	1.00	5.00	3.00	1.41
	Number of library branch per square mile	1.00	5.00	2.94	1.46
Urbanization level	Urbanization level	-1.77	1.50	0.00	1.00

Table 12 (cont'd)

Latent variable	Observed variable	Min.	Max.	Mean	S.D.
Neighborhood income	Median household income	-2.36	6.58	0.00	1.00
	Per capita income	-1.77	10.22	0.00	1.00
	Median real estate taxes	-1.31	6.89	0.00	1.00
School library use - schoolwork	For assignments	0.00	4.00	2.43	1.01
	For in-school projects	0.00	4.00	2.72	1.03
	For homework	0.00	4.00	1.94	1.04
	For research papers	0.00	4.00	2.76	1.10
School library use - non-schoolwork	For leisure reading	0.00	4.00	1.64	0.94
	To read magazines/newspapers	0.00	4.00	1.70	0.97
	For interests outside of school	0.00	4.00	1.76	1.01
School library use - Internet	Internet access	0.00	4.00	2.72	1.12
Public library use - schoolwork	For assignments	1.00	4.00	1.74	0.93
	For in-school projects	1.00	4.00	1.77	0.97
	For homework	1.00	4.00	1.55	0.85
	For research papers	1.00	4.00	2.15	1.13
Public library use - non-schoolwork	For leisure reading	1.00	4.00	1.62	0.93
	To read magazines/newspapers	1.00	4.00	1.41	0.77
	For interests outside of school	1.00	4.00	1.56	0.89
Public library use - Internet	Internet access	1.00	4.00	1.62	0.96

4.4 Initial Structural Model

With the structural model, the hypothesized pathways between latent variables are specified. The

model was again tested with LISREL 8.7 using the WLS estimation method. The initial structural

model is presented in Fig. 4 and the syntax is available in Appendix C. The overall model fits are

shown in Table 13. To avoid overcrowding, the covariances/correlations among exogenous variables[16]

and also the disturbances/measurement errors are not shown in the diagram.

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[16] An *exogenous variable* is a variable that predicts other variables; the exogenous variable itself is not predicted by any other variables in the model (Hair et al., 1998).
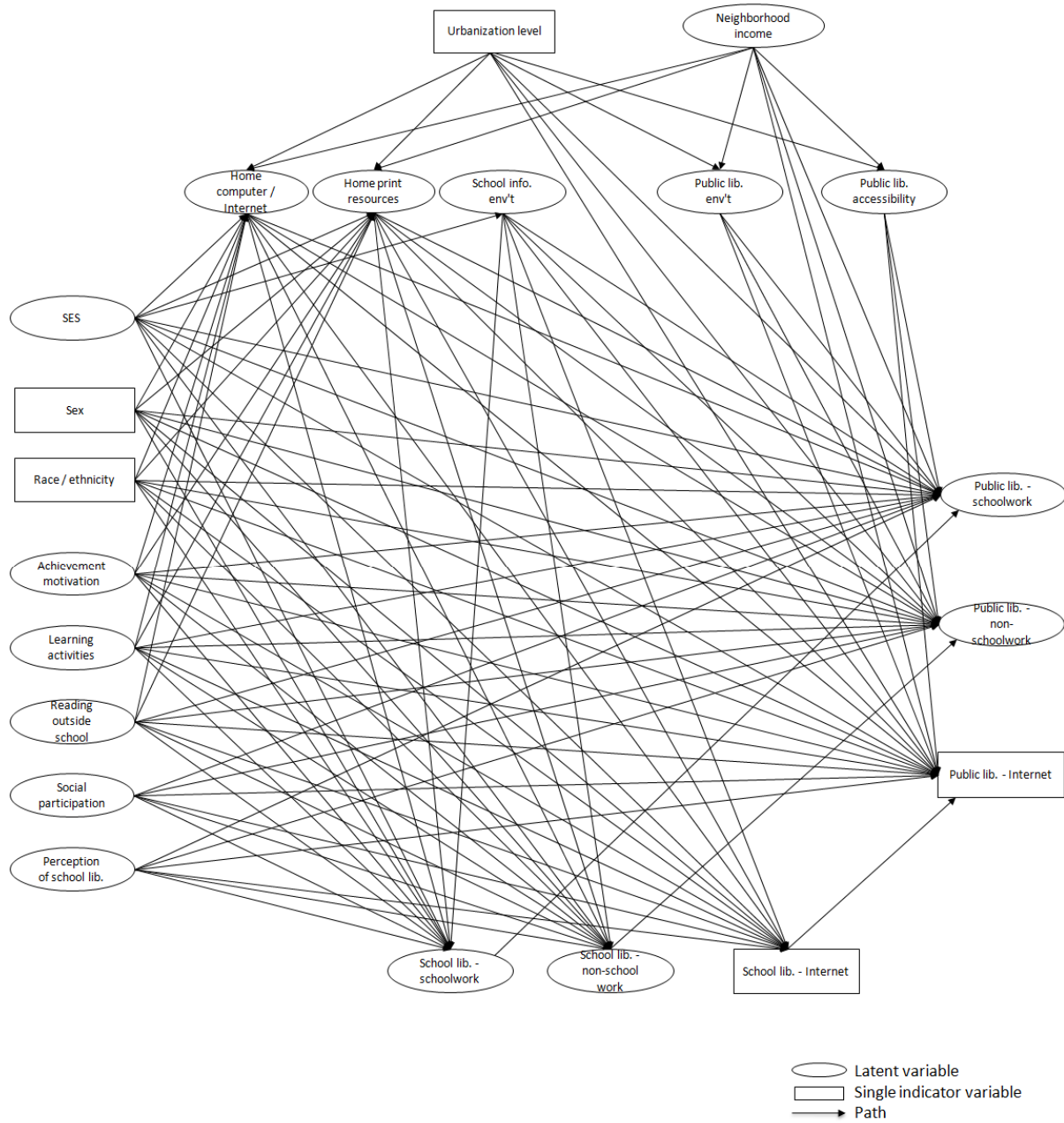
Figure 4. Initial structural model.

Table 13

Overall Fit of the Initial Structural Model

Index	Recommended level	Initial structural model
Chi-square	p > 0.05	18,319.42 (p < 0.001)
AGFI	> 0.9	0.98
NNFI	> 0.9	0.95
RMESA	<= 0.05	0.04
ECVI	Model with smaller ECVI is preferred	1.42
AIC	Model with smaller AIC is preferred	18,797.42

Similar to the model fit indices for the measurement model, all indices, except the chi-square measure of the structural model, meet the recommended levels. While the initial model had acceptable model fits, alternative models were also explored, as recommended in the literature. The respecification process is discussed in the next section.

4.5 Structural Model Respecification and Alternative Model Testing

There are three major areas that this researcher is interested in refining: (1) the potential feedback from public library use to school library use; (2) specification of the school environment variable; and (3) specification of variables related to personal characteristics. The following section presents the rationale of exploring these areas and the changes made during the respecification process.

The first change involved the pathways between school library and public library uses. The initial model hypothesized that school library uses would predict public library uses. In an alternative model, the possibility that public library uses may also in turn affect school library uses was tested. Because public library and school library can serve similar functions, it is possible that the frequency of public library use would affect the frequency of school library use. This potential bi-directional relation has been rarely tested in extant studies. Because this effect is seldom assessed, and because the alternative model did yield a better model fit (Table 14), this change is included in the final model.

The second modification involved how the School information environment (hereafter, *school environment*) variable was specified. Initially, school environment is hypothesized to be affected by students' SES. However, the initial model result for the school environment variable was not very satisfactory. The relation between SES and school environment is statistically significant but not substantively significant. The initial model could explain only about 7% of the variance in the school environment. A further model added Sex and Race/ethnicity as predictors. Later, Urbanization level and the residential Neighborhood income were also added. With these predictors added, the model still explained only about 9% of the variance in the school environment.

As a test, extra factors that are not directly related to public library use such as school size and school urbanity were introduced. This increased the model's ability to explain the variance in the school information environment. Nevertheless, introducing these variables less central to public library uses worsened the overall model fit. The study's ultimate focus is on the public library use. Thus, it was decided that the model would not seek to explain the differences in the school environment at the expense of the overall model fit. Instead, the school environment variable was specified as an exogenous variable. That is, it was recognized that the school environment was affected by factors beyond those analyzed in this model. The current study did not attempt to identify the mechanism affecting the school environment. Further research projects can be developed to focus on these disparities. Inclusion of more factors related to the school, school district, and state policy and funding should be fruitful for such a project.

The third area tested during the respecification process involved the specification of individual characteristics. Alternative models were tested but no changes were made to the final model in this

area. In the initial model, individual factors such as Academic motivation and Social participation were treated as exogenous variables. This is based on the rationale that these individual characteristics are developed and solidified over a long period of time in the student's life. It is hypothesized that these characteristics are shaped by many variables such as personality, life experience, and education experience. Ascribed characteristics (such as Sex and Race/ethnicity) in this model may influence some personal characteristics, but it is expected that the ascribed characteristics alone would not be able to completely explain the variances in the personal characteristics. It is thus beyond the scope of this study to fully explore the factors that predict these personal characteristics.

To ascertain whether it is indeed better to postulate these personal characteristics as exogenous, an alternative model was tested. In this model, SES, Sex, and Race/ethnicity were treated as exogenous variables; other personal characteristics such as Academic motivation and Social participation were treated as mediating variables. The alternative model yielded a lower model fit than the initial model (Table 14). Thus, individual characteristics were kept as exogenous factors in the final structural model.

4.6 The Finalized Model

The selected structural model is presented in Fig. 5. The SIMPLIS syntax is available in Appendix D. Among the alternative models, the final model had the lowest ECVI and AIC values, indicating a better overall model fit than the initial and alternative models (Table 14). For the final model, all fit indices, except the chi-square test, met the recommended level (Table 15).

Table 14

Overall Fits of Alternative Models

Index	Initial structural model	Same as left, except feedback added from public library use to school library use	Same as left, except school information environment specified as exogenous variable [Final model]	Same as left, except personal characteristics specified as mediating variables
Chi-square	18,319.42 (p < 0.001)	18,267.54 (p < 0.001)	16,093.32 (p < 0.001)	17,924.97 (p < 0.001)
AGFI	0.98	0.98	0.98	0.98
NNFI	0.95	0.95	0.96	0.95
RMESA	0.040	0.040	0.037	0.039
ECVI	1.42	1.42	1.26	1.39
AIC	18,797.42	18,751.54	16,595.32	18,392.97

Table 15

Overall Fit of the Final Structural Model

Index	Recommended level	Final structural model
Chi-square	p > 0.05	16,093.32 (p < 0.001)
AGFI	> 0.9	0.98
NNFI	> 0.9	0.96
RMESA	<= 0.05	0.037
ECVI	Model with smaller ECVI is preferred	1.26
AIC	Model with smaller AIC is preferred	16,595.32
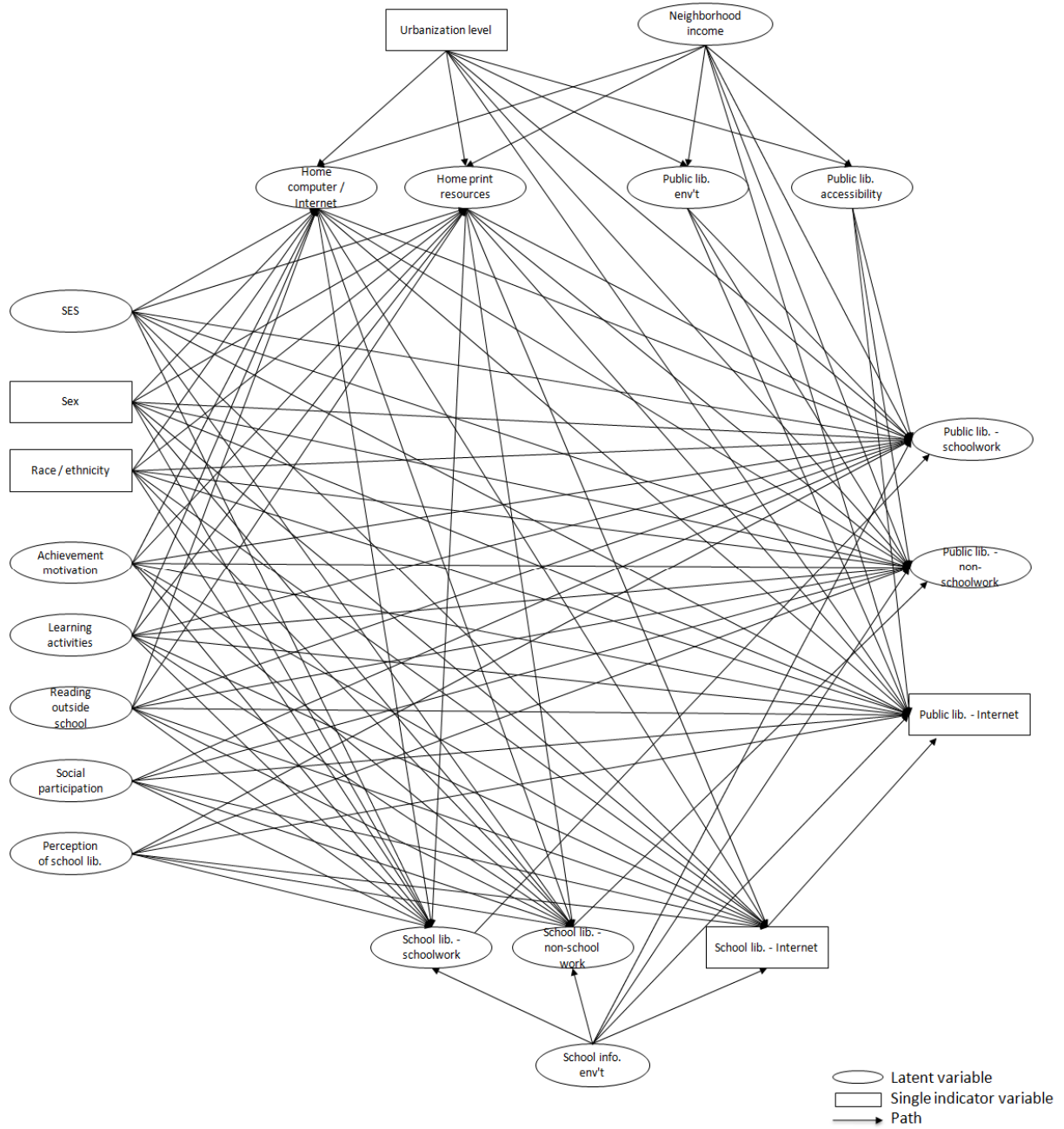
Figure 5. Final structural model.

4.6.1 Direct Effects

Fig. 6 shows the final model with the standardized structural coefficients. These coefficients are similar to regression coefficients. The value indicates the amount of change in the outcome variable with a unit change in the predictor variable. As the coefficients were standardized, one could compare the relative effects of different variables. Below is an example of how the value can be interpreted. The coefficient for the path from Home computer/Internet availability to Public library use for schoolwork is -0.1. This is interpreted as an increase of one standard deviation on the Home computer/Internet resource variable will lead to a decrease in the frequency of public library use by the amount of 0.1 standard deviation. Fig. 6 presents the latent variables and the pathways that are statistically significant. For easier visualization, the open source social network analysis program *Pajek* was used to create Fig. 7 where the path width is proportional to the structural coefficient. More parameters can be found in the tables following the graphs. Because the study included many indicators and latent variables, not all parameters are listed in this report.

Table 16 lists the standardized structural coefficients that are also presented in Fig. 6. This table indicates the direct effects between pairs of variables. It presents the extent to which the variable at the top directly affects the variable listed in each row. Coefficients that are not statistically significant are also included. Pairs of variables where the model did not hypothesize a direct pathway were marked with " - -" in the table.
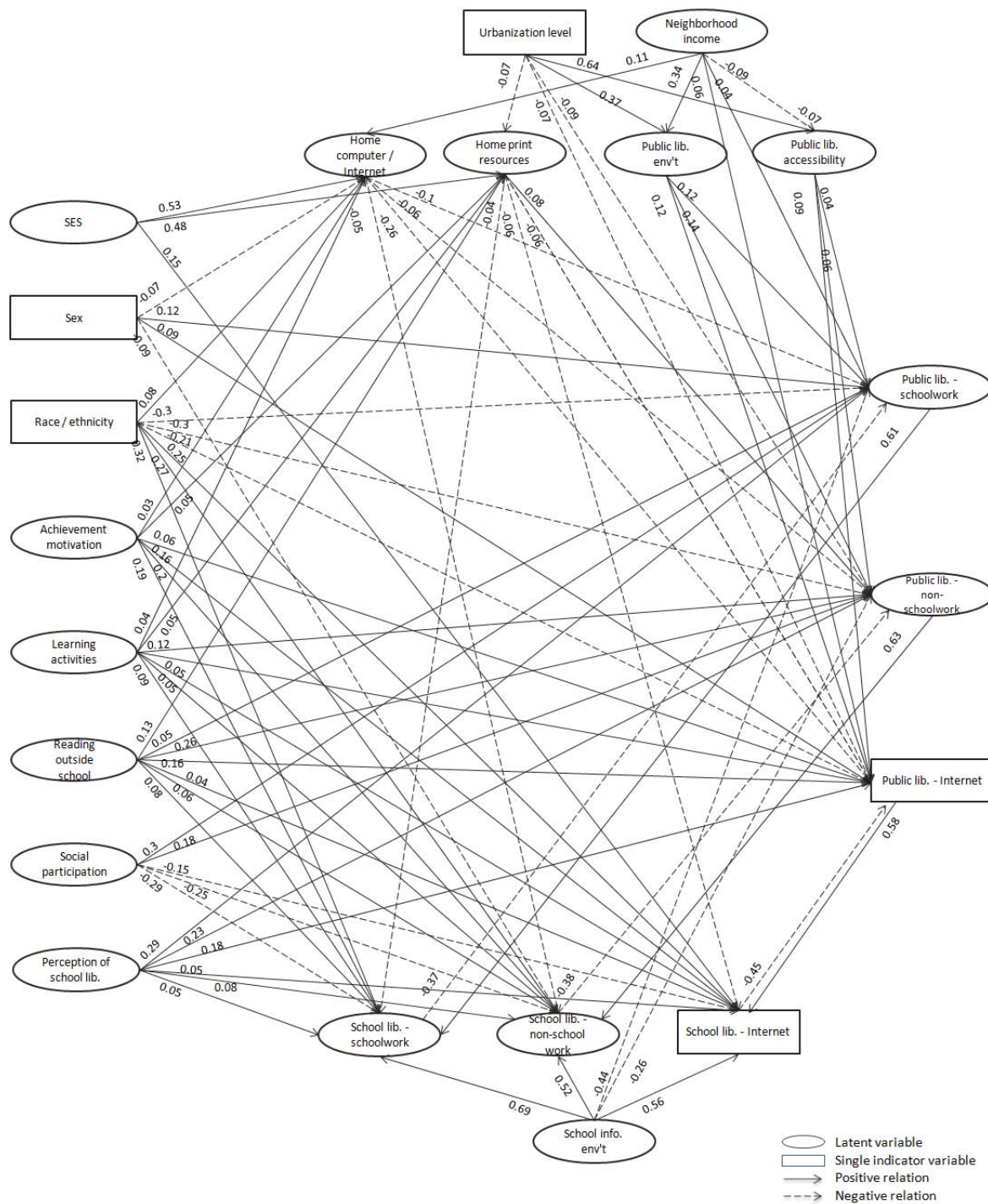
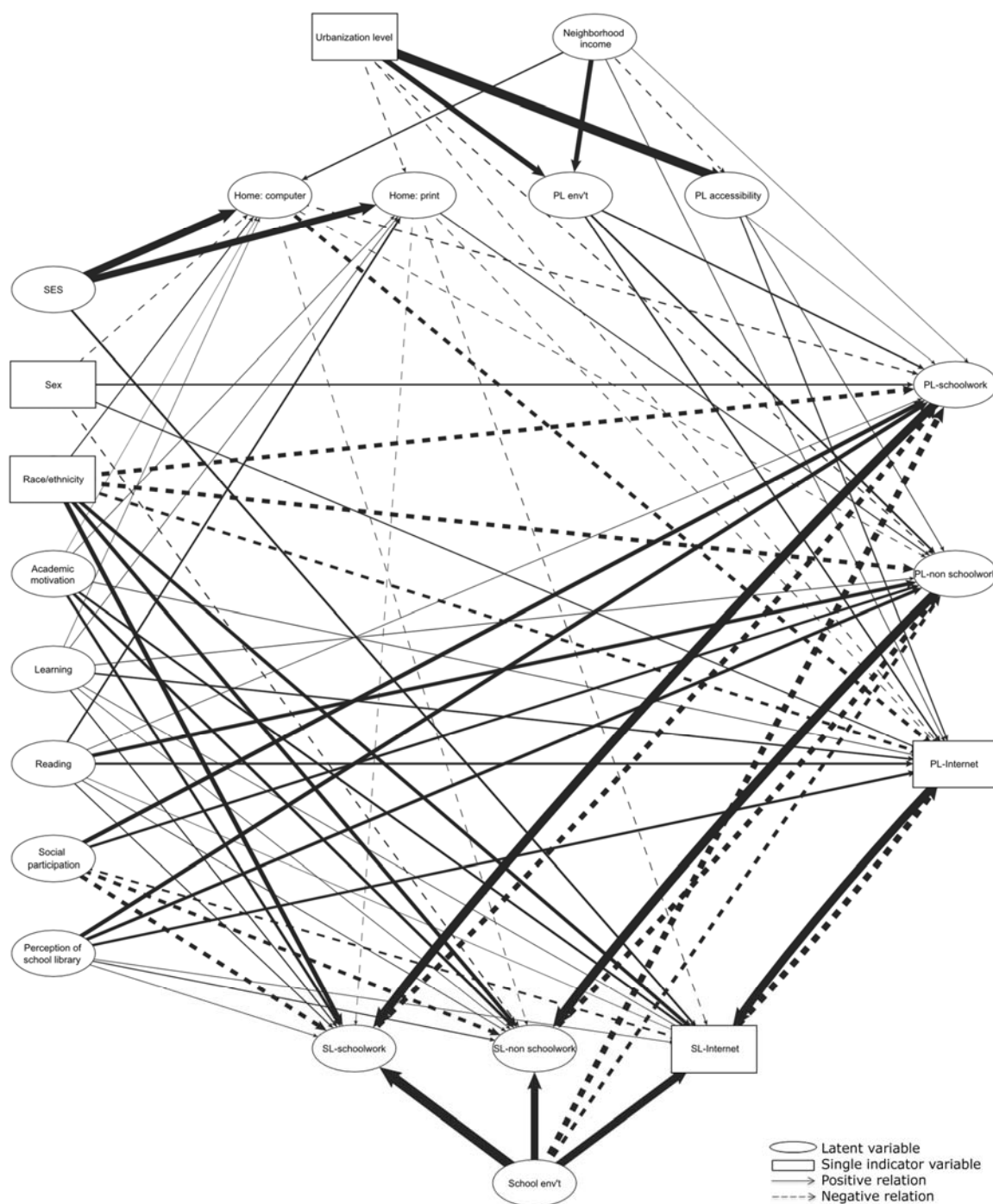*Figure 6.* Final structural model with standardized structural coefficients.

Figure 7. Final structural model (direct effects).

Table 16

Standardized Structural Coefficients for Direct Effects

	Direct effects from									
To	Home comp.	Home print	PL env't	PL access.	SL school work	SL non-school work	SL Internet	PL school work	PL non-school work	PL Internet
SL schoolwork	-0.03	-0.04*	- -	- -	- -	- -	- -	0.61*	- -	- -
SL non-schoolwork	-0.05*	0.00	- -	- -	- -	- -	- -	- -	0.63*	- -
SL internet	0.00	-0.06*	- -	- -	- -	- -	- -	- -	- -	0.58*
PL schoolwork	-0.10*	-0.01	0.12*	0.04*	-0.37*	- -	- -	- -	- -	- -
PL non-schoolwork	-0.06*	0.08*	0.14*	0.06*	- -	-0.38*	- -	- -	- -	- -
PL internet	-0.26*	-0.06*	0.12*	0.09*	- -	- -	-0.45*	- -	- -	- -

* $p < 0.05$

	Direct effects from										
To	Urban.	Neigh. income	SES	Sex	Race/ ethnicity	Motiva-tion	Learn-ing	Reading	Social part.	Percep-tion of lib.	School env't
PL access.	0.64*	-0.09*	- -	- -	- -	- -	- -	- -	- -	- -	- -
PL env't	0.37*	0.34*	- -	- -	- -	- -	- -	- -	- -	- -	- -
Home comp.	0.00	0.11*	0.53*	-0.07*	0.08*	0.03*	0.04*	-0.03	- -	- -	- -
Home print	-0.07*	0.02	0.48*	0.03	0.03	0.05*	0.05*	0.13*	- -	- -	- -
SL schoolwork	- -	- -	0.00	0.02	0.32*	0.19*	0.09*	0.08*	-0.29*	0.05*	0.69*
SL non-schoolwork	- -	- -	-0.03	-0.09*	0.27*	0.20*	0.05*	0.06*	-0.25*	0.08*	0.52*
SL Internet	- -	- -	0.15*	0.03	0.25*	0.16*	0.05*	0.04*	-0.15*	0.05*	0.56*
PL schoolwork	-0.01	0.04*	0.02	0.12*	-0.30*	0.04	-0.01	0.05*	0.30*	0.29*	-0.44*
PL non-schoolwork	-0.09*	0.00	-0.02	0.00	-0.30*	-0.03	0.06*	0.26*	0.18*	0.23*	-0.26*
PL Internet	-0.07*	0.06*	-0.01	0.09*	-0.21*	0.06*	0.12*	0.16*	0.05	0.18*	-0.02

* $p < 0.05$

Table 17 provides the same data as Table 16 - the direct effect of one variable on the other. The

difference is that Table 17 is organized to facilitate the comparison of the direct effect size. Only the

relationships that are significant at the $p < 0.05$ level are presented in Table 16. Predictor variables are

sorted based on the absolute direct effects in descending order.

Table 17

Sorted Direct Effects

	Outcome variable										
	Home comp.			**Home print**			**PL env't**			**PL access.**	
Rank	Predictor	Coef.		Predictor	Coef.		Predictor	Coef.		Predictor	Coef.
1	SES	0.53		SES	0.48		Urban.	0.37		Urban.	0.64
2	Neigh. income	0.11		Reading	0.13		Neigh. income	0.34		Neigh. income	-0.09
3	Ethnicity	0.08		Urban.	-0.07						
4	Sex	-0.07		Motivation	0.05						
5	Learning	0.04		Learning	0.05						
6	Motivation	0.03									

	Outcome variable							
	SL schoolwork			**SL non-schoolwork**			**SL Internet**	
Rank	Predictor	Coef.		Predictor	Coef.		Predictor	Coef.
1	School env't	0.69		PL non-schoolwork	0.63		PL Internet	0.58
2	PL schoolwork	0.61		School env't	0.52		School env't	0.56
3	Ethnicity	0.32		Ethnicity	0.27		Ethnicity	0.25
4	Participation	-0.29		Participation	-0.25		Motivation	0.16
5	Motivation	0.19		Motivation	0.20		SES	0.15
6	Learning	0.09		Sex	-0.09		Participation	-0.15
7	Reading	0.08		Perception	0.08		Home print	-0.06
8	Perception	0.05		Reading	0.06		Learning	0.05
9	Home print	-0.04		Home comp.	-0.05		Perception	0.05
10				Learning	0.05		Reading	0.04

Table 17 (cont'd)

Rank	PL schoolwork		PL non-schoolwork		PL Internet	
	Outcome variable					
	Predictor	Coef.	Predictor	Coef.	Predictor	Coef.
1	School env't	-0.44	SL non-schoolwork	-0.38	SL internet	-0.45
2	SL schoolwork	-0.37	Ethnicity	-0.30	Home comp.	-0.26
3	Ethnicity	-0.30	School env't	-0.26	Ethnicity	-0.21
4	Participation	0.30	Reading	0.26	Perception	0.18
5	Perception	0.29	Perception	0.23	Reading	0.16
6	PL env't	0.12	Participation	0.18	PL env't	0.12
7	Sex	0.12	PL env't	0.14	Learning	0.12
8	Home comp.	-0.10	Urban.	-0.09	PL access.	0.09
9	Reading	0.05	Home print	0.08	Sex	0.09
10	PL access.	0.04	Home comp.	-0.06	Urban.	-0.07
11	Neigh. income	0.04	PL access.	0.06	Home print	-0.06
12			Learning	0.06	Motivation	0.06
13					Neigh. income	0.06

4.6.2 Correlations

The structural model testing also evaluated the correlations between pairs of exogenous variables. The results are presented in Table 18. This study has 11 exogenous variables, and 54 pairs of relations. Presenting these correlation/covariance results with typical SEM graphing conventions (i.e., an arc between each pair of variables) would make the graph difficult to read. For viewing purposes, they are presented in a different way in Fig. 8. The figure only shows statistically significant relations, with the width of the path proportional to the size of the correlation.

Table 18

Correlations among Exogenous Variables

|	Urban.	Neigh. income	SES	Sex	Race/ ethnicity	Motiva- tion	Learn- ing	Reading	Social part.	Percep- tion of lib.
Neigh. income	0.47*									
SES	0.21*	0.43*								
Sex	0.02*	-0.02*	-0.09*							
Race/ ethnicity	-0.32*	0.09*	0.39*	-0.07*						
Motivation	0.05*	-0.04*	0.00	0.28*	-0.21*					
Learning	0.07*	0.10*	0.19*	0.31*	0.01	0.21*				
Reading	0.01	-0.02*	0.01	0.09*	-0.08*	0.18*	0.13*			
Social part.	0.14*	0.22*	0.30*	0.29*	0.03	0.37*	0.32*	0.14*		
Perception of lib.	-0.05*	-0.01	-0.02	0.10*	-0.01	0.23*	0.07*	0.08*	0.20*	
School env't	-0.02*	0.08*	0.03*	-0.06*	-0.17*	0.01	-0.08*	-0.10*	0.37*	0.45*

*p < 0.05
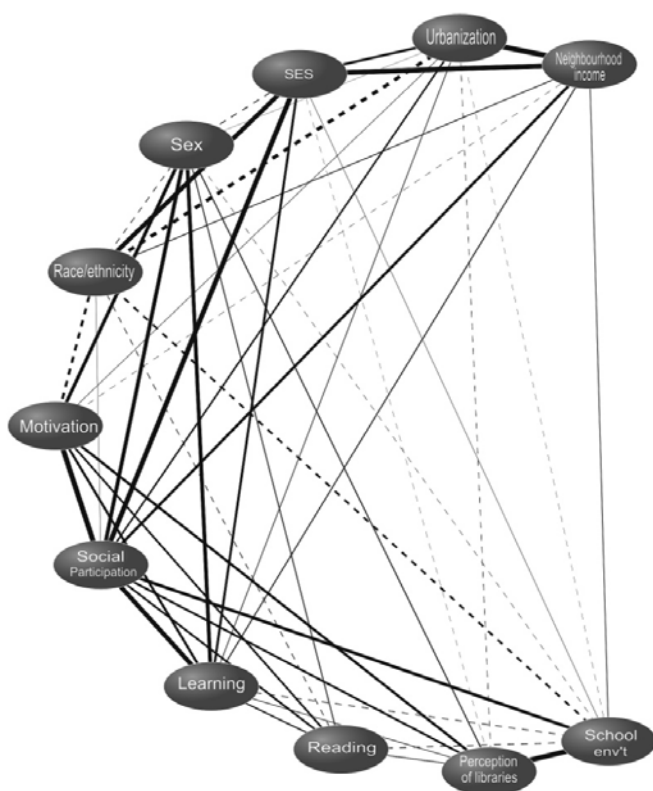
Figure 8. Correlations among exogenous variables.

4.6.3 Total Effects

The above tables present the direct effects of predictor variables on outcome variables, and also the correlation among exogenous variables. With this information, one can also evaluate how a variable indirectly influences an outcome variable. For example, neighborhood income can frequently affect public library use for schoolwork indirectly through its influence on public library accessibility and on the public library environment. The sum of a variable's direct and indirect effects on another variable is the total effect. Table 19 and Fig. 9 present the total effects statistics for the final model. Table 20 presents the absolute total effects in descending order. Only relations that are significant at $p < 0.05$ level are listed.

Table 19

Standardized Structural Coefficients for Total Effects

To	Total effects from										
	Urban	Neigh. income	SES	Sex	Race/ ethnicity	Motiva- tion	Learn- ing	Reading	Social part.	Percep- tion of lib.	School env't
PL access.	0.64*	-0.09*	- -	- -	- -	- -	- -	- -	- -	- -	- -
PL env't	0.37*	0.34*	- -	- -	- -	- -	- -	- -	- -	- -	- -
Home comp.	0.00	0.11*	0.53*	-0.07*	0.08*	0.03*	0.04*	-0.03	- -	- -	- -
Home print	-0.07*	0.02	0.48*	0.03	0.03	0.05*	0.05*	0.13*	- -	- -	- -
SL homework	0.03*	0.03*	-0.05*	0.08*	0.10*	0.17*	0.07*	0.09*	-0.08*	0.18*	0.34*
SL non-schoolwork	0.00	0.02*	-0.05*	-0.06*	0.06*	0.14*	0.07*	0.19*	-0.11*	0.18*	0.29*
SL Internet	0.02*	0.03*	0.01	0.07*	0.09*	0.15*	0.09*	0.10*	-0.10*	0.12*	0.43*
PL schoolwork	0.05*	0.06*	-0.02	0.10*	-0.35*	-0.03	-0.03	0.02	0.33*	0.22*	-0.56*
PL non-schoolwork	0.00	0.04*	0.01	0.03	-0.33*	-0.08*	0.04*	0.21*	0.22*	0.16*	-0.37*
PL Internet	0.03*	0.05*	-0.18*	0.07*	-0.27*	-0.02	0.07*	0.11*	0.09*	0.13*	-0.21*

*p < 0.05

Table 19 (cont'd)

To	Home comp.	Home print	PL env't	PL access.	SL school work	SL non-school work	SL Inter-net	PL school work	PL non-school work	PL Inter-net
						Total effects from				
SL schoolwork	-0.07*	-0.04*	0.06*	0.02*	-0.18*	- -	- -	0.50*	- -	- -
SL non-schoolwork	-0.07*	0.04*	0.07*	0.03*	- -	-0.19*	- -	- -	0.51*	- -
SL Internet	-0.12*	-0.08*	0.06*	0.04*	- -	- -	-0.21*	- -	- -	0.46*
PL schoolwork	-0.07*	0.01	0.10*	0.03*	-0.30*	- -	- -	-0.18*	- -	- -
PL non-schoolwork	-0.03	0.06*	0.11*	0.05*	- -	-0.31*	- -	- -	-0.19*	- -
PL Internet	-0.20*	-0.03	0.10*	0.07*	- -	- -	-0.35*	- -	- -	-0.21*

$*p < 0.05$

4.6.4 Variance Explained By the Final Model

The squared multiple correlation statistics indicate the extent to which the variations in an outcome variable are explained by the variables in the model. This is similar to the R^2 statistics in multiple regressions. For example, the final model explained 40% of the variance in students' home computer/Internet availability. The result for the final model is shown in Table 21.

4.6.5 Summary of Findings

In summary, the finding reveals that information inequality is prevalent. Public library resource and service levels are found to vary with neighborhoods' income and urbanization levels. There is also unequal availability of print and digital resources at the respondents' homes, schools and neighborhood public libraries based on their socio-economic status, race/ethnicity and gender. This research also finds that school information environment, frequency of school library use and race/ethnicity are the top three factors affecting the students' frequency of public library use. Similarly, the top factors

affecting the frequency of school library use are school information environment, frequency of public library use and race/ethnicity. These findings demonstrate that, even after controlling for individual differences, structural factors such as the information resources available at one's immediate environment have significant impacts on an individual's frequency of library use.
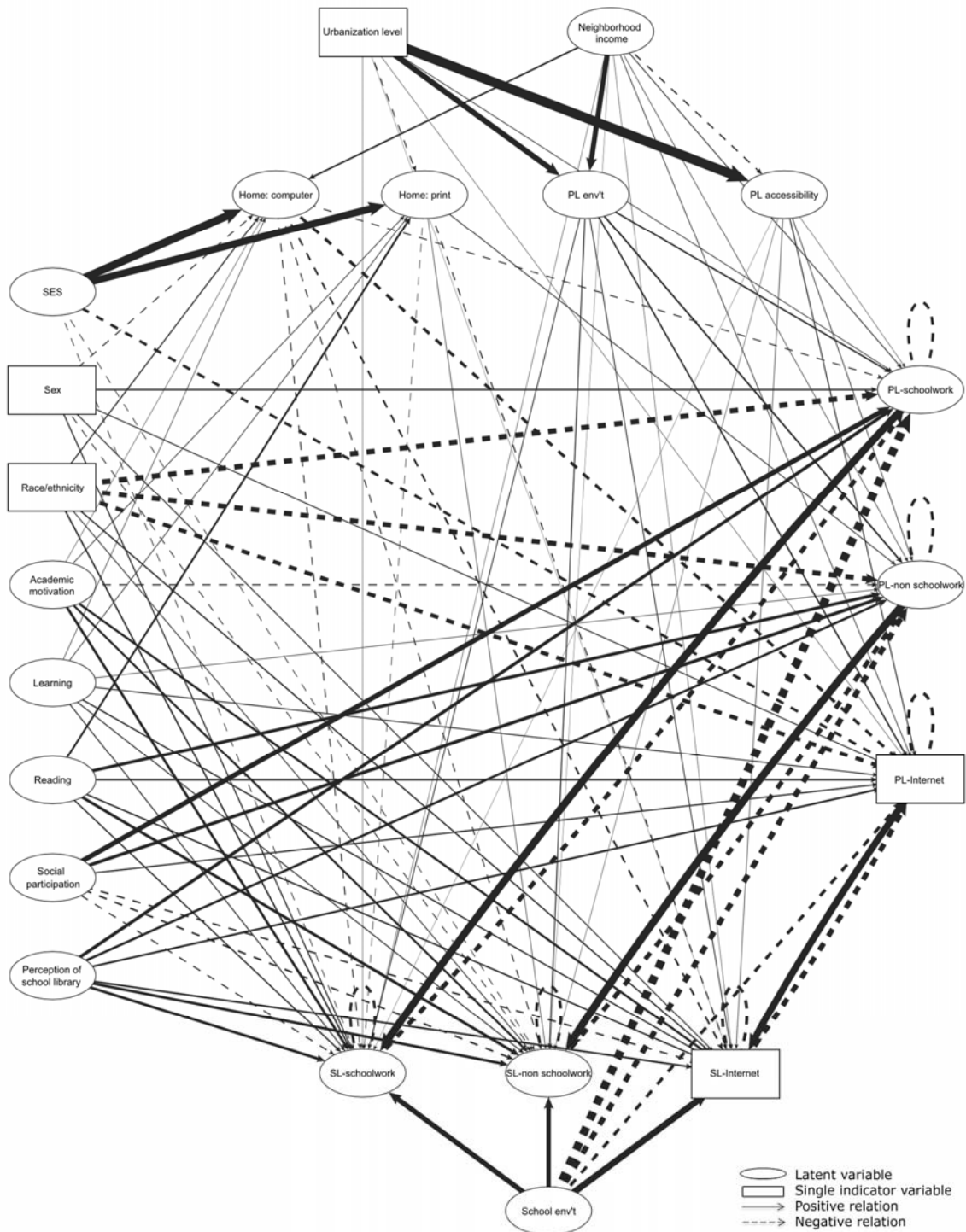
Figure 9. Final structural model (total effects).

Table 20

Sorted Total Effects

	Outcome variable							
	Home comp.		Home print		PL env't		PL access.	
Rank	Predictor	Coef.	Predictor	Coef.	Predictor	Coef.	Predictor	Coef.
1	SES	0.53	SES	0.48	Urban.	0.37	Urban.	0.64
2	Neigh. income	0.11	Reading	0.13	Neigh. income	0.34	Neigh. income	-0.09
3	Race/ethnicity	0.08	Urban.	-0.07				
4	Sex	-0.07	Motivation	0.05				
5	Learning	0.04	Learning	0.05				
6	Motivation	0.03						

	Outcome variable					
	SL schoolwork		SL non-schoolwork		SL Internet	
Rank	Predictor	Coef.	Predictor	Coef.	Predictor	Coef.
1	PL schoolwork	0.50	PL non-schoolwork	0.51	PL Internet	0.46
2	School env't	0.34	School env't	0.29	School env't	0.43
3	SL schoolwork	-0.18	SL non-schoolwork	-0.19	SL Internet	-0.21
4	Perception	0.18	Reading	0.19	Motivation	0.15
5	Motivation	0.17	Perception	0.18	Home comp.	-0.12
6	Race/ethnicity	0.10	Motivation	0.14	Perception	0.12
7	Reading	0.09	Participation	-0.11	Participation	-0.10
8	Participation	-0.08	Home comp.	-0.07	Reading	0.10
9	Sex	0.08	Learning	0.07	Race/ethnicity	0.09
10	Home comp.	-0.07	PL env't	0.07	Learning	0.09
11	Learning	0.07	Sex	-0.06	Home print	-0.08
12	PL env't	0.06	Race/ethnicity	0.06	Sex	0.07
13	SES	-0.05	SES	-0.05	PL env't	0.06
14	Home print	-0.04	Home print	0.04	PL access.	0.04
15	Neigh. income	0.03	PL access.	0.03	Neigh. income	0.03
16	Urban.	0.03	Neigh. income	0.02	Urban.	0.02
17	PL access.	0.02				

Table 20 (cont'd)

	PL schoolwork		**PL non-schoolwork**		**PL Internet**	
			Outcome variable			
Rank	Predictor	Coef.	Predictor	Coef.	Predictor	Coef.
1	School env't	-0.56	School env't	-0.37	SL Internet	-0.35
2	Race/ethnicity	-0.35	Race/ethnicity	-0.33	Race/ethnicity	-0.27
3	Participation	0.33	SL non-schoolwork	-0.31	School env't	-0.21
4	SL schoolwork	-0.30	Participation	0.22	PL Internet	-0.21
5	Perception	0.22	Reading	0.21	Home comp.	-0.20
6	PL schoolwork	-0.18	PL non-schoolwork	-0.19	SES	-0.18
7	Sex	0.10	Perception	0.16	Perception	0.13
8	PL env't	0.10	PL env't	0.11	Reading	0.11
9	Home comp.	-0.07	Motivation	-0.08	PL env't	0.10
10	Neigh. income	0.06	Home print	0.06	Participation	0.09
11	Urban.	0.05	PL access.	0.05	PL access.	0.07
12	PL access.	0.03	Neigh. income	0.04	Sex	0.07
13			Learning	0.04	Learning	0.07
14					Neigh. income	0.05
15					Urban.	0.03

Table 21

Variance Explained

	Outcome variable									
Model	**Home comp.**	**Home print**	**PL env't**	**PL access.**	**SL home-work**	**SL non-home-work**	**SL Internet**	**PL home-work**	**PL non-home-work**	**PL Internet**
Final model	40%	27%	37%	36%	23%	20%	26%	35%	25%	21%
Without neighborhood and information env't variables					14%	12%	13%	15%	15%	16%
SES, sex, and ethnicity only								12%	8%	13%

5. DISCUSSION AND CONCLUSION

This chapter discusses the study's findings and their theoretical and practical implications. The
limitations of the study will then be examined and future studies identified.

5.1. Empirical Findings

This section is structured in correspondence with the research questions identified in section 1.3. The
overarching goal of this research is to evaluate the applicability of the *Person-In-Environment* (PIE)
conceptual framework and its usefulness in understanding information behavior and information
inequity. This is conducted by testing the empirical model of 12th-graders' public library use, which
has been developed based on the PIE framework. Four research questions are raised with respect to the
empirical analysis, and they are first addressed below. The applicability of the PIE framework will
then be assessed in section 5.2.

5.1.1 Macro-Meso Linkage

RQ1: What are the relationships between the structural factors, that is between the macro-societal
factors (e.g., socio-economic environment) and meso-institutional factors (e.g., resource and service
levels of the neighborhood public library)?

The empirical model indicates significant relations between the macro and the meso factors. It reveals
widespread structural inequality in the distribution of information resources based on urbanization and
neighborhood income levels. Public libraries in urban neighborhoods are likely to have more resources
compared to their rural counterparts, as are libraries in higher income neighborhoods when compared
to those in lower income neighborhoods. The effect of urbanization level is slightly stronger than the
effect of neighborhood income in this study. As urbanization level is found to be positively correlated

with neighborhood income (correlation coefficient = 0.47), rural libraries are likely to be doubly-disadvantaged. The finding is disquieting as rural areas may already lack amenities, such as a community technology center, that could provide extra access to information and computer resources (Boris, 2005; Flatley, 2001).

This finding on the uneven distribution of library resources agrees with early national studies such as L. R. Wilson's (1938), a recent multivariate nationwide study by Sin (2008), case studies by Loreto & Tse (1999) and Neuman & Celano (2001), and personal account by Hall (2007). The fact that this disparity has been observed for some time and in different types of studies provides evidence that this inequality is ingrained and prevalent. Studies suggest that the current public library funding mechanisms have in part perpetuated this unequal distribution of library resources. A majority of the public library systems rely on local government funding (Chute, 2006). For the 2004 fiscal year, on average, 76.6% of the public library funding came from the local government (Sin, 2009). Scholars in public finance have pointed out that reliance on local government funding has the potential drawback of higher inequalities. This is because variations in local government revenue capacity often lead to varying levels of public services provision (Bennett, 1980; Warner, 2006). In the case of public library funding, libraries in lower income neighborhoods in general did receive a slightly higher per capita funding from State and Federal governments. However, since State and Federal monies only constitute a small portion of public libraries' total funding, the amount was not enough to equalize the funding gap across library systems (Sin, 2009). Active and large-scale interventions have to be taken to break this inequality pattern.

The current study also explored the differences in public libraries' accessibility. As expected, public libraries in urban areas are more accessible than those in rural areas in terms of physical distance. *Ceteris paribus*, libraries in higher income neighborhoods are slightly less accessible than those in

lower income neighborhoods. An explanation is that some of the higher income neighborhoods, such as those in the suburbs, may be less densely populated and have buildings more spread out. While the current model has controlled for urbanization level, it is possible that areas that are considered one hundred percent urbanized may still vary in densities. Future studies may consider introducing measures of population and spatial densities to test this hypothesis.

Furthermore, this study represents public libraries' physical accessibility using the oft-used measures of Euclidean distance (i.e., the straight-line distance between two points) (Jue et al., 1999; Shoham, Hershkovitz, & Metzer, 1990). One may also consider measures of accessibility in terms of time required to travel to the public library. An ideal situation is to collect travel time data for different transportation modes. This is because individuals in higher income neighborhoods may have better access to private means of transportation. Lower income individuals in lower income neighborhoods may have to rely on walking or the public transportation system. It is possible that while the physical distance to the library is shorter for those in a lower income neighborhood, it may still take them longer to reach the library.

Data collection issues may hinder incorporation of such time measures, however. It is possible to collect a respondent's estimation of distance to the public library in terms of travel time. Researchers have to take into account, however, that library non-users' estimations may be less precise than those from library users. This will still be a valuable variable in terms of gauging an individual's perception and relationship to the library, but, ideally, an external measure of travel time should also be included. At the moment, this is more costly to collect, but it is not impossible. Estimation of travel time can be obtained through GIS network analysis and through examination of the public transportation systems' routes and schedules. For studies that focus on a particular community, researchers may be able to try out the routes and measure the travel time by themselves. Including travel time may soon become

more feasible, as these data (such as estimations of walking time for some locations) are increasingly available through free web services such as Google Map (Google, 2009).

5.1.2 Macro-Meso-Micro Linkage

RQ2: What are the relations between structural factors and individual characteristics?

Structural inequality is evident not only in the distribution of resources across public library systems, but among individuals as well. This study shows that students in lower SES households face lower level of resources in various information environments. Lower SES students are substantially more likely to have less computer/Internet resources at home (standardized coefficient = 0.53). This finding coincides with the data from the Current Population Survey (CPS) October 2003 Internet and Computer Use Supplement (Day, Janus, & Davis, 2005) and a survey of children and youth by the Kaiser Family Foundation (Roberts, Foehr, & Rideout, 2005). The current multivariate study further demonstrates that this relation holds even when other factors are held constant. In addition, this study finds that lower SES students are also likely to have fewer print resources at home (standardized coefficient = 0.48). This is an area not examined in the aforementioned studies.

Adding to the problem is that lower SES students are also substantially more likely to be living in lower income neighborhoods, which tend to have public libraries with fewer resources. In addition, they are also likely to be attending schools that have lower levels of information resources. It is alarming that lower SES students tend to find themselves experiencing an inferior information environment - at home, in their neighborhood, and in their school as well. Such inequity is unfortunate, particularly at a peak time of learning when students are building a foundation for their further education and career. Such prevalent inequity needs to be addressed.

Race/ethnicity and information environment exhibit a slightly more complex relationship. In terms of direct effects, ethnic minorities are likely to have fewer computer/Internet resources at home. This finding is also consistent with Day et al. (2005) and Roberts et al. (2005). This study finds, on the other hand, that the relationship between ethnicity and home print resources is not statistically significant. Another small comfort is that when other variables are held constant, ethnic minority students are slightly more likely to be in a school with a better information environment. Nevertheless, minority students tend to be living in lower SES households and also in lower income neighborhoods. Thus, minority students are still likely to face a lower quality information environment than their Caucasian counterparts.

A limitation of this study is that students' race/ethnicity was classified as either Caucasian or non-Caucasian. Information about each student's specific ethnic background was not included in the analysis, as SEM is not suitable for the study of nominal variables. While multivariate SEM analysis of ethnic groups is not available in this study, descriptive data can provide some preliminary insights (Fig. 10). Similar to the CPS and the Kaiser Family Foundation survey reports (Day et al., 2005; Roberts et al., 2005), this study's descriptive data show that Asian, Hawaii/Pacific Islander and Caucasian respondents have more access to a computer and the Internet at home than the other ethnic groups. What is not highlighted in the aforementioned reports is the computer availability of American Indian/Alaska Native (hereafter, *Native American*) respondents. This study finds that among the different ethnic groups, Native American respondents have the lowest access to a home computer, and the second-lowest home access to the Internet.

The descriptive findings highlight the need to collect more data about the information environment of Native Americans. Surveys often do not systematically collect data of Native Americans (and to a certain extent, Asian Americans). This is partly due to their smaller population size. Based on data that

are available, researcher suggests that Native Americans, particularly those living on Indian reservations, face more barriers in information access (Burke, 2007; Patterson, 1995). About 25% of Native Americans live below the poverty line, a much higher rate than non-Hispanic Whites (10%) (U.S. Census Bureau, 2007). Data from the 2000 Census also show that about 11.88% of households that are headed by Native Americans do not have telephone service. The number for households that are headed by Caucasians is only 1.81% (U.S. Census Bureau, 2000). This substantial disparity in access to fundamental communication infrastructure is alarming. We need to collect more data and conduct further studies to draw attention to the information inequity facing the Native American population.

This study's descriptive data also indicate that the pattern of print resource availability differs from that of computer availability. As discussed above, Native American respondents have less access to home computer resources than students of other ethnic groups. On the other hand, Hispanic respondents are less likely to have sizable print collections at home when compared to the other ethnic groups (Fig. 10). This difference underscores the need to survey print resource availability at home, as statistics on this aspect are rarer than statistics on digital or multimedia resources at home.
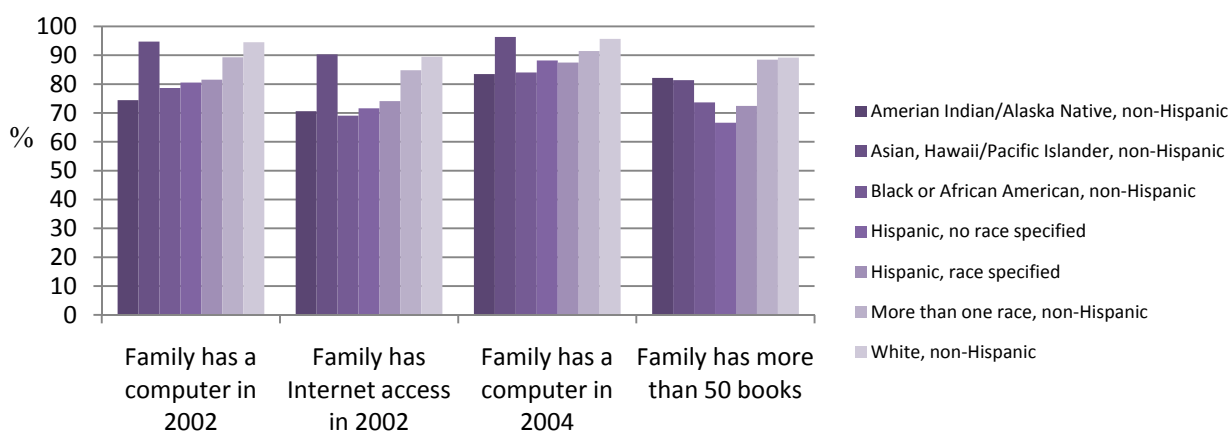

Figure 10. Home information environment by ethnic groups.

The relation between gender and home computer availability is rather elusive to determine, as extant data vary. Based on both the multivariate analysis result and the descriptive statistics, this study finds that female 12th-graders are likely to have fewer computer/Internet resources at home. The finding is different from the Kaiser Family Foundation survey discussed above (Roberts et al., 2005). Their survey included 2,032 respondents aged 8-18, and it found no descriptive gender difference in home computer and Internet availability. For children aged 3-17, the CPS October 2003 survey found a slightly higher percentage of females with access to a home computer (Day et al., 2005).

To identify data that are more comparable to this study, this researcher examined the same CPS Oct. 2003 survey (U.S. Census Bureau, 2009).[17] For this group, a larger percentage of females had no computer at home. This agrees with the findings of the current study. For example, 7.3% of this study's female respondents reported no home computer in 2004. The figure for male respondents with no home computer was 6.9%. There is a net difference of 0.4%. For the CPS 2003 data, the gender difference is even wider at 0.8%. Statistics about other population groups also show similar differences. The CPS 2003 data for those aged 18 or older indicate a large share of female respondents without home computers. The Pew Internet & American Life Survey shows that a higher percentage of the male respondents than the female respondents have broadband internet access at home (57% vs. 52%) (Fox & Vitak, 2008).

While the data vary, it seems that for the younger generation, the gender difference in home computer access, at least in terms of availability, may be closing as some have suggested. This is based on the

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[17] Ideally, CPS 2004 data would have been the most suitable for comparison, but the computer supplement was not used in 2004. Thus, data from children who were 11th-graders in the CPS Oct. 2003 survey were examined, as a majority of them became 12th-graders in 2004.

aforementioned findings: studies that include younger children tend to find no difference, while

studies that include older youth or adults tend to find females with fewer computer resources at home.

A larger scale study will be needed to test this observation.

Although the gender gap in home computer availability may be narrowing, one cannot ignore the still

complex relations between gender and technology. Women are still significantly underrepresented in

science and engineering occupations (National Science Foundation, 2008). Their representation rate in

education and occupations related to computer science is especially low. In 2006, for example, girls

constituted 56% of the students taking the Advanced Placement (AP) exams. However, girls

constituted only 15% of all computer science exam-takers (National Center for Women & Information

Technology, 2007). With respect to this study's finding, worth noting is that home computer

availability does not necessarily mean that the computer is equally accessible to every member of the

household. A study of undergraduates in the UK shows that 49% of the female respondents do not

have priority in using the computers at home. None of the male students in that study report this lack

of priority access (Gunn, McSporran, Macleod, & French, 2003). Besides computer accessibility,

computer ownership will also be an aspect worth studying in the future. The Kaiser Family Survey

mentioned above finds that more boys have their own computers (35%) compared to girls (26%).

There is still a considerable need to illuminate the influence of computer accessibility, learning

opportunities, gender stereotypes, socialization, and cultural values on an individual's use of

information technology.

5.1.3 Macro/Meso Factors and Micro Behavior

RQ3: What are the structural factors that are related to the individual's use of public libraries, and to what extent are they related?

One of the main goals of this study is to advocate the inclusion of structural factors in information behavior research. This study finds structural factors do exert significant influence on an individual's library use. The findings offer evidence that inclusion of such factors is indeed beneficial.

School information environment is one of the most significant factors in the model. The standardized structural coefficients indicate that school environment is among the top two factors affecting students' use of school library for schoolwork, non-schoolwork and Internet access. Better school environment contributes to higher frequency of school library use. What is more interesting is its equally strong impact on public library use; poorer school environment leads to higher frequency of public library use. The frequency of school library use is sometimes included in public library studies (Agosto et al., 2007). The effect of school environment, however, has seldom been studied. This research helps to address this gap.

In terms of students' use of public libraries for their schoolwork, this study reveals that school environment has the strongest impact. It is also the third strongest variable in terms of students' public library use for non-schoolwork. *Ceteris paribus*, a lower level of school environment is associated with higher frequency of public library use. An interpretation of this finding is that, when a school has fewer information resources, it cannot completely meet the students' needs. Students may turn to other places such as their home or public libraries for additional materials. As discussed above, students in higher SES households have more print and computer resources at home; they may be able to resolve their information needs with those materials. Students with fewer information resources at home, on

the other hand, may have a higher need to seek extra materials provided by the public library. This study shows that students do turn to public libraries when there are fewer resources available at their school. From the public library's perspective, this finding is encouraging. It indicates that public libraries are complementing school libraries and are helpful in serving the student population. From the students' perspective, however, simply based on the location, using the public library may be less convenient than using the school library. The fact that some students need to seek additional (and likely less convenient) resources outside of schools suggests that the disparity in the distribution of school resources also needs to be resolved.

Since the school environment is found to be highly influential, there is a strong need for assessing the magnitude and pattern of information resource inequity across the nation's schools and school libraries. A 1997 national survey of school libraries funded by the Department of Education found that about one-third of respondents felt that their collections were inadequate (J. Michie & Chaney, 2000). Large scale surveys, such as the Schools and Staffing Survey (National Center for Education Statistics, 2009b) and the Library Statistics Program's surveys of school libraries (National Center for Education Statistics, 2009a), offer a glimpse of the disparities in school libraries. Data from 2000 show, for example, that not all schools have a library. While 91.6% of public schools have a library, the figure for private schools was a rather alarming 62.6% (Holton et al., 2004). It would be beneficial to conduct more in-depth analysis, such as inferential testing. This would help identify whether the resource variations are disproportionately affecting certain types of student populations.

Public library environment also exhibits moderately strong, positive effects on all three types of public library uses. It ranks the 6th and 7th among the factors in the model. Previous research at the household level indicates that public library service level is positively associated with higher use of public

libraries (Hemmeter, 2006; Sin & Kim, 2008). This study provides stronger support; it shows that this positive relation remains strong, even after individual differences have been taken into account.

This finding has significant implications for public library planning. One of the oft-raised issues in public library management is, "If we build it, will they come?" Policy makers are interested in ascertaining whether lower use by selected groups can be changed with an increase in library service levels. The fear is that individuals will not be responsive to an increased service level, and the funding spent will be wasted. This question is particularly pressing in time of budget shortfall. This study offers empirical evidence that raising the public library service levels is likely to make a positive difference.

Earlier literature on information poverty suggests the lower frequency of information use was related to an individual's characteristics such as lower cognitive ability (Childers & Post, 1975). The current study highlights that lower use is not simply a matter of individual ability or disposition. Structural inequity plays a role. Lower level of public library services, for example, can depress public library use. Given that the study also finds prevalent structural inequity disadvantaging those in lower income households or neighborhoods, this researcher recommends that a higher portion of resources be devoted to public library systems in disadvantaged locations.

This author personally believes that the principles of social justice alone should suffice in recommending more resources for library systems in disadvantaged areas. Researchers such as Jue and colleagues (1999) and Japzon & Gong (2005) also expressed similar views. This view is not universally agreed upon, however. In the United States, there are some resistances against providing help to the disadvantaged, particularly if the assistance comes from the government. For example, when the Pew Research Center asked in 2007 whether "poor people today have it easy because they

can get government benefits without doing anything," 35% of the respondents agreed. Only about 54% of the respondents agreed with the statement that "the government should help more needy people even if it means going deeper into debt." These responses are already considered a more favorable view toward helping those in need, when compared to the data from the 1990s (Morin & Neidorf, 2007). It is hoped that this higher willingness to help will provide the support to tackle the inequity in information provision. The current economic downturn may mean that fewer resources are available for services such as the public library, however. LIS professionals may need to devote more efforts to convincing the public and the funding agencies that public libraries are essential to their communities. Research such as this study can provide empirical evidence regarding the impacts and differences that public libraries make. More of such research is needed to help improve public library services for disadvantaged groups.

Although views on social justice vary, investing extra resources in disadvantaged areas can be beneficial in an economic sense. The "law of diminishing marginal utility" is an established theory in economics ("Diminishing marginal utility," 2006). It postulates that as an individual obtains more and more quantities of a resource, an additional unit of the resource will provide less and less utility (i.e., value, satisfaction). To give an example, a bowl of soup will yield high satisfaction for someone who is hungry. But when the same individual has already eaten ten bowls of soup, eating an additional bowl of soup would not yield as much satisfaction as the previous bowls. Along this line, providing an additional unit of funding to less funded library systems should offer a higher utility than providing the same unit of funding to those systems that already have a large amount of resources. Future studies can be conducted to test this hypothesis. This may be done by focusing on the interaction effects. One can examine whether the same unit of funding increase contributes to differential increases in library use among library systems with different level of resources and services and among individuals with different characteristics.

An increase in public library accessibility also has positive effects on all three types of public library use (i.e., for schoolwork, non-schoolwork and Internet access). The effect is relatively weaker than other information environment variables. It ranks the 10th, 11th, and 8th among the variables. Accessibility is often found to be an important factor in an individual's selection of information sources (Fidel & Green, 2004; R. M. Harris & Dewdney, 1994; Leckie, Pettigrew, & Sylvain, 1996). A recent nationwide study also finds distance to the nearest library as the second highest factor affecting public library use/non-use at the household level (Sin & Kim, 2008). One explanation for the slightly weaker effect of accessibility in this study is the difference in survey populations. Students are in general more likely than other populations to be public library users (Campbell & Metzner, 1950; C. H. Kim & Little, 1987). They may embody two mechanisms contributing to the relatively lower impact of accessibility on public library use. First, students may have more concrete need for using the libraries as they have to complete their schoolwork. When there is a strong and definite need, issues such as accessibility may become less crucial. For example, this research finds that accessibility has less influence on the use of public libraries for schoolwork than on the use of public libraries for other purposes. The direct effect coefficient of accessibility on library usage for schoolwork is 0.04. For non-schoolwork and Internet use (which may be less essential), the coefficients are 0.06 and 0.09, respectively. Second, students have relatively more free time than working adults. A lower time cost may help lessen the inconvenience caused by lower physical accessibility. Along this line, this author hypothesizes that structural barriers may have a stronger impact on other groups than on students. More studies can be conducted for different user groups to evaluate this hypothesis.

Home information resource also has significant impact on individual information behavior. There has been considerable interest in identifying the influence of home computer/Internet access on public library use. This study suggests that home computer access does contribute to a lower level of public library use for schoolwork, non-schoolwork and Internet access. This finding coincides with what was

found in D'Elia et al. (2007). In addition, this research reveals that computer/Internet access at home also contributes moderately to a lower level of school library use for non-schoolwork. This may partly be attributed to changes in the students' leisure activities (Roberts et al., 2005). Students may be more interested in computer-related activities, for example, in playing computer games or in using social networking websites (Lenhart et al., 2008; Lenhart & Madden, 2007).

The competing effect between home information environment and library use is not limited to computer resources. A higher level of print resources at home is also associated with a lower level of school and library use in general. This suggests that having more information resources at home can reduce the need for seeking additional resources or leisure activities from libraries. The exception is that high level of print resources at home is related to higher level of public library use for non-schoolwork purpose. This study has controlled for the students' reading outside of school. Thus, the availability of home print resources may reflect an interest not only in reading, but also in library related activities such as library programs.

5.1.4 Micro Factors and Micro Behavior

RQ4: What are the individual characteristics that are related to the individual's use of public libraries, and to what extent are they related?

Many individual variables are found to be statistically significant in influencing the frequency of public and school library use. The following discussion will focus on the top variables, namely school and public library use, race/ethnicity, social participation and academic motivation.

School library use is one of the most significant factors in influencing public library use. High level of school library use is associated with low level of public library use. This suggests that to a certain

extent, the school library may be the preferred option, while the public library is supplementing school library use. The descriptive data show, for example, that students tend to use the school library more frequently than the public library for all types of activities. This is not to say that the public library is inferior. This is to note that as students spend most of their time at school, the school library is more convenient to access than the public library (Abbas, Kimball, Bishop, & D'Elia, 2008; Clabo, 2002). The result should not be interpreted as that school library use leads to non-use of public libraries.

While school library use has a negative effect on public library use, public library use has a positive effect on the use of school library. That is, high frequency of public library use is associated with high frequency of school library use. It is interesting that these two variables influence each other in different directions. As this bi-directional effect is rarely studied, more research is needed to conclude if this is a common pattern.

A tentative interpretation is that there is a difference between one's need for using the library and one's interest in using it. Part of the students' school library use may be mandatory, as students may be assigned to use the library during school hours. In addition, when definite information needs arise, students may turn to the library in proximity - the school library - to satisfy the information needs. Using a library to resolve a definite need is more finite. Once a particular need is fulfilled, there is no need to continue the library use until another need arises. This may partly explain the competing relationship between school and public library usage discussed above. That is, if the school library that is more accessible can be used to resolve one's needs, there is no reason for the person to turn to the public library. If the library is used for pursuing one's strong interest, however, it is unlikely that the library use will completely terminate one's interest. Therefore, such library use would not have a negative effect on the use of other libraries to further pursue the said interest. Furthermore, if the experience is positive, one may be encouraged to conduct the same activities at different types of

libraries. Public library use is more optional and voluntary. Thus, the frequent use of public library may be a better indication of one's strong interest in library-related activities than the use of a school library does. This may offer one explanation of why higher frequency of public library use predicts a higher frequency of school library use but not vice versa.

Another substantially significant variable affecting library use is race/ethnicity. Extant studies on the effects of this variable have yielded conflicting results. Several recent studies, nevertheless, find it to be significant (Hemmeter, 2006; Japzon & Gong, 2005; Kimball et al., 2007; Sin & Kim, 2008). What is a bit surprising in this study is the variable's strong effect. Race/ethnicity turns out to be among the top three factors influencing all types of school and public library use. When all other factors are held constant, Caucasian students use their school library more frequently than ethnic minority students do. On the other hand, ethnic minority students use the public library more often than their Caucasian counterparts.

As noted earlier, data about students' specific ethnic background are not included in the SEM analysis because of its nominal nature. An examination of the descriptive data shows that on average, Hispanic students use their school library less frequently than those of the other ethnic groups. This lower usage cannot be simply construed as a lower level of interest in information or libraries. This is because Hispanic students' average use of the public library is similar to other minority groups' usage and higher than the Caucasian students'. As race/ethnicity is found to be influential, future multivariate studies are needed to examine the differences among ethnic groups. It would also be beneficial to conduct a SEM analysis for each of the major ethnic groups (including African Americans, Asian Americans, Hispanics, and Native Americans).

In a similar vein, this multivariate analysis result shows that female students use the public library more frequently than male students, particularly for schoolwork and Internet access. Male students are more likely than female students to use their school library, especially for non-schoolwork. In summary, the dominant ethnic or gender groups (i.e., Caucasians, males) tend to use the more accessible school library frequently, while minority groups (i.e., ethnic minorities, females) use the relatively less convenient public library. This potential power differential is worth further investigation; several variables can be tested and they are identified below.

With regard to race/ethnicity, an area to examine is the high school tracking system and the students' curriculum. Studies suggest that ethnic minorities, especially Hispanic and African American students, are less likely to be placed on the college preparation track (Oakes, 1990). This often leads to a less academically rigorous curriculum. Many scholars have highlighted that such tracking systems affect the resource distribution within schools and among tracks. It contributes to differential learning opportunities and can adversely affect the academic achievements of students in the vocational track (Gamoran, 1987; Oakes, 1990). With respect to school library use, a rigorous curriculum may include more assignments requiring the use of the school library (Contreras & Lee, 1990).

Also worth studying is whether information literacy training is included in the curriculum. The importance of information literacy is increasingly being emphasized (American Association of School Librarians, 2007; American Library Association & Association for Educational Communications and Technology, 1998). Nevertheless, there are considerable variations in information literacy standards across states and schools (F. J. Harris, 2003). Schools also vary in funding, trained staff, and facilities available for providing literacy training (Strizek, Pittsonberger, Riordan, Lyter, & Orlofsky, 2007; The Education Trust, 2008). Such differences in curriculum and required learning activities can directly influence the frequency of school library use. The differential use of library for coursework can have

an indirect impact on the student's familiarity with the library. This can subsequently affect the student's skills in, and propensity of, using libraries for both school and non-schoolwork (Adkins & Hussey, 2006; Haras, Lopez, & Ferry, 2008). We must begin to critically evaluate whether the current education systems and curricula inadvertently widen the gap in information literacy among students, as this would perpetuate the information divide.

With respect to the differential library use by gender and ethnicity, the culture and environment of the libraries are important areas to study. The current study has controlled for students' perceptions of the helpfulness of the school library staff. Better perception has a positive effect towards both school and public library use. The correlation statistics show that female students have a more positive perception of the library. This finding agrees with previous studies (Agosto et al., 2007). The correlation between ethnicity and perception is not statistically significant. Future studies may need to consider adding more individual level variables measuring the students' perception about different aspects of the library environment. One can also add more structural variables related to culture and values, such as the library's openness to diversity and the relevancy of materials and services to minority students.

Recently, public libraries have engaged in more effort to encourage cultural diversity and sensitivity (Josey & Abdullahi, 2002; Nelson, 2008). A study of Latino college students, for example, suggests that respondents see the public library as more culturally relevant to them than the academic library (Adkins & Hussey, 2006). The current findings on the higher frequency of public library use by minorities may reflect that the public library has achieved some level of success in providing a welcoming environment and useful services for the minority groups. Literature on school librarianship also shows an interest in promoting multiculturalism, especially through multicultural literature (Agosto, 2001; Corona & Armour, 2007; Latrobe & Laughlin, 1992). Whether students hold similar

views about the school libraries' cultural relevancy and diversity is worth examining. More efforts to cultivate sensitivity toward minority groups in all types of libraries should be encouraged.

Social participation is another significant variable in this study. Previous public library studies of adults suggest that active social participation, such as participation in community services, is correlated with higher library usage (Bolton, 1982; D'Elia, 1980; Madden, 1979; Westin & Finger, 1991; Zweizig, 1973). This study finds similar positive relations with 12th-graders' use of public libraries for schoolwork and non-schoolwork. Interestingly, social participation has a significant, but negative, impact on the frequency of school library use. Perhaps the amount of time devoted to service related extra-curricular activities lead to a decrease in time available for visiting the school library. Academic motivation, on the other hand, has a positive impact on the frequency of school library use. Worth highlighting is that academic motivation was not a significant factor in the frequency of public library use for schoolwork. This may be interpreted as that while in some cases school and public libraries can substitute each other, there is still a level of differentiation. Students do use both the school and public libraries for their schoolwork and non-schoolwork. Nevertheless, it seems that the school library use still reflects a stronger academic purpose, while public library use may include a more social component.

In lights of this potential differentiation, a follow-up question is raised: To what extent does the public library satisfy the students' academic needs? As discussed earlier, students with lower levels of home and school information environments are likely to use the public library for their schoolwork. While public libraries seek to better serve students' academic needs, they also have to serve a wide variety of user groups (J. Michie & Chaney, 2000). It is natural that the public library collections will not be as focused on students as a school library would. Further research needs to be conducted to survey students who use public libraries for schoolwork, particularly those who have a low quality school

environment. The studies can examine the extent to which the respondents feel their academic needs are satisfied. This author hypothesizes that interlibrary loan services and the Internet may in part help address the limitation posed by a library's physical collection. It has to be noted, however, that the quality of Internet access varies across public libraries (Bertot et al., 2007). In addition, a public library's access to electronic journal subscription, a resource that may be of particular use to the high school student, is widely unequal (Gini coefficient = 0.98 where 1 indicates complete inequality) (Sin, 2008). The implication is that while the public library may serve some of the academic functions of a school library, it may not be a perfect substitute. Efforts to improve students' information environments are not completed unless the inequity in the school information environment is also being tackled.

5.2 Applicability of the PIE Framework

As discussed in chapter 2, one of the barriers in conducting information behavior research is the difficulty in applying extant conceptual frameworks. The results from this empirical analysis demonstrate that the PIE framework is applicable. Using the PIE framework, this study helps reveal the pattern of information inequity across neighborhoods and among students. It provides empirical evidence that structural factors do make a difference even after accounting for individual differences. The PIE framework can contribute to both information behavior and information inequity research.

The theoretical implication for LIS research is that there is a need to identify the extent of information inequity in all types of environments. Researchers need to examine an individual's information resources in his/her home, school, workplace, and community. In addition, our field should be alerted that traditional media and resources are still unevenly distributed. Our focus cannot be cast solely on the digital divide. Even the public library, an institution seen as the key to bridging the information gap, has been experiencing markedly uneven funding and resource distribution. The disparities in

public and school library funding and service provisions must be highlighted and addressed. Income inequality is widespread (Mishel et al., 2006). This can further widen the information gap between the haves and the have-nots. Such inequity will persist unless systematic efforts are taken to remedy the situation. LIS scholars can aid in these efforts by revealing the magnitude and pattern of information inequity and by advocating for changes toward equity.

This study demonstrates the need to fully integrate structural factors into information behavior research. While we acknowledge individuals' agency in constructing their own view of the world, at the same time, there is a need to recognize that individuals do not go about their daily life in a vacuum. External environment can still play a role in affecting individual's behavior. Including information environment factors would allow researchers to better evaluate the potential barriers in service provision and the power structure of the society. This can help avoid situations where individuals are perceived as bad users, and help ensure that the actual barriers are identified and tackled (R. M. Harris & Dewdney, 1994). Therefore, an appreciation of the constructivist epistemology and the use of emic/participants' measures need not preclude the inclusion of etic/observer measures of the environment. Many disciplines such as education, sociology and health sciences are increasingly interested in integrating individual and structural factors. Using approaches such as the PIE framework proposed in this study, LIS and information behavior research can contribute to this front.

5.3 Limitations

This study is based on an analysis of a nationwide survey of 12th-graders. As with any survey, the findings are not intended to be generalized beyond the survey population. Based on extant studies, students are more likely to be library users than other population groups (Campbell & Metzner, 1950; C. H. Kim & Little, 1987; Sin & Kim, 2008). Students are also more likely to have a better information environment than other populations. Not only do they have access to school libraries, they

may also have better home computer access compared to others, such as those in a similar age group who are not in school. For example, Fairlie (2005) examined the CPS 2001 data and found that for youth aged 16-18 and enrolled in school, 78.5% of them had a home computer. For those in the same age group but not enrolled in school, only 52.1% of them had a home computer. The difference in information environment between these two groups is worth highlighting. This is because in the U.S., a sizeable number of youth are out of school. The 2006 data from NCES indicate that more than 3.4 million youth aged 16 to 24 in the U.S. are not enrolled in school and do not have high school credentials (i.e., *status dropout*). This amounts to about 9.3% of the youth population in that age group. Youth from low income families constitute a large proportion of all status dropouts. Especially alarming is that more than 1.4 million (about 22.1%) of Hispanic youth are status dropouts (Laird, Cataldi, KewalRamani, & Chapman, 2008). This author hypothesizes that status dropouts are facing more structural barriers and impoverished information environments than those studied in this analysis. More research on youths who are not enrolled in schools is called for.

In addition to expanding the investigation into different population groups, further PIE studies can also attempt to include structural factors that are measured at a more detailed unit of observation. In the current study, neighborhood environment is measured at the zip code level. Ideally, a smaller unit, such as the census tract or the census block, would allow a more precise examination of the respondents' immediate neighborhoods. Nevertheless, it is unlikely that such data will be available from a large-scale secondary dataset. This is due to the need to protect the respondents' confidentiality. In addition, measuring public library services at the branch library level would also be ideal. In this study, the data are measured at the public library system level. This is because the *Public Libraries Survey* does not include library collection and staffing data for each branch library. Future studies, particularly an in-depth study focusing on specific geographic community, may consider collecting primary data from individuals and also from local branch libraries.

The focus of this study is to evaluate how structural factors affect individuals' information behavior. Because this is a hitherto underexplored area, selecting the variables and conducting the empirical test are explorative in nature. The study included the major categories tested in extant studies, but it is not an exhaustive investigation of all potential factors. The number of variables that can be included in a quantitative analysis is sometimes limited. Another limitation of statistical analyses is that the variables' measurement scales affect what type of statistical methods can be used for the analysis and vice versa. Researchers using secondary analyses are especially constrained by the questions available in the dataset. For this study, SEM is selected in part to address some of the issues mentioned above. SEM acknowledges that the model will not include all potential variables. It recognizes that the outcome variables are affected by variables not included in the model. In addition, it also takes into account measurement errors. That is, the observed variables may not be a complete representation of the abstract constructs. This exploratory research provides us with insights into what structural and individual factors are salient in influencing 12th-graders' public and school library use. Based on the findings of this study, this researcher identified several areas that can be examined in future studies. They will be discussed in the next section.

5.4 Future Studies

Future PIE studies can explore several categories of predictor variables. First, one could examine variables about an individual's cognitive and affective styles. Scholars have increasingly recognized the effect of individual styles on information behavior, particularly in the human-computer interaction area (Kim, 2001; Kim & Allen, 2002; Nahl, 2005; Nahl & Tenopir, 1996). There is also evidence that these styles, such as problem-solving styles and self efficacy, can influence one's perception and selection of information sources (Jiao & Onwuegbuzie, 1999; Kim & Sin, 2007; Waldman, 2003). The latter is especially relevant to PIE studies that focus on source selection. Second, future studies could include social support and influence. This may be specially worth examining for children and youth

groups, as authority figures or peer influences may have a strong effect on their behaviors (Berndt, 1992; Gaviria & Raphael, 2001). Third, research could focus on variables about an individual's perception of the environment. This study finds perception to be a significant variable on one's behavior. Future studies may include more categories such as an individual's perception of the physical environments, staffs, and collections of libraries, and also whether he or she feels welcome.

For structural variables, there are more areas to discover as this is an under-examined realm. This study shows that the information environment is influential. Thus, one may include more variables from this category and also test what indicators measure the information environment the best. Data may be more difficult to collect, but it will be beneficial to include external measures of the quality of information resources. Such external variables can include training and cultural sensitivity of the staff, speed of Internet access, and age and inclusiveness of collection. Efforts to measure the culture and values of information institutions and the professionals should particularly be encouraged. The main difficulty in including these variables may be in variable operationalization. One may consider content analyses of an organization's mission, policies, and standards. Surveys of professionals can also be developed and conducted to gauge their beliefs and values.

An individual's social network is another type of information environment that can be included in future PIE studies. Individuals often turn to family, friends, and colleagues for information. Measures of this include the type and number of personal sources one turns to. But this author believes that incorporating the techniques and measures of social network analysis (SNA) offers an even richer research avenue. SNA focuses on relational data such as the connections and ties among individuals and groups. SNA is not new to LIS researchers. It is often used in bibliometrics study and citation analysis (Otte & Rousseau, 2002). There is rising interest in SNA, particularly in the study of computer-mediated communication. The use of SNA in information behavior research has been

identified (Haythornthwaite, 1996; Sonnenwald et al., 2001). Nevertheless, empirical information behavior studies using SNA are fewer than expected. This may be partly due to the fact that gathering social network data from participants can mean a more intensive data collection process. Also, quantitative study is not as frequently conducted in information behavior research. This author is interested in SNA because in addition to mapping one's social network, SNA offers many quantitative measures of network structure, such as its density and centrality (J. Scott, 1994). These measures can be calculated using software such as *Pajek*. The measures can be easily used as observed variables in studies based on the PIE framework.

For structural variables related to the societal environment, factors beyond socio-economic data can be incorporated. As discussed earlier, effects of culture, values, and power structure of a society would be especially worth examining. One may examine, for example, the government's policies and the public's attitudes toward issues of equality, social justice, diversity, education, or intellectual freedom. As noted before, historical and critical research can inform researchers about salient structural factors. Operationalization of and data collection for such variables may pose some challenges. Nevertheless, large-scale social surveys such as the *General Social Survey* (National Data Program for Social Sciences) or the *World Values Survey* ("World values survey,") can offer data related to societal values. One of the important issues to address is the unit of observation. These surveys may only allow geographical breakdown at a country or state level. It will be difficult to identify variations in cultural values, say, at the neighborhood level. Thus, large-scale secondary datasets may be more useful for cross-cultural PIE studies, which is also a fascinating area to research. For studies focusing on local culture and values, primary data collection is likely to be needed. To aid variable operationalization, researchers may consider using established survey instruments, such as those examined in Robinson, Shaver & Wrightsman (1990; 1999).

In addition to testing additional predictor variables, the PIE framework can also be used to analyze other outcome variables. The current empirical study centers on the use of public libraries. Future studies can include other information sources such as the Internet and the use of personal networks. Furthermore, one can move beyond the study of factors affecting information behavior and towards the study of how an individual's information behavior affects one's life. An area that has drawn considerable attention is the factors affecting students' academic performance. There are research studies examining whether the presence, quality, or use of school libraries influence students' academic performance (Krashen, 1995; Lance, Wellborn & Hamilton-Pennell, 1990; J. S. Michie & Chaney, 2009). Most studies suggest that there exist positive influences. Nonetheless, there is still room to further develop this research field. Extant research mainly uses a group (such as a school) instead of individual students as the unit of analysis. While structural variables such as school or neighborhood characteristics are sometimes included, individual characteristics such as a student's prior academic performance are seldom controlled. With the focus of both structural and individual factors, the PIE framework and the use of multivariate analysis can offer more empirical findings and insights in this area.

The current PIE framework, by incorporating the neighborhood environment, adds a space dimension to information behavior research. This researcher is keen to explore another dimension - the time dimension. The PIE framework can be expanded to study the factors shaping an individual's characteristics. The current study includes the students' perception of the school library and their reading habits outside of school as exogenous variables. That is, the study does not attempt to explain the factors affecting these characteristics. A research question that follows is - what factors and processes shape the students' perception and reading habits? This researcher views that an individual's characteristics, perceptions, and behaviors are shaped through learning, socialization, and his/her interactions with the environment. Using longitudinal data, this view can be tested with the PIE

framework. The predictor variables can include past structural environment, past information environment, prior family and peer influences, previous information behavior, and the individual's characteristics, especially ascribed characteristics. The outcome variable can be one's current characteristics and lifestyles, such as one's perception of libraries. An individual's childhood and youth experiences are especially salient in shaping one's character; they can be the focus of such studies. These investigations will help evaluate and underline the subtle but sometime long-lasting influences of structural factors on an individual's life.

5.5 Conclusion

The rapid advancements in information technology have offered unprecedented opportunities for better information communication. Unfortunately, such technological improvement has not alleviated the persistent inequity in information provision and use. LIS scholars and professionals have long been a stalwart in working towards information equity. There are still many new avenues to further strengthen our efforts, however. Answers to the following questions are essential for tackling information inequity: First, what are the patterns of inequity in both traditional and digital information resources? Second, what are the social and structural factors that create or perpetuate the aforementioned inequity? Third, what are the factors and mechanisms affecting an individual's use or non-use of information resources? Lastly, what are the relative impacts of structural conditions and individual characteristics on the individual's information behavior?

This author has developed the Person-In-Environment (PIE) framework to help address the questions listed above. It provides a conceptual framework for information behavior research to incorporate an individual's structural environment, particularly his or her information and neighborhood environments. To demonstrate the utility of the PIE framework, this researcher has used it to test the factors affecting the public library use of 12th-graders. The empirical data analysis supports the

framework's applicability. The analysis has exposed, for example, the pattern of information inequity across neighborhoods and among the 12th-graders based on SES. It has identified the salient factors influencing the students' library use. More importantly, this study has established that even after controlling for individual differences, structural conditions have a significant impact on individual behaviors. Due to the potency of structural factors, it is paramount that information behavior researchers expand beyond the focus on individual level variables. The current interest in the "context" of information behavior is a promising development. Structural factors, however, are still an under-explored research frontier. It is the goal of this researcher to advance LIS research into this area. The PIE framework and this empirical study have provided the foundation for this endeavor.

Such integration of structural and individual factors will not only address the gap in LIS research; empirical studies based on the PIE framework will also provide evidence that is useful for information policy recommendations. Studies often find that disadvantaged individuals infrequently seek information from quality sources. Since extant researchers tend to focus on the individual, whether this lower information use is due to individual dispositions or structural factors has not been empirically tested. The findings are left open to interpretation. It is not uncommon that policy makers and the public interpret such findings as the effect of the individual's shortcomings. This tendency adds to the reluctance in making structural policy improvements; it can inadvertently perpetuate social and information inequities. This researcher aims to provide the evidence to counter this tendency. The conceptual PIE framework and empirical studies can offer a means to systematically demonstrate if and how structural conditions affect an individual's socialization and also limit his or her information choices. It is hoped that these PIE studies will encourage the much needed understanding of, and support for, other individuals in society, particularly those who are less fortunate.

Individuals sometimes face unfair obstacles that affect their opportunities to pursue their life interests. By confronting information inequity, the LIS profession can make a difference. It is time that we work towards individual-structure integration, so as to further our body of knowledge and marshal the public support needed to overcome the barriers affecting individual lives.

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Appendix A

Initial measurement model: LISREL SIMPLIS syntax

 SYSTEM FILE from file 'D:\T1\Libuse.dsf'

 !Asymptotic Covariance Matrix From File 'D:\T1\Libuse.acm'

 Sample Size = 13200 [18]

 Latent Variables sex race homeenv pluse1 pluse2 pluse3 sluse1 sluse2 sluse3 access plenv ses mot social schenv neigh urban learn percept

 Relationships

 BYS52Bfl = percept

 BYS52Afl = percept

 BYS43re = learn

 BYS44F = learn

 BYS84H   = homeenv

 BYS84C   = homeenv

 BYS84D   = homeenv

 F1HomeCo = homeenv

 F1S29A   = sluse1

 F1S29B   = sluse1

 F1S29C   = sluse1

 F1S29D   = sluse1

 F1S29E   = sluse2

 F1S29F   = sluse2

 F1S29H   = sluse2

 F1S29I   = 1.068*sluse3

 F1S30A   = pluse1

 F1S30B   = pluse1

 F1S30C   = pluse1

 F1S30D   = pluse1

 F1S30E   = pluse2

---

[18] Following the NCES's Restricted Use Data requirement, the sample size number shown here has been rounded to the nearest ten.

F1S30F   = pluse2

F1S30H   = pluse2

F1S30I   = 0.911*pluse3

PLmlsqb5 = access

DPlmed5b = access

NMASTERp = plenv

NTOTEXPC = plenv

NTOTINCM = plenv

F1MOTHED = ses

F1FATHED = ses

BYINCOME = ses

BYS54O   = mot

BYS27Dfl = mot

BYS37   = mot

BYS71E = social

BYS41F   = social

F1SchCom = schenv

BYL11JA = schenv

BYL12F   = schenv

ZUrbanPC = 0.945*urban

ZMedianH = neigh

ZPerCapi = neigh

ZMedianR = neigh

F1SEX   = 1.00*sex

F1RACERr = 1.00*race

Set the Error Variance of ZUrbanPC to 0.099

Set the Error Variance of F1SEX   to 0.00

Set the Error Variance of F1RACERr to 0.00

Set the Error Variance of F1S30I to 0.092

Set the Error Variance of F1S29I to 0.126

Path Diagram

Wide Print

LISREL OUTPUT AD=off MI SC

Method of Estimation: Weighted Least Squares

End of Problem

Appendix B

Final measurement model: LISREL SIMPLIS syntax

 SYSTEM FILE from file 'D:\T1\Libuse.dsf'

!Asymptotic Covariance Matrix From File 'D:\T1\Libuse.acm'

Sample Size = 13200 [19]

 Latent Variables sex race hprint hcomp pluse1 pluse2 pluse3 sluse1 sluse2 sluse3 access plenv ses mot social schenv neigh urban learn read percept

 Relationships

 BYS52Bfl = percept

 BYS52Afl = percept

 BYS43re = 0.76*read

 BYS44F = 0.963*learn

 BYS84H   = 0.331*hprint

 BYS84C   = hcomp

 BYS84D   = hcomp

 F1HomeCo = hcomp

 F1S29A   = sluse1

 F1S29B   = sluse1

 F1S29C   = sluse1

 F1S29D   = sluse1

 F1S29E   = sluse2

 F1S29F   = sluse2

 F1S29H   = sluse2

 F1S29I   = 1.068*sluse3

 F1S30A   = pluse1

 F1S30B   = pluse1

 F1S30C   = pluse1

 F1S30D   = pluse1

 F1S30E   = pluse2

 F1S30F   = pluse2

---

[19] The sample size number shown here has been rounded to the nearest ten.

F1S30H   = pluse2

F1S30I   = 0.911*pluse3

PLmlsqb5 = access

DPlmed5b = access

NMASTERp = plenv

NTOTEXPC = plenv

NTOTINCM = plenv

F1MOTHED = ses

F1FATHED = ses

BYINCOME = ses

BYS54O   = mot

BYS27Dfl = mot

BYS37   = mot

BYS71E = social

BYS41F   = social

F1SchCom = schenv

BYL11JA = schenv

BYL12F   = schenv

ZUrbanPC = 0.945*urban

ZMedianH = neigh

ZPerCapi = neigh

ZMedianR = neigh

F1SEX   = 1.00*sex

F1RACERr = 1.00*race

Set the Error Covariance of pluse1 and pluse2 Free

Set the Error Covariance of pluse1 and pluse3 Free

Set the Error Covariance of pluse2 and pluse3 Free

Set the Error Covariance of sluse1 and sluse2 Free

Set the Error Covariance of sluse1 and sluse3 Free

Set the Error Covariance of sluse2 and sluse3 Free

Set the Error Covariance of NTOTINCM and NTOTEXPC Free

Set the Error Covariance of F1FATHED and F1MOTHED Free

Set the Error Variance of ZUrbanPC to 0.099

Set the Error Variance of F1SEX   to 0.00

Set the Error Variance of F1RACERr to 0.00

Set the Error Variance of BYS84H to 0.012

Set the Error Variance of F1S30I to 0.092

Set the Error Variance of F1S29I to 0.126

Set the Error Variance of BYS44F to 0.103

Set the Error Variance of BYS43re to 0.064

Path Diagram

Wide Print

LISREL OUTPUT AD=off MI SC

Method of Estimation: Weighted Least Squares

End of Problem

Appendix C

Initial Structural model: LISREL SIMPLIS syntax

SYSTEM FILE from file 'D:\T1\Libuse.dsf'

!Asymptotic Covariance Matrix From File 'D:\T1\Libuse.acm'

Sample Size = 13200 [20]

Latent Variables sex race hprint hcomp pluse1 pluse2 pluse3 sluse1 sluse2 sluse3 access plenv ses mot social schenv neigh urban learn read percept

Relationships

BYS52Bfl = percept

BYS52Afl = percept

BYS43re = 0.76*read

BYS44F = 0.963*learn

BYS84H   = 0.331*hprint

BYS84C   = hcomp

BYS84D   = hcomp

F1HomeCo = hcomp

F1S29A   = sluse1

F1S29B   = sluse1

F1S29C   = sluse1

F1S29D   = sluse1

F1S29E   = sluse2

F1S29F   = sluse2

F1S29H   = sluse2

F1S29I   = 1.068*sluse3

F1S30A   = pluse1

F1S30B   = pluse1

F1S30C   = pluse1

F1S30D   = pluse1

F1S30E   = pluse2

F1S30F   = pluse2

F1S30H   = pluse2

F1S30I   = 0.911*pluse3

PLmlsqb5 = access

DPlmed5b = access

NMASTERp = plenv

NTOTEXPC = plenv

NTOTINCM = plenv

F1MOTHED = ses

F1FATHED = ses

BYINCOME = ses

BYS54O   = mot

BYS27Dfl = mot

BYS37   = mot

BYS71E = social

BYS41F   = social

F1SchCom = schenv

BYL11JA = schenv

BYL12F   = schenv

ZUrbanPC = 0.945*urban

ZMedianH = neigh

ZPerCapi = neigh

ZMedianR = neigh

F1SEX   = 1.00*sex

F1RACERr = 1.00*race

hprint = sex race ses neigh urban mot learn read

hcomp = sex race ses neigh urban mot learn read

plenv = neigh urban

access = neigh urban

schenv = ses

sluse1 = sex race hprint hcomp schenv mot social ses learn read percept

sluse2 = sex race hprint hcomp schenv mot social ses learn read percept

sluse3 = sex race hprint hcomp schenv mot social ses learn read percept

pluse1 = sex race hprint hcomp sluse1 access plenv ses mot social schenv learn read percept neigh urban

pluse2 = sex race hprint hcomp sluse2 access plenv ses mot social schenv learn read percept neigh urban

pluse3 = sex race hprint hcomp sluse3 access plenv ses mot social schenv learn read percept neigh urban

Set the Variance of ses to 1.00

Set the Variance of mot to 1.00

Set the Variance of social to 1.00

Set the Variance of neigh to 1.00

Set the Variance of percept to 1.00

Set the Error Covariance of pluse1 and pluse2 Free

Set the Error Covariance of pluse1 and pluse3 Free

Set the Error Covariance of pluse2 and pluse3 Free

Set the Error Covariance of sluse1 and sluse2 Free

Set the Error Covariance of sluse1 and sluse3 Free

Set the Error Covariance of sluse2 and sluse3 Free

Set the Error Covariance of NTOTINCM and NTOTEXPC Free

Set the Error Covariance of F1FATHED and F1MOTHED Free

Set the Error Variance of ZUrbanPC to 0.099

Set the Error Variance of F1SEX   to 0.00

Set the Error Variance of F1RACERr to 0.00

Set the Error Variance of BYS84H to 0.012

Set the Error Variance of F1S30I to 0.092

Set the Error Variance of F1S29I to 0.126

Set the Error Variance of BYS44F to 0.103

Set the Error Variance of BYS43re to 0.064

Path Diagram

Wide Print

LISREL OUTPUT AD=off MI EF SC

Method of Estimation: Weighted Least Squares

End of Problem

Appendix D

Final structural model: LISREL SIMPLIS syntax

SYSTEM FILE from file 'D:\T1\Libuse.dsf'

!Asymptotic Covariance Matrix From File 'D:\T1\Libuse.acm'

Sample Size = 13200 [21]

Latent Variables sex race hprint hcomp pluse1 pluse2 pluse3 sluse1 sluse2 sluse3 access plenv ses mot social schenv neigh urban learn read percept

Relationships

BYS52Bfl = percept

BYS52Afl = percept

BYS43re = 0.76*read

BYS44F = 0.963*learn

BYS84H   = 0.331*hprint

BYS84C   = hcomp

BYS84D   = hcomp

F1HomeCo = hcomp

F1S29A   = sluse1

F1S29B   = sluse1

F1S29C   = sluse1

F1S29D   = sluse1

F1S29E   = sluse2

F1S29F   = sluse2

F1S29H   = sluse2

F1S29I   = 1.068*sluse3

F1S30A   = pluse1

F1S30B   = pluse1

F1S30C   = pluse1

F1S30D   = pluse1

F1S30E   = pluse2

F1S30F   = pluse2

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[21] The sample size number shown here has been rounded to the nearest ten.

F1S30H   = pluse2

F1S30I   = 0.911*pluse3

PLmlsqb5 = access

DPlmed5b = access

NMASTERp = plenv

NTOTEXPC = plenv

NTOTINCM = plenv

F1MOTHED = ses

F1FATHED = ses

BYINCOME = ses

BYS54O   = mot

BYS27Dfl = mot

BYS37   = mot

BYS71E = social

BYS41F   = social

F1SchCom = schenv

BYL11JA = schenv

BYL12F   = schenv

ZUrbanPC = 0.945*urban

ZMedianH = neigh

ZPerCapi = neigh

ZMedianR = neigh

F1SEX   = 1.00*sex

F1RACERr = 1.00*race

hprint = sex race ses neigh urban mot learn read

hcomp = sex race ses neigh urban mot learn read

plenv = neigh urban

access = neigh urban

sluse1 = sex race hprint hcomp schenv mot social pluse1 ses learn read percept

sluse2 = sex race hprint hcomp schenv mot social pluse2 ses learn read percept

sluse3 = sex race hprint hcomp schenv mot social pluse3 ses learn read percept

pluse1 = sex race hprint hcomp sluse1 access plenv ses mot social schenv learn read percept neigh urban

pluse2 = sex race hprint hcomp sluse2 access plenv ses mot social schenv learn read percept neigh urban

pluse3 = sex race hprint hcomp sluse3 access plenv ses mot social schenv learn read percept neigh urban

Set the Variance of ses to 1.00

Set the Variance of mot to 1.00

Set the Variance of social to 1.00

Set the Variance of schenv to 1.00

Set the Variance of neigh to 1.00

Set the Variance of percept to 1.00

Set the Error Covariance of pluse1 and pluse2 Free

Set the Error Covariance of pluse1 and pluse3 Free

Set the Error Covariance of pluse2 and pluse3 Free

Set the Error Covariance of sluse1 and sluse2 Free

Set the Error Covariance of sluse1 and sluse3 Free

Set the Error Covariance of sluse2 and sluse3 Free

Set the Error Covariance of NTOTINCM and NTOTEXPC Free

Set the Error Covariance of F1FATHED and F1MOTHED Free

Set the Error Variance of ZUrbanPC to 0.099

Set the Error Variance of F1SEX   to 0.00

Set the Error Variance of F1RACERr to 0.00

Set the Error Variance of BYS84H to 0.012

Set the Error Variance of F1S30I to 0.092

Set the Error Variance of F1S29I to 0.126

Set the Error Variance of BYS44F to 0.103

Set the Error Variance of BYS43re to 0.064

Path Diagram

Wide Print

LISREL OUTPUT AD=off MI EF SC

Method of Estimation: Weighted Least Squares

End of Problem