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Towards a comprehensive measurement of the information rich and poor

Based on the conceptualization of individuals as information agents

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Abstract

Purpose – Following the assumption that studies of information inequality need to be based on precise discrimination between society's information rich and poor and against the context that a mechanism for such discrimination is still lacking, the purpose of this paper is to explore the possibility of establishing a holistic informational measurement.

Design/methodology/approach – It does so by developing a measurement based on the conceptualization of the individual as an information agent and his/her information world as his/her characterization. The development procedure consists of four steps: operationalization of the theoretical constructs and the initial drafting of the questionnaire instrument; revisions of the questionnaire based on pilot tests with small groups of people; weighing of the questionnaire items for the purpose of calculating index-type variable scores; formal test of validity and reliability.

Findings – The resulting measurement consists of eight variables corresponding to eight theoretical constructs of an individual's information world, each being measured by a group of questionnaire-based items which, in turn, generate an index-type score as the variable's value. Validity and reliability tests show that the measurement is, on the whole, able to distinguish the information poor from the information rich and to measure individuals consistently.

Originality/value – The study demonstrates that it is possible to distinguish the information rich and poor by informational measurement in the same way as to distinguish economic groups by income, ethnic groups by race and intelligence groups by IQ; and that such a measurement has arguably multifaceted value for information inequality research.

Keywords Information society, Information agent, Information inequality, Information poor, Information rich, Informational measurement

Paper type Technical paper

1. Introduction

Starting from the 1970s, concepts such as "information poor," "information rich," "information inequality" and "information divide" have become an integrated part of the information society discourse. Together, these concepts attest to the belief that as information becomes a strategic resource of society, so people's information-related characteristics become a defining factor of their social status, to complement existing defining factors such as income, education and occupation.

However, unlike the latter factors which categorize people by established operational variables, few information-related factors (e.g. information access, information use) are congenial for such operationalization, not least because they are often assigned with varied and elusive meanings. Therefore, although significant progress has been made in studying information poverty, information inequality and digital inequality since the 1970s, few operational "informational" criteria exist to precisely distinguish society's information rich and poor.

In the absence of such criteria, the research communities and policy makers often opt to identify the socio-economic rich and poor as information rich and poor and to further describe the resulting groups using one or more information-related indicators (e.g. quantity of media use; access, or the lack of it, to information technologies; access, or the lack of it, to library services; digital skills, etc.). The literature review section will provide details on this approach to studying the information poor and rich; it suffices here to note that, as conclusions thus achieved are about the socio-economic poor or rich, they cannot guarantee adequate understanding of the true information poor and rich. It can be argued, in fact, that a simple identification of the socio-economic rich and poor as the information rich and poor may hamper our understanding of information inequality in a number of ways. First, by grouping people of similar socio-economic status into one informational cluster, this type of research will likely pay little attention to information-based disparities between people of the same socio-economic status. As a result, we may miss the opportunity to study the experiences of the reversely placed members (e.g. the relatively information rich among the socio-economic poor). Second, by treating the information poor and the socio-economic poor as identical, this type of research assumes an exclusive causal relationship between socio-economic disadvantages and information poverty. This will likely lead us to overlook other factors that may contribute to or even create information poverty; an example of such factors is a poorly designed education system and pedagogy. Third, by sampling the information poor/rich using socio-economic criteria and measuring them using ad hoc information access indicators, this type of research can hardly be expected to unveil genuine relationships between people's socio-economic and informational statuses.

If the concepts of information rich and information poor are to be truly useful for information inequality research, an informational measurement is called for. This study attempts to begin to explore the possibility of developing such a measurement. It does so by tentatively operationalizing a newly proposed concept in library and information science (LIS), the concept of "an individual's information world." Section 3 of this paper will explicate the concept in detail, but in a nutshell, an individual's information world is defined as a space-time-intellect delimited life sphere of the individual in which sources of information are accessed and converted into a personal information resource base and information assets through intentional, conscious and involuntary information practices (Yu, 2012). This concept is chosen for a number of reasons: first, it emerged from an empirical study of information inequality and was proposed particularly for the purpose of differentiating the information poor from the rich;

second, it was formed through an examination of individuals as information agents (as opposed to social and economic agents) and accentuates, particularly, their informational characteristics; and third, it denotes the characteristics of individuals (as opposed to characteristics of environment or communities) and is, therefore, appropriate for comparing and classifying individuals. In relating its operationalization to the general purpose of this study, this paper addresses the following specific questions: What theoretical constructs can be derived from the concept of an individual's information world? How are these theoretical constructs operationalized into variables? How valid and reliable is the resulting measurement? What advantage and limitations has it shown for information inequality research? It is hoped that this exercise will provide information inequality research with at least a provisional informational measurement and a starting point for further improvement.

2. Existing measurements of the information rich and poor: a review of related literature

The concepts of information poor and rich began to gain popularity during the 1970s, coinciding with the new epoch denoting concepts such as "information society" and "post-industrial society." However, until now, the concepts are seldom explicitly defined. Examination of the early usage of "information poor" reveals four categories of literature, each implying a different referent for the term. The first category uses "information poor" to refer to an unspecified socio economically disadvantaged section of society. This category is exemplified by LeDonne (1977), Trezza (1978) and Soedjatmoko (1979). Trezza (1978), for instance, sees the National Commission on Libraries and Information Science planned library services in the 1970s' US as model services for information poor people, but does not specify who these people are. The second category uses the term to denote specified socio economically disadvantaged groups. This category is exemplified by Childers and Post (1975), where they identify Mexican-Americans, Puerto Ricans, other Spanish-speaking people, American-Indians and Eskimos, poor black and white Americans, Appalachians, poor farmers, migrant workers, aging adults, prisoners and the blind or deaf as American's information poor. The third category uses the term to refer to an unspecified informationally disadvantaged section of society. This category is exemplified by Katzman (1974). Katzman raises the concern that with the advancement of information technologies, the gap between people who already have high levels of information and ability (the information rich) and people with lower initial levels (the information poor) will be widened, but does not explain what "information and ability" means. The fourth category uses the term to mean a specified informationally disadvantaged section of society. This is exemplified by Parker (cited in Swartz, 1975) and Sweetland (1993). These authors see the information poor as people who do not have the chance or motivation to use traditional information sources such as libraries and the emerging information technologies.

Later research on information poverty, information inequality and digital divide or digital inequality are largely based on these diverse and implicit conceptualizations of society's information poor (e.g. Chatman, 1991, 1992, 1996; Cartier *et al.*, 2005; DiMaggio *et al.*, 2004; Haider and Bawden, 2007; Jaeger, 2006; Jaeger and Bowman, 2005; Kim and Kim, 2001; Lievrouw, 2000; Lievrouw and Farb, 2003; Spink and Cole, 2001; Thompson, 2007; van Dijk, 2005; van Dijk and Hacker, 2003; Yu, 2010) but, increasingly, related studies began to see information inequality as a complex and multi-dimensional phenomenon. With regard to digital divide, for instance, van Dijk (2005) sees it as consisting of four successive and accumulative categories of access (motivational,

material, skills and usage) and as determined by a variety of personal and positional factors; DiMaggio *et al.* (2004) similarly see it as consisting of five dimensions (access to technological means, autonomy in access, skills of access, social support for access and purpose of access). With regard to information poverty, Yu (2010) sees it as manifesting in three aspects: limited freedom and/or opportunities in claiming society's information resources into a person's own information resource base; restricted information practices in developing his/her information resource base and obtaining information utilities from it; and impoverished information assets to empower himself/ herself in normal and problematic situations. Haider and Bawden (2007) see it as constructed by four types of discursive practices: association of information poverty with material deprivation (economic determinism); association of information poverty with inaccessibility of ICTs (technological determinism); association of the "information poor" with the object of the nineteenth century public library services (historicizing the information poor); and association of information poverty with the library profession's moral obligation and responsibility.

The past two decades have also seen a growing number of studies focussing on situational information poverty where actors experience dire scarcity of information on certain topics critical to them because the nature of the topics prevents them from seeking information from normal sources or channels (Veinot, 2009; Lingel and boyd, 2013; Sligo and Jameson, 2000; Hasler *et al.*, 2014). Veinot (2009) and Lingel and boyd (2013), for instance, examine, respectively, the topical information poverty experienced by people with HIV/AIDS and people with extreme body-modification. Hasler *et al.* (2014) survey the range of situations where people experience great difficulty in obtaining relevant information and identify a variety of such situations, including health condition, relationships, pregnancy, health resources, legal issues, abuse, sex, etc.

The complexity of information poverty and inequality as revealed by these studies indicate clearly a need for sophisticated informational criteria to gauge people's informational status and attest against any simplified demarcation between the information rich and poor. However, up till now, development of operational measurement for the information poor and rich has fallen short of this complexity. As a result, empirical studies of information inequality tend to adopt one or a limited number of information-related indicators, often without theoretical justification, to demonstrate how socio economically disadvantaged groups lag behind the rest of society on the chosen indicators, or how demographically defined groups of society fare on these indicators. These indicators or measurements are, therefore, developed mainly to describe the socio economically or demographically defined groups rather than to distinguish informational groups for further study and theorizing. In this way, they tend to presuppose the identification between the socio-economic rich and poor on the one hand, and the information rich and poor on the other. Typical indicators of this type include, among others, media ownership and exposure (Whiting and Stanfield, 1972; Greenberg and Dervin, 1970), library use (Sin and Kim, 2008; Japzon and Gong, 2005), access to information sources and/or channels (Spink and Cole, 2001), knowledge acquisition after being exposed to certain information dissemination (Tichenor *et al.*, 1970; Ettema *et al.*, 1983; Gaziano, 1983; O'Leary and Gaziano, 1996), access to information and communication technologies (Cartier *et al.*, 2005; Martin and Robinson, 2004; Robinson *et al.*, 2003; van Dijk, 2005), digital skills (Hargittai, 2002; van Deursen and van Dijk, 2008, 2010; van Deursen *et al.*, 2011) and digital divide index (International Telecommunication Union 2005; Wong *et al.*, 2010; Jung, 2008). Table I provides a summary of these indicators.

Indicators	Meaning
Media ownership	Range or type of media that one owns
Media exposure	Amount of time spent on given media within a given period of time
Use of information sources/channels	Range or type of information sources or channels that one uses
Knowledge acquisition score	Test result of one's knowledge about a topic before and after the dissemination of related information
Information literacy scores	Test result of one's information literacy according to a certain information literacy framework
Access to the internet	Whether one uses the internet (regardless of venue); whether one uses the internet at home; or whether one uses the internet at home or at work
Autonomy of internet use	Range and type of places where one can access the internet
Intensity of internet use	Frequency with which one uses the internet
Usage of the internet	Range or type of activities one conducts with the internet; or range or type of websites one visits
Access to computer	Whether one uses computers
Access to cell phone	Whether one uses a mobile phone
Digital (ICT) skill scores	Test results of one's skills in using the internet to resolve given problems
Personal informatization index	An index-type indicator developed by the Korean Agency for Digital Opportunity and Promotion (Wong *et al.*, 2010) based on weighted computation of three dimensions of ICT access – access, capacity and utilization
The internet connectedness index	An index-type indicator developed by Jung (2008); it is obtained from ordinal scale scores of five dimensions of ICT use as reported by the respondents – scope of internet activities, intensity of internet activities, time spent on the internet, degree that one misses computer (computer miss) and the internet (internet miss) when deprived of these

Table I.
Major indicators for describing the socio economically defined information poor and rich

Applying these indicators to socio-economically defined groups inevitably leads related research to arrive at conclusions about these groups. The results tend to confirm that the economic poor, the less educated, the disabled, the aged, ethnic minorities and other socio economically disadvantaged sections of society make significantly less use of public libraries and other formal communication channels, have a lower level of internet access, less knowledge acquisition from mass media communication and fewer digital skills. It is not certain, however, the extent to which these findings reflect the genuine state of the information poor. In any case, no results based on samples of population A can be generalized to population B without running into external validity problems. Valid theory concerning society's information rich and poor – hence about information inequality – hinges on accurate discrimination of people informationally which, in turn, calls for a holistic measurement of individuals as information agents.

3. The individual as an information agent and his/her information world as his/her characterization: conceptual basis

When we refer to an individual as an economic agent, social agent, political agent, moral agent and so on, we are actually talking about his/her multiple roles and his/her ability to take actions in each of these roles. Each has associated with it certain choices, decisions, actions, and certain arenas in which these choices, decisions and actions are usually made. A political agent, for instance, typically conducts such actions as participating in political organizations, elections, lobbying activities and policy debates in arenas like parliament, town halls, organizations, meeting venues, public spaces and

the media. An economic agent, on the other hand, typically conducts such actions as making investments, producing products or services, consuming products or services and engaging in personal financial management in arenas like factories, banks, shops and companies. The same is true with the information agent. In science and technology literature, the term "information agent" is often used to refer to software which can perform certain tasks for its users intelligently and autonomously. Here we use it to refer to an individual's role that generates information-related activities, choices, decision making and preferences. Typical arenas in which the role of information agent is played include offices, libraries, museums, lecture halls and meeting venues. Intuitively, we know it is possible to distinguish a strong or active agent (e.g. a political activist) from a weak or inactive one by looking at their actions, choices, and the type of arenas they regularly attend.

There is no doubt that an individual's multiple roles often overlap. For example, purchasing and reading a book can be seen as an information activity of an information agent, but it can also be seen as a cultural consumption activity of an economic agent. However, this overlap does not change the fact that from the perspective of each role, we see a unique side of the individual that differs from what we see from other perspectives. Intuitively, we also know that a strong agent in one role does not necessarily make a strong agent in another role. Just as we cannot assume a political activist to be definitely wealthy, we cannot assume a wealthy person to be definitely information savvy.

It can be argued that the information poor are people who are relatively weak in their role as information agent. Therefore, a measurement that can distinguish the information poor from the information rich needs to be based on a concept that reflects as holistically as possible the characteristics of individuals as information agents.

The concept of an individual's information world is meant to be such a concept. It is developed through an empirical study examining how people differ informationally (Yu, 2010, 2012) and is defined as a space-time-intellect delimited sphere in which sources of information are accessed and converted into a personal information resource base and information assets through intentional, conscious and involuntary information practices that are performed by the individual as an information creator, provider, transmitter, seeker, receiver and user. According to this concept, one's information world can be described by three key parameters: the substances, the dimensional boundaries and the dynamics for change.

The substances of one's information world consist of all the objects that the individual-as-information-agent can act upon. These objects are related to the individual (hence are able to differentiate individuals) on four levels. On the first level are sources of information that are physically available to the individual – these are sources that are provided or exist near the individual. In this respect, there may be people who have in their vicinity a great variety of sources that modern society affords for informational purpose (libraries, bookshops, museums, exhibitions), and in their social networks people with different expertise; but there may also be people who have neither sources of information nearby nor knowledgeable persons in their social networks. On the second level are sources of information which the individual is able (both physically and intellectually) and willing to access. For those who are guaranteed the physical availability of certain sources, accessibility may still be prevented by limitation of economic affordability, literacy, habit, preferences and/or lack of awareness. A person who cannot or does not read, for instance, may choose not to access either libraries or bookshops. In this case, even if there are libraries and

bookshops in the person's vicinity, this availability does not result in accessibility. On the third level are information resources that the individual uses regularly enough to claim "usership." Two people who both use the city library regularly may use very different categories of information therein (e.g. academic vs fictional), and are entitled to claim usership only over the type of materials they regularly use. On the fourth level is the specific information (information in certain books, articles, etc.) that the individual has actually used and the knowledge and skills he/she has thus acquired. Two people who are similarly positioned on all the first three levels may still differ on this level because of, for instance, the amount of time spent on information acquisition, reading speed and intelligence. The coexistence of these four levels suggests that people who have the same substances to act upon at lower levels can be further differentiated by the substances at higher levels. Each of these levels therefore tells something about the individual's information world that other levels cannot, and ought therefore to be taken into account when designing measurement for assessing information inequality.

The dimensional boundaries (as opposed to geographical boundaries) of one's information world refer to the spatial, temporal and intellectual delimitation within which the individual regularly access and utilize the above substances as a conscious information agent. The spatial boundary refers to the physical and virtual spaces that one attends for informational purpose. Empirical evidence shows that people differ greatly in this regard (Yu, 2012). On the one hand, some people not only regularly visit many types of spaces that society establishes for informational purposes but also frequently transform non-informational spaces (the dining room for instance) to serve their informational purpose. On the other hand, there are people who seldom visit society's informational spaces and rarely use non-informational space for informational purposes. The time boundary refers to the amount of time that one spends as a conscious information agent. The intellectual boundary refers to the level of intellectual sophistication that characterizes one's process of information access and utilization. Like the space and time dimensions, one's intellectual sophistication plays an important role in setting the scope of one's information accessibility. A person who can master English, for instance, will have access to a much wider range of information resources than her Chinese-only colleagues; a person who is skillful in information searching has more opportunities to be led to a wider range of information than one who is not; and a person who tends to think critically and analytically is more likely to rely on information than one who does not.

The dynamics of one's information world refer to forces generated by the individual's information practices that cause its substances and boundaries to change. For example, the action of reading a book will add something new to the individual's information assets, thereby making the information world different from before reading the book. Empirical evidence (Yu, 2010, 2012) shows three types of information practice that people regularly perform both at work and in everyday life: intentional practices driven by specific needs to solve certain problems, conscious information practices driven by general needs to keep oneself up to date with certain fields or certain affairs and involuntary information practices which are driven by non-informational purpose but happen to involve information acquisition. While the last type of practice is normally performed by individuals in their roles other than as information agents, they do sometimes add useful information to the individual's information world without the person realizing it, or invoke the other two types of information practice which then consciously alter the individual's information world. So it can be argued that all three

types of information practice provide dynamics for an individual's information world to change, and that the more frequently the individual performs these information practices the greater the dynamics of his/her information world.

Like Savolainen's (1995) "way of life" and "mastery of life," the concept of an individual's information world is meant to describe the informational characteristics of individuals and their aggregates rather than communities or social environments. In light of the major theoretical constructs of this concept, the information poor can be defined as those whose information worlds are inadequately developed. More specifically, the quintessential information poor are those who have limited available and accessible sources of information, a limited range of materials over which they can claim "usership," limited accumulation of used information and acquired knowledge and skills; who are confined in space, time and intellectual sophistication for accessing information; and who are inactive in conducting information practices to increase the substances and boundaries of their information worlds. If appropriately operationalized, the concept may serve the purpose of measuring and discriminating individuals into groups of information rich and poor.

4. Development procedure of the measurement for an individual's information world

Based on the above conceptualization of an individual's information world, this study develops a questionnaire-based, index-deriving instrument for measuring individuals by their information worlds. The development procedure consists of the following four steps. First, the theoretical constructs as explicated in Section 3 are operationalized into eight variables which are in turn measured by a number of observable variables (items). Second, drafts of the resulting questionnaire underwent five rounds of testing and revision, each with a small group of different people (five to ten). This process ended when people participating in the test stopped raising questions while filling in the questionnaire. Third, items included in the questionnaire were weighed according to their importance in the context of the variable they intended to measure (e.g. importance as sources of information in general), through a process of consultation with a group of LIS scholars. A weight for each item – to be used for calculating the score of each variable – was obtained by averaging the rating of these scholars (see section 5.2 "Weights of variable items" for details). Fourth, a formal pilot study was conducted to test the validity and reliability of the measurement. For validity, the measurement was tested by its ability to predict the difference between two groups of people who are known to be informationally different; for reliability, it was tested by its ability to gather consistent answers from the same group of people at two different times, one week apart.

Having achieved acceptable validity and reliability, the questionnaire was applied to surveying information inequality among and between Chinese urban and rural residents as part of a National Science Foundation of China project (Yu and Zhou, in press). In both the urban and rural surveys, the researchers observed some minor problems in the questionnaire design, which led to some adjustment of presentations and items. As these are all minor changes, the study did not conduct a new formal test of validity and reliability. The final version of the questionnaire is provided in Table AI to this paper. In a recent PhD study on the influence of different pedagogies on students' informational characteristics, the questionnaire has also been adapted to suit middle school students.

5. The resulting measurement

5.1 Variables

Based on the theoretical constructs explicated in Section 3 and through the operationalization procedure described in Section 4, the three parameters of an individual's information world are operationalized into eight variables. The substance parameter gives rise to four variables corresponding to the four levels of substance. These are called, respectively, information availability, information accessibility, information resource base and information assets.

By definition, the construct of "availability of sources of information to an individual" refers to sources which actually exist near the person. In practice, as it is not possible to ascertain the existence of such sources for every person surveyed, the variable "information availability" is measured instead by first asking the respondents to indicate as far as they know which of the given sources (e.g. libraries, museums/exhibition centers, government information access outlets, the internet and people with different expertise) are physically available to them, and then weighing the selected sources to form the item scores which are then added up to form the variable score (procedures for weighing the items and calculating the variable score are presented in detail in section 5.2). As such a variable in fact measures a person's awareness of the availability rather than the objective availability itself, it is therefore a proxy variable for the "availability of sources of information" construct.

The "information accessibility" variable and the "information resource base" variable are operationalized in a similar way: by asking the respondents to select from the given items and then weighing the items to form item scores which are then added up to form the variable scores. The "information accessibility" variable is measured by asking the respondents to indicate which of the given sources of information they have the opportunity, ability and willingness to access; the "information resource base" variable by asking the respondents to indicate which of the given categories of information they used within six months before the survey, where the given categories of information are formulated by crosstabing major types of format (books, journals/magazines, newspapers, TV programs, websites) with major types of content (stories, knowledge and facts, practical instructions, policies, news). One's information resource base consists of the categories of materials that he/she used within six months before the survey.

By definition, the theoretical construct "information assets" refers to the accumulated amount of information one ever used and all the knowledge he/she has thus acquired. As it is difficult if not impossible to measure one's life-long accumulation of information assets, the construct is again measured by a proxy variable: it is measured by asking the respondents to indicate on a four-level ordinal scale (ranging from 0 to 3) the quantity of materials that they actually used within the six months before the survey, and then multiplying the ordinal score with the weight assigned to each category to form item scores, which are then added up to form the variable score.

As the "information resource base" and "information assets" variables involve the same categories of information, the two variables are measured by the same set of questions in the questionnaire instrument (questions 7-12) but, from responses to these questions, the former takes a binary value and the latter an ordinal value.

The dimensional boundary of one's information world is operationalized into three variables – space, time and intellectual sophistication. The space variable is measured by asking the respondents to indicate in which of the given places they have accessed, received or used information within the 12 months before the survey for the purposes

of problem solving, learning, and current awareness; and then weighing the selected items to form item scores which are then added up to form the variable score. The time variable is measured by asking the respondents to indicate on an ordinal scale the number of hours they spend daily on accessing, receiving or using information for the purposes of problem solving, learning and current awareness. The selected level forms the variable score directly.

The theoretical construct of "intellectual sophistication" shares great affinity with the concepts of "intellectual ability" and "cognitive ability" in education and psychology, which are normally measured by specially designed tests. Considering the difficulty to operationalize this type of construct in a survey instrument, this study chose to focus on factors that have direct bearing on one's information accessibility. It asks the respondents to indicate: their ability to read materials in their mother tongue and the second language on a four-level scale; their ability to search for information, respectively, in work and everyday life contexts on a four-level scale; and their ability to critically analyze the information obtained from television and texts on a three-level scale. These are totaled to form the variable score.

As explained earlier, the dynamics of one's information world depend on how frequently the person performs the three types of information practices. The dynamics of one's information world are therefore operationalized into one variable (called "dynamics") which, in turn, is measured by nine observational variables showing, respectively, the frequency with which the individual performs intentional, conscious and involuntary information practices with conventional documents (books, periodicals and newspapers), the internet and TV programs, respectively, (3×3), all on a three-level ordinal scale. Both the type of information practices (purposes of information activities) and the type of media are weighed and then multiplied by the frequency to form scores for the nine observational variables; these are then added up to form the overall score of the dynamics variable.

According to the explication of the theoretical basis of these variables in Section 3, it is logical for the measuring instrument (the questionnaire) to begin with the substance variables, followed by the boundary variables and then by the dynamic variable. However, tests of the earlier versions of the instrument with small groups of people show that respondents find it easier to follow when the instrument begins with the dynamic variable. Variables in the questionnaire are arranged to conform to the respondents' preference. The complete set of variables and the corresponding items in the questionnaire are shown in Table II.

5.2 Weights of variable items and the calculation of variable scores

In defining an individual's position in information inequality, different sources (e.g. libraries, internet, television, social networks), resources (e.g. categories of books, television programs and websites) and practices (intentional, conscious and involuntary) may play different roles with some being more significant than others. LIS has believed that there exists a certain order among different sources and resources of information in terms of information richness or utilities (Childers and Post, 1975). Libraries, for instance, have been regarded as one of the most important sources of information by LIS scholars; some even went so far as to define the information rich and poor by individuals' use and non-use of this source (Parker cited in Swartz, 1975; Sweetland, 1993). Since the 1990s, the internet has been perceived as equally important, to such an extent that access to ICT or lack of it is also seen as a dividing line between the information rich and poor. This mandates a process to weigh different sources,

624

Variables	Definition	Measurement	Questions in the questionnaire
Information availability	Physical availability of sources of information within one's vicinity and social networks	Total score of sources of information that exist within easy reach from where the individual lives or works	Questions 4, 5
Information accessibility	Accessibility enabled by both availability and the person's ability, interest and willingness to use	Total score of sources of information that the individual has the opportunity, ability and interest and willingness to access	Question 6
Information resource base	Categories of information which the individual accesses regularly enough to claim usership	Total score of categories of information used in the past six months	Questions 7-12 (0 or > 0)
Information assets	The accumulated amount of information used and knowledge acquired	Total score of information that the individual actually used in the past six month	Questions 7-12 (quantities)
Space	Range of venues that the individual visits for informational purposes	Total score of venues in which the individual accesses, receives and utilizes information within 12 months before the survey for the purposes of problem solving, learning and current awareness	Question 13
Time	Amount of time spent on activities for informational purposes	Number of hours spent daily on accessing, receiving and utilizing information for the purposes of problem solving, learning and current awareness	Question 14
Intellectual sophistication	Literacy and cognitive abilities with which an individual accesses, receives and utilizes information	Total score of: level of literacy for native and a foreign language, respectively; complexity of search strategies used for work and life-related information, respectively; level of information processing with TV programs and texts, respectively	Question 15-17
Dynamics	Forces generated by the individual's information practices that change the substances and boundaries of his/her information world	Total score of intentional, conscious and involuntary information practices with conventionally packaged materials, the internet and television programs	Questions 1-3

Table II.
Variables for measuring an individual's information world

resources and practices if they are to be used to measure the information rich and poor. For the majority of items involved in the information world variables, however, there are no solid theoretical justifications to place them in order of significance. This study therefore invited nine LIS scholars to rate the importance of each items in the general context of each variable (not in relation to their own needs) on a seven-level scale. The average rating of each item is calculated and all items are ordered according to their average ratings. The one with the lowest average rating is assigned the weight 1 and the one with the highest rating the weight n ($n =$ the number of all items ordered; items with the same rating are given the same weight). The weights of the questionnaire items are shown in Table III.

Items	Weight	Items	Weight
Information activities for problem solving	2	Stories as a category of information	1
Information activities for learning/current awareness	2	Knowledge as a category of information	3
Information activities for recreation	1	Instructions as a category of information	3
"Read conventionally packaged materials" as information activities	2	Policies, laws, e-government as a category of information	2
"Browse/search the internet" as information activities	2	News as a category of information	2
"Watch TV" as information activities	1	Libraries as a type of information space	4
Libraries as a source of information	2	Museums as a type of information space	3
Bookshops/news stands as a sources of information	1	Training venues as a type of information space	4
Government information outlets as a source of information	1	Meeting venues as a type of information space	3
The internet as a source of information	3	Bookshops as a type of information space	2
Government officials as a source of information	1	Places on a journey as a type of information space	1
Researchers as a source of information	3		
Professionals as a source of information	3		
Journalists as a source of information	2		

Table III.
Weights of items in
the measurement of
an individual's
information world

To observers of the information landscape of contemporary society, the experts'
rankings in Table III are perhaps not much surprising. In the context of each variable,
items associated with active information seeking (e.g. problem solving and learning/
current awareness), concentrated information sources (e.g. libraries, the internet),
knowledge and instruction providing sources (e.g. knowledgeable social networks and
books/journals containing knowledge) are rated more important than other items. It can
be argued that in an information-based society, "things" represented by these items are,
indeed, more likely to afford their haves or doers significant advantages, hence more
likely to make them information rich.

As already mentioned, the score of each variable is calculated as follows: where the
variables are measured by a group of items with binary values (yes and no), each
selected item (with the value yes) is first assigned the value 1 which is then multiplied
by its weight to achieve the item score. These item scores are then added up to form the
variable score. Variables "information availability," "information accessibility,"
"information resource base" and "space" are scored in this way. Take "information
availability" as an example. If a person selected "libraries" (weighed 3) and "the
internet" (weighed 3) as his/her available sources of information, his/her score on this
variable would be 6 $(1 \times 3 + 1 \times 3)$.

Where the variable is measured by a group of weighed items on an ordinal scale,
each item (or sub-variable) score is obtained by multiplying the selected level with the
item weight; the variable score is obtained by summing up all item scores. Variables
"information assets" and "dynamics" are measured in this way. Take the "dynamic"
variable as an example. As already explained, the variable is measured by asking the
respondent to indicate, respectively, the frequency with which he/she performs
intentional, conscious and involuntary information practices with conventional
documents (books, periodicals and newspapers), the internet and TV programs,

all on a three-level ordinal scale. The score of each sub-variable was obtained by multiplying its ordinal score (frequency score) with the purpose weight and then with the media weight. Supposing that a person indicates that she consults books and periodicals for problem-solving purposes often; with the weights for books, periodicals or newspapers and for problem-solving purposes being both 2, and the ordinal score for "often" being 3, then dynamics generated by consulting books and periodicals often for problem-solving purposes would be 12 (2×2×3). The final dynamic score is the sum of scores associated with information activities on all types of media for all purposes (i.e. all sub-variables).

Where the variable is measured by one or a group of unweighed items on an ordinal scale, the variable score is taken directly from the ordinal level selected by the respondent, or, in the case where multiple items are involved, by summing up the ordinal scores of all items. Variables "time" and "intellectual sophistication" are measured this way: the former by a single ordinal score; the latter by the sum of all associated ordinal scores.

In formal statistical analysis, these scores can be transformed into scores on the 100-point scale to facilitate data interpretation.

5.3 Validity and reliability of the measurement

As stated earlier, the purpose of this study is to develop a measurement for demarcating the information poor and rich. Therefore, for this instrument to be valid, it needs to be able to distinguish the information poor correctly from the information rich, i.e. to place into the information poor category those who are truly informationally poor and into the information rich category those who are truly informationally rich. For this purpose, a predicative (criterion) validity test is regarded as the most appropriate. With the predicative validity, a measurement is judged as valid if it produces a result coinciding with the result whose validity is certain, e.g. result produced by another validity-proved measurement.

As a validity-proved measurement does not yet exist, this study applied the measurement to two theoretically and intuitively distinctive informational groups. One consisted of 59 low-skilled migrant workers on a construction site and the other of 59 university students. The migrant workers had almost every feature of Chatman's (1996) impoverished small world: they were de-rooted from their home communities and lived a rather secluded life in the strange and unwelcoming urban environment and, at the time of the test, were deprived of most urban public services. Their contrastive group, the university students, on the other hand, were not only well-served by their departmental, university and city libraries, but also engaged in information intensive activities as a matter of routine. Related studies (Zhang and Yu, 2009; Mo, 2006) together also revealed that these two groups have markedly different information needs and behavior.

While these two groups differed greatly from each other, they also demonstrated notable homogeneity within themselves. The migrant workers all lived collectively in isolated accommodation close to the construction site, with access to few modern amenities apart from basic daily necessities and TVs; their lives (not simply their information activities) were very much organized by this environment and monotonous long working hours. The university students also lived collectively in university provided accommodation on campus, but with access to a range of modern facilities such as broadband networks, TVs, libraries, various clubs, etc., their lives were very much organized by the campus environment and activities. It is fairly safe

to believe that the two groups formed, respectively, a relatively homogeneous information poor group and a relatively homogeneous information rich group, and that they would differ from each other by a large scale on nearly all variables concerned. It can be assumed that if the measurement reveals the same result, there is a great likelihood that it is valid.

For the measurement to be reliable, it needs to be able to categorize and distinguish the information poor and rich consistently. To test the reliability of the measurement, this study applied it to the same group (27 university students) twice, with the first and second administrations of the questionnaire taking place one week apart. It is assumed that if the respondents provide the same answer to the same question in both surveys, then there is a great likelihood that the measurement is reliable.

Tables IV and V show, respectively, the comparisons between the students and migrant workers and between the two tests of the 27 students, based, respectively, on independent-samples t-test and paired-samples t-test. Table IV shows that there is a very large difference between the two compared groups, with the migrant workers a long way behind the students. This result coincides with our knowledge about these two groups, indicating a good predicative validity of the measurement in this case. Table V, on the other hand, shows that there is no significant difference between answers given at two different times by the same group. This indicates that the measurement has returned fairly consistent results about the group.

Initial application of the measurement to assessing information inequality in urban and rural Chinese societies has yielded some interesting results which can be well-related to existing theories of information inequality, such as the information have-less theory of Cartier *et al.* (2005) and Qiu (2009). The urban survey, for example, shows that four groups, instead of a binary "haves vs have-nots," best characterize Chinese urban society informationally, and that the distribution of people among these groups conforms to normal distribution, confirming the above authors' identification of a large section of information have-less in China (Yu and Zhou, in press). These findings, particularly their compatibility with existing theories, offer further evidence for the validity and reliability of the measurement.

Variables	Groups	Mean	SD	t	Sig.
Information availability	Students	12.46	3.303	10.359	0.000
	Migrants	5.27	3.814		
Information accessibility	Students	11.46	3.186	10.941	0.000
	Migrants	3.73	3.745		
Information resource base	Students	69.12	16.859	12.073	0.000
	Migrants	34.63	21.746		
Information asset	Students	131.20	41.714	9.629	0.000
	Migrants	53.78	36.546		
Space	Students	11.36	5.848	10.723	0.000
	Migrants	4.46	4.485		
Time	Students	2.20	0.610	7.19	0.000
	Migrants	1.12	0.745		
Intellectual sophistication	Students	39.49	6.358	8.657	0.000
	Migrants	14.22	8.092		
Dynamics	Students	81.08	11.542	18.8	0.000
	Migrants	39.68	28.452		

Table IV.
Comparison between the information world scores of migrant workers and university students

Variables	Tests	Mean	SD	t	Sig.
Information availability	First time	11.89	3.714	−0.215	0.831
	Second time	12.00	3.162		
Information accessibility	First time	9.96	3.808	−1.327	0.196
	Second time	10.89	2.651		
Information resource base	First time	62.07	15.512	−0.688	0.498
	Second time	64.56	18.523		
Information asset	First time	109.74	37.054	−0.483	0.633
	Second time	113.26	43.264		
Space	First time	10.63	5.464	2.040	0.052
	Second time	11.96	5.530		
Time	First time	2.04	0.649	1.363	0.185
	Second time	2.15	0.602		
Intellectual sophistication	First time	36.56	7.693	−1.422	0.167
	Second time	37.67	6.788		
Dynamics	First time	78.41	9.124	1.632	0.115
	Second time	74.48	13.377		

Table V.
Comparison between
the information
world scores
obtained at two
different times

Notes: Statistics in this table is based on weighed scores. An earlier set of statistics (Yu and Zhou, in press) was based on the scores before weighing. Both sets show that the instrument is able to return fairly consistent responses

6. Limitations

Initial application of the measurement to surveying information inequality in China has also revealed a number of limitations in the current version of the measurement and its instrument (the questionnaire). One of the major limitations of the measurement lies in fact in its intended advantage for information inequality research. In trying to offer a comprehensive criterion for identifying society's information rich and poor, the measurement, hence the questionnaire instrument, has incorporated a large variety of variables. Most observational items in these variables need to go through a weighing process to compute the variable scores. This has inevitably made the instrument rather complex to use. To make it even more complicated, the questionnaire begins with the dynamics variable and proceeds to the substance variables and then to the boundary variables, in line with the respondents' preference but not with the logical relationship between the theoretical constructs of an individual's information world. The second major limitation lies in the fact that a number of items (libraries, museums and bookshops) are used both as sources of information and as spaces. Although these are used to serve different purposes, their repeated appearance in the questionnaire does seem to have produced a degree of clumsiness and redundancy. The third limitation lies in the fact that while the measurement is meant to be based on the conceptualization of individuals as information agents, the operational variables has little to do with information production. In addition, the weighing of the informational items by a panel of LIS scholars may also be questioned by those who believe that only users judge significance of informational items. However, for this last limitation, there may not be a way out. The information inequality concept assumes inherently the comparability between individuals in informational terms, and consequently, assumes the possibility of a general value assessment of information sources and resources.

An ongoing PhD project at the Department of Information Resource Management, Nankai University, China, which attempts to adapt the instrument for a survey to compare the informational impact of different pedagogies seems to indicate that the

validity of the "information assets" variable may be sensitive to populations. When it is uncommon for a population to regularly use certain media (it appears uncommon for Chinese middle school students to regularly use conventional newspapers, for instance), the variable can return results that are biased in favor of those who occasionally use it. The fact that this variable includes a great many meticulous items (25 in total) may have also made it over-sensitive to the variation of the population. It is suggested that future studies which intend to use this measurement retest the validity of this variable and consider combining some of the items (e.g. to retain the distinction between information content but remove the distinction between media).

7. Conclusion

The purpose of this study is to explore whether it is possible to develop a multi-dimensional informational measurement to distinguish society's information poor and rich. It does so by developing and testing a measurement based on the conceptualization of individuals as information agents and the operationalization of an individual's information world concept. The resulting measurement simultaneously takes access, behavioral and cognitive dimensions of the information agent into account. With regard to the access dimension, it takes into account four levels of access: information availability (an individual's physical proximity to sources of information); information accessibility (an individual's opportunities, abilities, interest and willingness to access sources of information); "information resource base" (a person's eligibility to claim usership over certain categories of information); and information assets (a person's actual use of information and acquisition of knowledge). With regard to the behavioral and cognitive dimensions, it considers three categories for each: intentional, conscious and involuntary information practices for the behavioral dimension; literacy, information search and information analysis for the cognitive dimension. In this way, it provides a relatively comprehensive measurement of individuals as information agents.

Such a measurement may have multifaceted value for information inequality research. First, it can serve both the purpose of describing the informational characteristics of existing socio-economic groups and the purpose of discriminating the information poor from the rich. Once members of society are truly classified informationally, their experience can be studied more pertinently to improve our understanding of information inequality. This may lead us to heed new factors contributing to information inequality, e.g. different pedagogies. The resulting "information classes" can also be examined in relation to existing socio-economic classes to observe how they are correlated; this may uncover some complex relationships that have been, hitherto, obscured by the simple identification of the socio-economic poor as the information poor. Second, it can simultaneously measure and compare individuals from multiple dimensions and is, therefore, more able to reveal complex patterns of information inequality than any single factor-based measurement (e.g. public library use, ICT access). A study of the information inequality in contemporary urban China using this measurement, for example, has shown that the information rich and poor are advantaged and disadvantaged, respectively, in very different manners: the information rich are particularly advantaged in information availability and accessibility in comparison with the middle groups, while the information poor are particularly disadvantaged in information assets, information resource base (the range and type of information resources for which they can claim usership) and intellectual sophistication.

This study therefore shows that, in spite of the limitations of the measurement developed by this study, a comprehensive informational measurement based on the conceptualization of individuals as information agents is theoretically viable and promising. It can be further argued that if the theoretical prospects promised by this kind of measurement are realized, we may be better informed in devising strategies to intervene information inequality of the information society.

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Appendix

1. In your current work and life roles, how often do you conduct the following activities for recreational purposes?

Read books, periodicals or newspapers	① Never or rarely	② Sometimes	③ Often
Surf or search the internet	① Never or rarely	② Sometimes	③ Often
Watch television or listen to the radio	① Never or rarely	② Sometimes	③ Often

2. How often do you conduct the following activities for current awareness or learning?

Read books, periodicals or newspapers	① Never or rarely	② Sometimes	③ Often
Surf or search the internet	① Never or rarely	② Sometimes	③ Often
Watch television or listen to the radio	① Never or rarely	② Sometimes	③ Often

3. How often do you conduct the following activities for problem solving?

Consult books, periodicals or newspapers	① Never or rarely	② Sometimes	③ Often
Surf or search the internet	① Never or rarely	② Sometimes	③ Often
Watch television or listen to the radio	① Never or rarely	② Sometimes	③ Often

4. As far as you know, are these things within easy reach from where you live or work? Please tick if they are.

Libraries	❑	Museums or exhibition centres	❑	The Internet	❑
Bookshops	❑	Government information outlets	❑		

5. Are you acquainted with the following types of people?

Government officials	❑	Professionals	❑
Researchers	❑	Journalists	❑

6. Do you have the opportunity, ability and the interest in consulting the following sources of information?

Libraries	❑	Museums or Exhibition centres	❑	Researchers	❑
Bookshops	❑	The Internet	❑	Professionals	❑
Gov. Inf. outlets	❑	Government officials	❑	Journalists	❑

7. In the past six months, how many of the following BOOKs did you read? If you did not read, please tick "0"

	0	<5	5-10	>10
Books containing stories, biographies, prose, poems	❑	❑	❑	❑
Books containing knowledge	❑	❑	❑	❑
Books containing instructions	❑	❑	❑	❑
Books containing policies or laws	❑	❑	❑	❑

8. In the past 6 months, how many ISSUES of the following PERIODICALS did you read? If you did not read, please tick "0"

	0	<5	5-10	>10
Periodicals containing stories, biographies, prose, poems	❑	❑	❑	❑
Periodicals containing knowledge	❑	❑	❑	❑
Periodicals containing instructions	❑	❑	❑	❑
Periodicals containing policies, laws, or commentaries	❑	❑	❑	❑

9. In the past six months, how often did you read the following types of newspaper column?

	rarely	sometimes	weekly	daily
Pages containing stories, personal experiences, prose, poems	❑	❑	❑	❑
Pages containing knowledge	❑	❑	❑	❑
Pages containing news or commentaries	❑	❑	❑	❑
Pages containing instructions or advertisements	❑	❑	❑	❑

10. In the past six months, how long did you spend on watching the following television programs DAILY?

	Did not watch	Less than 1 hour daily	1-3 hours daily	More than 3 hours daily
Programs containing stories, personal experiences	❑	❑	❑	❑
Programs containing knowledge	❑	❑	❑	❑
Programs containing news or commentaries	❑	❑	❑	❑
Programs containing instructions or advertisements	❑	❑	❑	❑

Table AI.
Questionnaire for
measuring an
individual's
information world

11. In the past six months, how many times did you access the following web sites MONTHLY?

	Did not access	Less than 5 times	5-10 times	More than 10 times
Sites containing stories, personal experiences, games, videos	☐	☐	☐	☐
Sites containing knowledge	☐	☐	☐	☐
Sites containing news or commentaries	☐	☐	☐	☐
Sites containing government information or e-government	☐	☐	☐	☐
Sites containing instructions or social media	☐	☐	☐	☐

12. In the past six months, how many times did you consult the following persons?

	Did not consult	1-2 times	3-5 times	More than 5 times
Government officials	☐	☐	☐	☐
Researchers	☐	☐	☐	☐
Professionals	☐	☐	☐	☐
Journalists	☐	☐	☐	☐

13. In the past twelve months, in which of the following places did you access, receive or use information for the purposes of learning, current awareness, or problem solving?

Libraries	☐	Bookshops	☐	Museums/Exhibition centre	☐
Training venues	☐	Meeting venues	☐	During travel	☐

14. How much time do you spend each day on accessing, receiving and using information for purposes of learning, current awareness or problem solving?

Little	☐	1-3 hours	☐	5-10 hours	☐
Less than 1 hour	☐	3-5 hours	☐	More than 10 hours	☐

15. When using search engines, library catalogues or databases, how do you usually do the search?

	① Use simple search	② Use advanced search	③ Use professional skills like word truncation
For life related information	☐	☐	☐
For work related information	☐	☐	☐

16. Which of the following levels most closely describe your reading abilities in your mother tongue and second language?

	① Cannot read at all	② Can read simple stories	③ Can read newspaper or manuals	④ Can read academic works
Mother tongue	☐	☐	☐	☐
Second language	☐	☐	☐	☐

17. Which of the following most closely describes your ability to process information received from television or texts?

	① Able to comprehend	② Able to make relevance or value judgment	③ Able to engage in critical analysis
Television programs	☐	☐	☐
Textual information	☐	☐	☐

Table AI.

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635