ABSTRACT
This paper has two goals: (1) to introduce the Person-in-Environment (PIE) framework, which the author developed to measure the relative impacts of socio-structural and individual factors on individual information behavior; and (2) to demonstrate PIE’s applicability. An empirical study on the factors of students’ library usage is presented. PIE addresses a research gap in the information behavior area—the shortage of societal-level research. In PIE, individual factors (e.g., cognitive and affective) and socio-structural factors (e.g., information resources distribution) are conceptualized as inter-related. Thus, they need to be tested simultaneously with a multivariate method such as structural equation modeling (SEM). Previously, it was difficult to link individual and socio-structural factors. This is because their units of observation often vary. This author proposes linking diverse datasets with geographic information systems (GIS), using spatial location as the key. The PIE framework can contribute to theoretical and methodological discussions in information behavior research. It also offers scholars and policymakers a way to empirically assess the contributions of information services.

Keywords
Information behavior in context, socio-structural factors, information environment, public library usage.

INTRODUCTION
The information behavior (IB) field has seen many exciting advancements in the past decades. The shift from a system-centered to a user-centered paradigm has been apparent since Dervin and Nilan’s seminal paper (1986). In the late 1990s, the field expanded into studying information behavior in context (ISIC). ISIC’s central tenet is well captured in the following statement: “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).

With these advancements, we have a better understanding of individual demographics, cognitive and affective factors; work and everyday life information behavior; purposive and accidental information acquisition; contextual factors such as task and situation; and conceptualization of information environment such as information ground (e.g., Allen & Kim, 2001; Erdelez, 1997; Nahl & Bilal, 2007; Pettigrew, 1999; Savolainen, 1995; Spink & Cole, 2006). The blurring of information contexts and the mobility of places are highlighted in recent discussions (Burnett & Erdelez, 2010).

However, the societal level remains a frontier requiring exploration (Vakkari, 1997; Courtright, 2007). The barriers are theoretical and methodological. The theoretical issue parallels the agency-structure debate (Ritzer & Gindoff, 1994). Social structure is the most basic, enduring, and orderly pattern in social life. Individual agency refers to the capabilities of an individual to resist structural constraints. In embracing a holistic view that recognizes individuality and contextual influences, our field faces the following questions: How do we study structural factors, while keeping the individual as our focus? How do we recognize the interplay between individual agency and societal influences, while avoiding the pitfalls of determinism?

Complicating the issue is that agency-structure integration requires a complex research design (Vakkari, 1997). Operationalization is difficult (Savolainen, 1995). Qualitative methods (e.g., Chatman’s ethnographic research) have been more successfully applied. While it is difficult to design quantitative studies, it is still worthwhile. Specifically, it can help compare the respective impacts of personal characteristics and structural factors. This and the generalizability of quantitative studies complement the rich and in-depth exploration offered by qualitative research.

PURPOSE
To address the aforementioned gaps, the author proposed and tested a Person-in-Environment (PIE) framework (Sin, 2009). The following section presents six PIE principles.
Thereafter, the research design and findings of an empirical study follow. The test case used PIE framework, secondary analysis, GIS and SEM, analyzing a sample of 13,000 high school seniors nationwide. It addresses the questions: 1) Does PIE actually work; and 2) Does incorporating structural factors contribute to a better understanding of information behavior?

CONCEPTUAL FRAMEWORK: CENTRAL PRINCIPLES OF THE PERSON-IN-ENVIRONMENT FRAMEWORK

Principle 1: The individual is the center of research. The recommended unit of analysis is at the individual level. This follows the principles of the user-centered paradigm, which recognizes individuality. PIE can be used for analyzing groups when the research question calls for it. In most cases, the goal is to study personal characteristics, behavior, and outcomes at the individual level.

Principle 2: Environmental factors as explanatory variables.
Principle 2 reflects the attention to contextual factors, as advocated in information behavior in context research. For the PIE framework, the term environment includes more than the physical environment; it covers the cultural, social, economic, political, and information environment as well. To tackle the agency-structure debate, special attention is given to socio-structural (hereafter, structural) factors. Structural factors are defined here as: (1) factors that are related to the basic, recurring pattern of the institutional and societal environment where an individual lives; and (2) factors that are beyond the individual’s immediate control. It is important to note that, in the PIE framework, environmental factors are not used only for discussion purposes. These factors should also be measured and tested in the model as explanatory variables.

Principle 3: The information environment is a crucial category of explanatory variables.
This reflects the field’s strong interest in the information environment (e.g., Zweizig, 1973; Wilson, 1981; Pettigrew, 1999). By giving this component central stage, information inequality can be analyzed. This helps to evaluate the impacts of unequal resource distribution on individuals.

Principle 4: Interactionism among individual and environmental factors, not determinism.
Individual and environmental factors interact with each other; they jointly influence individual behavior and outcomes. This is similar to the view of the person-in-situation approach (Allen & Kim, 2001). Such a bi-directional relationship has methodological implications: (1) factors are often not independent (thus, the term explanatory variable is preferred), and (2) factors need to be analyzed simultaneously. Therefore, multivariate methods are recommended. Different from the person-in-situation approach (which focuses on the interaction effect), the PIE framework focuses on the pathways among variables (including those among explanatory variables).

Principle 5: Flexible unit of observation for environmental factors. Neighborhood-level is recommended.
Depending on the research focus, environmental factors can be measured at different scales (e.g., city, state). The author recommends using as refined a unit as possible. We want to measure an individual’s immediate environment, where the individual goes about his or her daily life. This helps us detect variations otherwise not observable if data were aggregated at a distal level. For this purpose, most research selects the neighborhood level (i.e., neighborhood effects research). Zip code or census tract areas are often used.

Principle 6: Inclusion of both emic and etic measures.
The PIE framework includes an individual’s view of the environment (i.e., emic perspective), as well as measures provided by external parties such as researchers (i.e., etic). The IB literature has discussed the subjective nature of an individual’s knowledge of the world. The value of an emic perspective is recognized. Comparatively, etic measure has received less attention in recent years. It may be that the etic perspective is often viewed as being too close to positivism or the system-centered approach.

Precisely because IB embraces a subjective epistemology (e.g., social constructivism), this author believes we should include etic measures. If everyone had the same view, emic and etic measures would be the same; measuring both is unnecessary. But views do differ; we need to capture the users and third-parties’ perspectives. Including emic measures would not privilege the external view over an individual’s view. The multivariate aspect of PIE prevents such an assumption. We will empirically test how each view affects an individual’s behavior in each context.

Because we want data from multiple sources, the data collection procedures are more complex. This author recommends taking advantage of the many datasets offered by the government or reputable sources. Incorporating emic and etic measures helps us distinguish perceptual and affective barriers from service barriers. Such knowledge helps provide better policy recommendations.

EMPIRICAL TESTING: MODELING STUDENTS’ FREQUENCY OF PUBLIC LIBRARY USAGE

Method
Data collection and linking
Secondary analysis was used. The datasets were: (1) Education Longitudinal Study of 2002 (ELS) restricted-use data, from the National Center for Education Statistics (NCES); (2) Public Libraries Survey (PLS) 2004 from NCES; and (3) Census 2000 data. ELS includes a nationally representative sample of more than 13,000 students who were 12th-graders in 2004. PLS 2004 includes statistics of 9,207 U.S. public library systems with a total of 16,532 outlets. Census data were obtained at the census tract level, which are small and relatively stable geographic units of about 2,500 to 8,000 persons.
The three datasets have different units of observation (i.e., individual student, public library system, census tract). This hinders data linking with a regular database program. Data linking is a major methodological barrier for agency-structure research. This author used spatial location as the link. ArcGIS, a GIS program, was used to merge the data. Public libraries were mapped using the addresses listed in PLS (i.e., geocoding). The public library layer was overlaid with the zip code and the census tract layers. Measures of distance and density were then conducted. With these spatial joins, the researcher can identify which library outlets were in a student’s residential neighborhood.

**Data analysis: Structural Equation Modeling (SEM)**

SEM is a multivariate statistical technique. It is considered a combination of factor analysis, regression, and path analysis. SEM focuses on latent variables, which are variables that are not directly measured. Latent variables are measured indirectly through indicators (i.e., observed variables). In SEM, the measurement model involves specifying variables. The variables’ validity and reliability are examined. Measurement assessments can alleviate part of the operationalization issues mentioned in the introduction section. The structural model tests the relationships among latent variables. Du (2009) offers an overview of SEM and its application in LIS research.

SEM is particularly suitable for PIE. For example, explanatory variables are not assumed to be independent. SEM can test the relationships among all variables. The pathways can be represented visually through a path diagram. In addition, measurement errors are explicitly modeled. This fits the view of a subjective epistemology. It acknowledges that variables are only approximations of the constructs we want to measure.

Based on the PIE framework, this author developed a conceptual model of 12th-graders’ library usage. Literature on information behavior and public libraries provide the theoretical background for the indicators. More information can be found in Sin (2009). An individual student was the unit of analysis. Environmental factors were measured at the neighborhood level as defined by the students’ residential zip code areas. LISREL was used for SEM analysis. This study included non-continuous variables. Thus, PRELIS was used to pre-process the data; weighted-least squares (WLS) was used to estimate the SEM models. The study went through iterations of model testing. First, the conceptual model was tested. Then, alternative models were built and their model fits (e.g., ECVI and AIC) were compared.

**Findings**

Figure 1 presents the final structural model. The path width is proportional to the standardized structural coefficient ($\beta$). $\beta$ indicates the amount of change in the outcome variable with a unit change in the explanatory variable; it can be used to compare the relative effects of variables.

The result shows structural factors (such as information resources available in one's immediate environment) have a significant impact on an individual's information behavior. It also reveals widespread information inequality. Public library (PL) resource and service levels varied substantially with neighborhood income levels ($\beta=0.34$) and urbanization levels ($\beta=0.37$). There were also notable individual–level disparities in print and digital resources. The respondents’ home, school and neighborhood public library resource levels varied with their socio-economic status (SES), race/ethnicity and gender.

Such resource distribution affects individual behavior. High resource levels at PL, for example, encouraged more frequent use of PL for non-school work ($\beta=0.14$), school work ($\beta=0.12$) and Internet access ($\beta=0.12$). This holds true even after we accounted for individual differences such as SES, achievement motivation and reading habits. These findings have policy implications. First, the limited access to information resources by some students shows there is a strong need for library funding; equally important, the study shows that committing more resources to libraries does make a difference.

It is notable that the direct effect of SES on PL usage was not significant. Lower SES individuals were often found to be library non-users or infrequent users. The current study distinguishes the various pathways between SES and library use. To illustrate, it shows that high SES was correlated with high participation in social activities (r=0.3), which
was associated with higher library usage. The coefficient of social participation on PL school work use was 0.30. In addition, library use is not solely a matter of individual disposition. As noted above, library resource levels make a difference. In this study, the infrequent use of PL by lower SES individuals was partly explained by the following: Lower SES $\rightarrow$ higher probability of living in low income neighborhood $\rightarrow$ lower PL resource level $\rightarrow$ lower individual-level library usage. There were also counter forces at play. For example, lower SES students tended to attend school with fewer resources ($r=0.03$), which could in turn contribute to more frequent public library use for school work ($\beta=-0.44$), non-school work ($\beta=-0.38$) and Internet access ($\beta=-0.45$).

**DISCUSSION AND CONCLUSION**

Structural factors are rarely included in individual-level analysis due to theoretical and methodological issues. This PIE study shows that such integration is beneficial and feasible. Frameworks such as PIE allow us to untangle the intricate relationships among individual characteristics, socio-structural factors and individual behavior. We are no longer bound to individual-level factors or emic measures. We are also not limited to testing whether factors are related. We can theorize and test the various forces at work. We can begin to uncover how individual agency and social structure shape individual information behavior.

In conclusion, PIE helps address the research gap discussed above. It also measures the impact of unequal information resources distribution. The PIE framework presented here is a first step toward agency-structure integration. This beginning framework offers a conceptual framework, methodological tool, and empirical findings to further understand information behavior and fine-tune policy recommendations. The author is conducting further testing. The new test will evaluate PIE’s applicability in modeling not only information behavior, but individual outcomes such as academic performance.

Untangling individual and structural influences is a complex issue; further research on a variety of frameworks and methods would benefit such endeavor. It is hoped that the PIE framework will encourage more studies of structural factors. Based on what the IB field has accomplished in the past decades, the author believes that our field has a strong foundation to tackle this issue and bridge the agency-structure gap.

**REFERENCES**


