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RUNNING HEAD: Cross national comparisons of Internet use

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Abstract

In studies that compare Internet use between groups, factor analysis is often used to create broader categories of use. Composite variables are constructed using a factor structure that fits the overall data. This approach overlooks tests that show whether the constructs are valid and whether items relate similarly to the general constructs in different countries. In this study World Internet Project survey data were submitted to multi-group latent variable analysis and tested for configural and measurement invariance to illustrate why these tests might be important in cross-national comparisons. It was found that while the general Internet use constructs were applicable across national contexts, the way in which the items contributed was different.

Keywords: Internet Use, Cross-national Comparisons, Methodology, Uses and Gratifications, Factorial Invariance.

A common strategy to examine the ways in which people engage with media is to classify content into different categories and then describe which types of people or groups of people use the media in ways that correspond to these categories. The Uses and Gratifications (U&G) framework is most commonly associated with this approach (Katz & Aspden, 1997; Rosengren, Palmgren, & Wenner, 1985) but others have also used the same strategy without explicitly placing themselves within this paradigm (e.g. Hills & Argyle, 2003).

U&G based approaches to media use start from the premise that individuals have different needs and that they choose specific media to gratify these needs. Self-reports in surveys are used to measure the needs that people have (Rubin, 2008) and statistical methods such as factor analysis are used to classify types of uses (Dobos & Dimmick, 1988).

In the U&G paradigm researchers assume that it is the differences between individuals' characteristics and needs that determine who uses the Internet for what. This assumption has been criticized for ignoring wider social forces that act on an individual's preferences and for placing too much emphasis on individual consumption (Massey, 1995; Ruggiero, 2000). As an alternative, structuration and political economy theorists propose that contexts such as national characteristics and infrastructures limit individual agency and thus media use (Ang, 2006; Lievrouw, 2001; Severin & Tankard, 2009). Research based on collection of data on individuals in one context cannot therefore be generalized to others. Conversely, cross-national comparison is one area of research that can give

researchers insight into how macro (socio-cultural) factors are related to the take up of certain online activities (e.g. Blake & Neuendorf, 2004; Hermeking, 2005; Westlund, 2010).

Most studies on cross-national comparisons of Internet use tend to conduct simple descriptive analyses to compare percentages or averages on items between countries (e.g. Eurobarometer, 2010; WIP, 2009; World Bank, 2010). There are a few that go further and do multivariate analysis using composite measures of use. The categories of use are mostly determined through factor analyses on all the individual countries in international datasets which are subsequently used to compare countries (e.g. Raban, 2004; Helsper & Galacz, 2008; Wellman et al, 2002). These thus use the same analytical strategy as U&G researchers do to determine micro-level (individual) differences.

This paper argues that these comparative studies of Internet use, even when based on different theoretical premises, commit the same fallacy by assuming that the structure or classification of the data is the same between different groups of individuals. That is, in each country the same items measure the same constructs and thus the factorial structure is equivalent for people from different countries or social groups. However, this assumption is rarely tested in media studies. Work in other areas shows that this assumption might be erroneous. Frequently, constraining measurement models to be equal across countries results in models with poor fit, suggesting that the same items do not measure the same constructs across different groups or countries and that conclusions about similarities or differences are problematic (e.g. Davidov, Meuleman, Billiet, &

Schmidt, 2008; Davidov, Schmidt, & Schwartz, 2008; Heyder & Schmidt, 2003). As such, testing whether the measurement of concepts is equivalent across populations should be a prerequisite when working with cross-group comparisons (Vandenberg & Lance, 2000) on media and Internet use.

Therefore this paper aims to answer the following general methodological question in relation to cross-national research: *Are researchers comparing the same constructs when they compare different categories of Internet use across national boundaries?* More specifically, *are factor structures similar across different countries?*

While this paper focuses on cross-national comparisons, the conclusions are thought to be relevant to comparisons between different groups of individuals (e.g. gender or age comparisons) often made in U&G research. Partly because the Internet has grown to embrace an extremely wide variety of functions and a seemingly infinite supply of constantly updated content, its emergence as a mass medium has refreshed an interest in classifying functions of media (Flanagin & Metzger, 2001, 2003; Papacharissi & Rubin, 2000; Ruggiero, 2000; Stafford, Stafford, & Schkade, 2004).

Background

There are a variety of approaches for explaining how people use media. This section outlines those that have been most commonly applied to cross-national and group comparisons. It focuses on the U&G framework since this has been the basis of most

attempts at classifying the range of Internet uses and it has also influenced other areas of research.

U&G's point of departure is that *"the media choices that people make are motivated by the desire to satisfy a wide variety of functions . . . the research on uses and gratifications has been concerned with identifying the specific gratifications satisfied by the use of media"* (p. 48, Cho, Gil de Zúñiga, Rojas, & Shah, 2003).

U&G research is concerned not only with the gratifications that people seek but also with the gratifications that people obtain. Often this research uses quantitative survey methods, almost inevitably entailing the use of factor analyses to group different gratifications sought and different groups of applications or uses together into the psychological functions they serve (i.e. needs) and the genres of use (i.e. gratifications obtained). In traditional broadcast media research, uses of media have been classified according to two main functions: instrumental or cognitive (e.g. information seeking) and ritual or affective (e.g. entertainment, passing time) (Dobos & Dimmick, 1988; Rubin, 2008; Weiser, 2001).

After the emergence of Internet as a popular medium, Internet researchers started to apply factor analyses to understand which genres of use exist and whether Internet use can be classified in the same ways as the uses of traditional media. They mostly come up with the same basic categories – information seeking and entertainment – and often an additional social use category (Eighmey & McCord, 1998; Papacharissi & Rubin, 2000;

Song, LaRose, Eastin, & Lin, 2004; Stafford, Stafford, & Schkade, 2004). The work of social capital theorists (see Castells, 2007; Wellman et al, 2002) has led to a more nuanced classification of social uses that separates early forms of digital communication such as emailing from social media applications such as social networking. A number of studies have also looked specifically at uses related to individual and social identity building (e.g. Valkenburg et al, 2005). However, most general studies on Internet use do not include enough different items to make these fine grained distinctions and when exploratory factor analyses are conducted a general or at most two categories of social use are found.

This paper will use the following categories, which have been identified consistently over time, to measure Internet use: Information, Social/Communication, Entertainment, and Financial/Commercial engagement (Ayhan & Balci, 2009; Eastin, 2005; Kargaonkar & Wolin, 1999; Raban, 2004; Song, Larose, Eastin & Lin, 2004). It is possible to make more fine grained distinctions within these categories and include a wider variety of uses and this has been done elsewhere (e.g. Helsper & Galacz, 2008). However, in a context where countries are at varying stages of adoption of Web 2.0 comparisons using more fine-grained distinctions inhibit cross-country comparisons, as they make invariance even more difficult to establish than for more general communication categories.

This paper is concerned with improving survey research on cross-national comparisons of Internet use, as opposed to making a theoretical contribution about Internet use. The broader categories help make this methodological point because they are more robust and

invariance is more likely. By using this best case scenario, the paper can offer a methodological critique of the statistics commonly used in cross-national and social group comparisons in U&G research and in cross-national studies in general. It does this by suggesting testing for measurement invariance as a fundamental prerequisite for comparative, quantitative Internet research.

To give an overview of the field, the paper will start by discussing the issues that have come up in studies that have tried to categorize uses of the Internet. This will be followed by a discussion of measurement invariance in social group comparisons and the issues of comparability found in these studies. These studies highlight the importance of testing for measurement equivalence since issues even occur when comparing different socio-demographic groups within a country and thereby set the scene for comparing Internet use across countries. Thereafter a specific case of cross-national comparisons in Internet use will be used to show that given translation and other problems it might be even more difficult to find measurement equivalence in such studies.

Classifying Internet use

One of the issues for current researchers is that the Internet studied at the beginning of the 21st century is different from the Internet the one a decade later. For example, in 2007 social networking was a 'to do' activity for the first time, while two years later it has become common place and now Twitter is the latest 'to do' activity in many countries (boyd & Ellison, 2008; Dutton, Helsper, & Gerber, 2009; Livingstone, 2008). Anderson and Tracey (2001) therefore argue that the Internet should not be studied as a single unit,

as it is a "*delivery mechanism for a range of services that are continually evolving and are used differently by different people*" (p. 462). Yet, to our knowledge, despite its relevance, there are no studies that have tested for measurement invariance of Internet use over time.

While studies in other areas have found similar factorial structures when considering different time spans (e.g. Barbosa-Leiker et al, 2011 for metabolic syndromes and Wu et al, 2009 for life satisfaction), it is unclear whether these findings of invariance in other areas of social science can be replicated for Internet use. The fact that both activities and user problems rapidly change on the Internet could be problematic when creating classifications of Internet use (Center for the Digital Future, 2009; Dutton, Helsper, & Gerber, 2009; Pew Internet & American Life Project, 2010). Classifications used for previous generations of Internet users can thus not be automatically applied as a template for more studies on current Internet users, even if the same measures/items are used. For instance, the earlier discussed social capital and identity construction uses were not measured as separate Internet use categories in more general Internet use studies until 2009 and then mostly in studies done in Northern Europe and the US. Since these are recent classifications it is not possible to discuss how these types of uses have developed, simply because they were not measured before. In the case of cross-national comparisons, this change in what the Internet is is even more problematic because different countries are at different stages of diffusion and therefore also likely to be at different stages of development in Internet uses.

Thus even when longitudinal surveys exist with the same items measured over time, their temporal context might have changed the way in which items relate to broader uses and this might be different in different countries. Browsing might still be browsing but on a higher level it might have changed from fulfilling an information function to fulfilling an entertainment function. Therefore it seems that there are as many classifications of Internet use as there are studies and that classifications and their interpretation have changed over time. It also means that when researchers want to know whether people's engagement of a certain type has increased in different countries it might be equivalent to comparing apples with oranges even if they use the same items. In addition, Internet research often combines items about applications, functions, and settings to create categories of Internet use that muddles the field further (LaRose & Eastin, 2004). The latter makes any classification of Internet content a challenge.

Social group comparisons

In studies that do comparisons between groups within one country, comparisons are usually based on social status, gender, age, ethnicity, and education levels. Here measurement invariance might be expected to be more likely and a few studies suggest that for technology related issues this might be the case. Measurement invariance was established for technology acceptance by different gender, age, and digital skills groups (Lai & Li, 2005) and for the intention to use technology by different genders (Teo, 2010). However, research in other areas suggests that the composition of underlying constructs (and thus factor structures) is not the same in different socio-demographic groups when it comes to behaviors (Chen, 2007). Research that examines this for different types of

Internet uses seems to be absent. This is problematic because the use of factor analysis is very common in comparisons of Internet use by different groups.

Most existing studies that describe the differences in Internet use between gender, age, and other socio-demographic groups, apply an approach based on a factor analytical-descriptive comparison of scales. For example, Jackson et al. (2001) described the differences between men and women based on six factors they found through exploratory factor analyses and came to the conclusion that men were more likely to use the Internet for cognitive (information seeking) purposes and women were more likely to use it for social (communication) purposes. Weiser (2000) using similar methodologies found a preference of women for social uses (communication) and of men for affective uses (entertainment) of the Internet. Other studies using a slightly different classification but based on factor analysis also concluded that men and women use the Internet differently (e.g. Wasserman & Richmond-Abbott, 2005). Cho et al. (2003) examined socio-economic status and age differentials, whereby younger well off Internet users were more likely to engage in categories (factors) of uses that could be considered instrumental and were more efficient at finding the types of uses that would satisfy the gratifications they sought. Helsper and Eynon (2009) using a similar approach came to the conclusion that older people are less likely to engage with most activities with the exception of instrumental finance and civic engagement activities. The only qualification they make is that generational differences can be explained to a large extent by other experience and skill variables. Hills and Argyle (2003) also found generational and gender differences

between their constructed home use factor (more by older participants), and work and social factors (more by younger people).

What all these studies of Internet use have in common is that they deduce the factors of use based on a factor analysis of uses in the whole population and assume that these factor structures fit the generational or social groups they are comparing. If they lack similarity, it would mean that comparing factors across groups is erroneous because the same items are differently contextualized within each group.

National comparisons

The same critique expressed earlier for comparisons between social groups is valid for cross-national studies based on factor analyses; they assume that the relationship between use items is the same across different countries.

In cross-national research a lot of effort goes into translating items so that they signify the same thing in different countries, and country specific examples of social networking sites or other online spaces are often provided to ensure that participants are discussing the same type of application. After effort has been invested in translation, not many cross-national surveys on Internet use check whether direct comparisons of items or factors of use across national boundaries are generating errors. Nevertheless, the validity of comparisons based on these items might be limited because researchers have to assume that the well-translated items relate in the same way to one another across different countries.

Given the difficulty of translating items to different languages in addition to other possible cultural differences in Internet use, measurement invariance might be more difficult to establish when comparing countries. In fact research in diverse areas has consistently failed to find invariance across countries. Examples include studies on social values (Davidov, Meuleman, Billiet, & Schmidt, 2008; Davidov, Schmidt, & Schwartz, 2008; Heyder & Schmidt, 2003), engagement with technology and science (Stares, 2009), national identity (Heath, Martin & Spreckelsen, 2009; Medina, Smith & Long, 2009) and consumer behavior (Benedict, Steenkamp & Baumgartner, 1998). In all these studies, constraining measurement models to be equal across countries resulted in models with poor fit, suggesting that the same items do not measure the same constructs across different countries.

There are only a few studies with research in a cross-national context that would allow a detailed classification of engagement with digital content similar to that done for within country group comparisons. This research is scarce mostly because it is costly to conduct the large-scale cross-national research projects these types of classifications require. Nevertheless, there is increased pressure from international organizations and bodies such as the EU and the UN to conduct cross-national comparative research. This is especially true in the case of the Internet, since it is the first medium that knows few national boundaries (Shea, Ariguzo, & White, 2007). Key examples of studies that collect detailed cross-national information on types of use and access to technologies are, in Europe, the Eurobarometer (e.g. Eurobarometer, 2010), and, in the rest of the world, World Internet

Project (World Internet Project, 2009) and studies by the World Bank (e.g. World Bank, 2010) and the United Nations (e.g. UNDP, 2001). Since the measures of uses are usually rather limited in these cross-national comparative studies, the analysis mostly focuses on access, infrastructure, and very basic types of engagement. Even those databases that do have different types of use data – such as the WIP and the Eurobarometer – often stick to descriptive item level comparisons. Similarly, the e-Living study that included 6 European countries and identified 3 clusters of usage based on 9 items (Raban, 2004) never looked at the validity of the cross-national comparability of Internet use types. As several large scale surveys are planned over coming years (e.g. EU Kids Online[1]; ICT and Youth at risk of social exclusion[2]), the moment is opportune for validating the analytical strategies that are most likely to be employed.

One study by Helsper & Galacz (2009) factor analyzed the WIP data and found that within Europe there were some country differences between Britain, the Czech Republic, Sweden, and Hungary. Sweden in particular was found to be more instrumentally oriented. Chen et al. (2002), using data from a national geographic web survey, categorized uses into instrumental and recreational but found very few differences between world regions. Similarly, Wellman et al. (2002) using the same data did not find differences in social network uses. One critique of the last two studies would be that the questionnaire was only available in English and only to people who subscribed to or visited the National Geographic website which is likely to have skewed the sample.

[1] http://www.lse.ac.uk/collections/EUKidsOnline/
[2] http://is.jrc.ec.europa.eu/pages/EAP/eInclusion.html

This paper will contest the implicit assumption that broad classifications of Internet use can be compared cross-nationally by testing whether Internet use factors are similar (i.e. comparable) across different countries.

Explanations of cross-national differences

Another problem with many cross-national comparisons of media use is that there is often no hypothesis about what explains differences between countries. This leads to ad hoc explanations of differences instead of a priori directed testing of hypothesized differences or similarities. Culture is often used in this ad hoc way to explain the differences. Katz and Aakhus (2002) and Campbell (2007) have conducted research on mobile phones that points towards cultural differences in the interpretation of information and communication technologies (ICTs) and their function. Nevertheless, they did not have a priori hypotheses about which aspects of culture were supposed to have effects and their models were descriptive rather than predictive of differences. Others have suggested that telecoms and media policy frameworks explain take up of different ICTs (Hasebrink, Ólafsson, & Stetka, 2010; Trepte, 2008).

Studies with traditional broadcast media have focused on cultural proximity as an explanation of media use (see for example, Hoskins & McFadyen, 1996; Straubhaar 1991, 2007). Various authors have pointed out how important linguistic proximity is in this context (Kaizek & Webster, 2008; Straubhaar et al., 2002). Language is thereby used as a proxy for cultural similarity, although similarities in language are often associated with similarities in socio-political systems and economic development as well as cultural

similarities. In a different study Trepte (2008) shows that while Hofstede's (2001) framework is useful for understanding media use, geographical proximity is a better indicator of proximity in the evaluation of content. Schwartz' (2009) model that looks at the complications of cross-cultural research also includes linguistic and geographical proximity amongst the indicators of cultural proximity in values. It therefore seems that the framework of cultural proximity for cross-national comparisons in Internet use could be an interesting, but so far unapplied, way of theorizing about the underlying processes in interpretation of and engagement with internet activities.

While this paper adopts the cultural proximity framework as used in other comparative media research, its main aim is not to design an explanatory framework for cross-national differences in Internet use. Without a priori hypotheses about explanations of differences it is impossible to conduct tests of measurement invariance on a diverse group of countries. This particular paper restricts itself to a methodological critique and applies two commonly used indicators of cultural proximity (linguistic and geographical proximity) to explore whether cross-national comparisons in Internet use are plausible. Other starting points and other types of cultural classifications could have been used for comparisons, such as the differences in Internet diffusion history or differences in the characteristics of the Internet using population. This choice was made with full awareness that there are problems with the way in which cultural proximity has been operationalized and applied conceptually in cross-national research (e.g. Schwartz, 2009) [2]. To make its main, methodological point, this paper uses these classifications of culture to guide the analyses and contextualize the findings. While the paper examines differences and

similarities in factor structures across countries that are culturally proximate, the paper does not attempt to draw definite and comprehensive theoretical conclusions about the explanations for differences between countries. Given the limited number of countries considered in this study and the associated low variability in characteristics, it is not possible to study which specific characteristics associated with cultural proximity might explain *why* countries do or do not differ in their factor structures. Further research will have to explore the theoretical implications of the results presented in this paper.

This paper limits itself to hypothesizing that *countries that share the same language or are geographically proximate, that is those that share indicators of cultural proximity, will have similar factor structures of Internet use, while structures will differ when these contexts differ*.[3]

Before presenting the analysis and the results it is important to note that qualitative research would be able to offer insight into the interpretation of items by different individuals from different countries but it does not allow for generalizations or objective testing of whether different activities group together in the same way at a national level. It would also not allow for comparisons of these relationships across a variety of countries. In this paper tests of measurement invariance are used to examine this hypothesis on the World Internet Project (WIP) 2007 data (World Internet Project, 2009).

Methodology

Measurement invariance – also called factorial invariance – is concerned with the equivalence of factors across different groups, both in terms of their measurement and of their structural relationships (Byrne, Shavezlson, & Muthen, 1989). As Kline (2005) put it in everyday language, measurement invariance indicates *"…whether a set of indicators assesses the same constructs in different groups.*" (p. 295)

Testing for multi-group invariance allows researchers to examine whether the items of a measurement instrument work in the same way across populations and whether the factorial structures can be considered equivalent. Invariance is tested by constraining certain parameters to be equal across populations (e.g. factor loadings and factor variances/covariances) and by testing the fit of increasingly restrictive models (Byrne, 2001; Vandenberg, 2002). Testing for multi-group invariance is important not the least because measures bearing different meanings across groups may lead to inference problems. It should thus be a prerequisite for inter-group comparisons (Chen, 2007).

This paper is concerned with examining if the factor structures of Internet use types have measurement invariance (i.e. similarity) across a range of different countries and thus whether they are suitable for use in cross-national comparisons. In line with Vandenberg and Lance's (2000) suggestions, three invariance tests are considered. First, an Omnibus Test of equality of covariance matrices is conducted. If the null hypothesis of equality of covariance matrices is not rejected, this will provide evidence in favor of overall measurement equivalence across groups. In a second step, a test of configural invariance – also called "weak factorial invariance"– is conducted. In this test the same factorial

structure is specified for the different countries. However, no constrains about parameters being equivalent is specified. Configural invariance can be assumed if the same factorial structure has a good fit across different countries. This test is considered a requirement if metric invariance – also called "strong factorial invariance"– is to be tested. This is the third step. For metric invariance, factor loadings of like items are constrained to be equal across countries. Non-significant differences between factor loadings across countries can be considered as evidence of metric invariance.

Confirmatory factor analysis (CFA) was used for testing configural and metric invariance. For this study, three fit criteria were used to test for invariance: Chi- square test, RMSEA and CFI tests (see Bartholomew, et al., 2008; Byrne & Stewart, 2006; Chen, 2007). The chi-square statistic tests the null hypothesis that the hypothesized model generates the observed covariance matrix. Thus failing to reject the null hypothesis is evidence of a good model fit (Bartholomew et al., 2008). However, given that chi-square tests tend to be very sensitive to sample size, this test should be supplemented with other fit statistics (see for example Chen, 2007). RMSEA and CFI are therefore also used as criteria. RMSEA measures the discrepancy between the observed and the model covariance matrices. Values less than .05 are normally considered a good fit, with the confidence interval falling under .10 (Browne & Cudeck, 1993; Kline, 2005). Meanwhile, the CFI compares the tested model to an alternative model. It ranges from 0 to 1, with values higher than .90 being considered as an acceptable fit (Kline, 2005).

Despite its sensitivity to sample size, chi-square difference statistics have usually been used to test measurement invariance, i.e. when comparing a baseline model to a restricted version of this model (see Chen, 2007; Byrne & Stewart, 2006). If the chi-square difference between both models is statistically significant, it suggests that the restrictions added to the baseline model do not hold since models with more restrictions are more difficult to fit. When testing metric invariance this means that loadings are not equivalent across groups. Meanwhile, CFI and RMSEA can also be used to compare nested models. According to Chen's recommendations (2007), a change of $\leq$ -0.005 in CFI supplemented by a change of $\geq$ 0.01 in RMSEA indicates non-invariance. More stringent criteria can be used when sample size is adequate and equal across groups. In this case, he suggests that a change of $\leq$ -0.01 in CFI supplemented by a change of $\geq$ 0.015 in RMSEA indicate non-invariance.

This paper starts its analyses by testing whether the theoretical factor structure fits the full data of the World Internet Project following the strategy commonly employed in U&G and cross-national comparisons of Internet use that assume comparability of factor structures across countries and does not test fit at a country level. The four factors tested were based on the most common categories of uses as identified in the U&G literature: social, entertainment, financial and informational.[4] Three subsequent steps are conducted to test for the measurement invariance of this factor structure: first, it tests the equality of the covariance matrices, then it tests whether the established model has a good fit within the individual countries (configural invariance) and lastly it examines whether the factor loadings are the same (metric invariance) for all countries. It is common practice to

compare individual countries and explain differences based on cultural differences in an ad hoc manner. This ad hoc approach is not desirable for any study and is especially problematic when testing for invariance across multiple groups. Prior to comparisons of countries a theory needs to be in place to hypothesize which country might differ based on a theoretical classification. Thus the last step focuses on testing invariance using an established theoretical framework of cultural proximity – using geographical (European and non-European countries) and linguistic (English and non-English speaking countries) proximity as indicators.

Dataset

The World Internet Project's (WIP) questionnaires were developed over a period of 8 years until items reached interpretative comparability on the item level. The procedure in relation to Internet use types was stricter; a core set of items was agreed upon and translated literally from the English version questionnaire across countries. Examples given to illustrate which platforms were associated with certain uses were adapted to the local context. All WIP partner countries collect representative samples of the population but the methodology is not equivalent across countries, some conduct telephone surveys and some face-to-face surveys (for more details on the specific methodology in each country please see the World Internet Project Report, 2009).

In 2007 data was collected for the following 14 countries: Australia, Bolivia, Canada, (Urban) China, Colombia, Czech Republic, Hungary, Israel, Macao, New Zealand, Singapore, Sweden, UK and the USA. The datasets for Bolivia and Macao were

incomplete for the items of interest for this paper and these countries were therefore eliminated from the database. The data from the remaining 12 countries were used to determine the Internet use classifications. To be able to compare countries with different sampling strategies, this study considered only respondents over 18.

These countries can be grouped in terms of geographical proximity (Europe versus rest of the world) and language (English versus other languages), as the objective is to test whether countries that are geographically proximate or share language will also be similar in Internet use. As indicated in the literature review, linguistic proximity relates not only to cultural proximity but also socio-political and economic similarity. Given the relatively small number of countries considered in this study, it is not possible to determine which common factors (e.g. socio-political or economic similarity) are responsible for different countries being more or less similar in their measurement of Internet use beyond the cruder indicators of cultural proximity.

Measures of Internet use

The core questions of the WIP survey were organized into nine general subject areas: Internet users and non-users, access to online information sites, access to online services, online purchasing and views about credit card security, the Internet and social connections, the Internet and the political process, media reliability and importance, online communication, and the Internet and education. In this paper the focus is on the users in all the participating countries and on the items that measure the frequency of different types of use. There are 28 common items in the questionnaires which ask ‘How

often do you use the Internet for the following purposes?' All these items are measured on a 6 point scale from 'Never' to 'Several times per day' (World Internet Project, 2009).

--Table 1 about here---

Table 1 shows that using the Internet is almost equivalent to emailing. In most countries it was the most popular of the 28 activities measured. The exceptions were China and Israel where browsing was more popular than emailing. Overall writing a blog was the least popular activity followed by distance learning. At this 'least undertaken activity' end of the scale, however, most countries were exceptions to the general 'rule'. In Columbia, the Czech Republic, Hungary, New Zealand and Singapore investing was the least popular. In Britain and China looking at religious sites was the least prevalent and in Israel it was using chat rooms. In New Zealand writing blogs was, contrary to the general trend, extremely popular – 89% of the adult Internet users had undertaken this activity more than never in the last year. It is important to note that the overall trends are not weighted according to the age of Internet users, the considerably lower number of older Internet users in some countries links the global trend more strongly to the countries with larger Internet user populations (Britain, Canada, Sweden and the US) which have older Internet users (see Helsper & Galacz, 2009).

Nevertheless, the distribution (rank order and prevalence) of each activity seem to differ between countries. This does not directly signify that the types of uses (or genres of use)

differ between the countries. To understand whether this is the case a factor analysis is required that groups these items into the different categories.

Factors

The starting point for this paper was a confirmatory factor analysis of the 28 items in the WIP database that correspond to the four most commonly observed Internet use types, that is instrumental (information), ritual (entertainment), social (communication), and the added category of financial or economic uses. In previous exploratory factor analyses of WIP data these were shown to construct separate categories of variables (Helsper & Galacz, 2009).

The two emailing variables (sending emails and sending attachment with your emails) and the two formal learning variables (looking for school/work information and distance learning) were not included. Emailing was not considered because it was basically a proxy for Internet use with no variance between users and it would dominate any fit calculated in the model. The learning variables were deleted because they did not show good fit with the information seeking variables, which was probably due to the fact that related questions were only asked to students or people in employment.

This process of elimination was conducted to make the factor structure as clean as possible and avoid problems in fitting the model in any individual country due to its complexity. Since the point of this paper was not to construct a new theoretical model for Internet use but to contribute methodologically by testing whether or not the factor

structures of the most consistently identified uses in U&G research are comparable between countries, this was considered a necessary concession.

This meant that from the 28 common items 16 items were selected that would theoretically fit best within the four factor classification. The fit of this model (see Figure 1a) was good for all countries combined ($\chi^2_{(93)}$=2884.40, p>.001; CFI=.94; RMSEA=.05, C.I.=.05-.05).

For each of these factors we calculated the average frequency of engagement score by averaging the scores across the items that loaded on these factors.

--- Figure 1 about here---

Figure 1 shows the way in which configural and metric invariance between countries were tested in this paper. Figure 1a shows that the same items load on the four underlying constructs in each country (configural invariance) and Figure 1b hypothesizes that the items not only load on the identified four factors, but they also have the same loadings on those factors across the different countries (metric invariance).

Findings

Omnibus test of equality of covariance

Following the recommendation in Vandenberg and Lance's (2000) review paper an omnibus test for equality of covariances was conducted. The results showed that the covariance matrices were not equal across countries (($F_{1496, 1931497}$)= 8.67, p<.001). This meant that the way in which the different types of uses covaried was not equal (i.e. non-

invariant) in the different countries and that the underlying structure was thus not the same. This is a first indication that perhaps comparing uses across countries is not as plausible as it is made out to be. Nevertheless, covariance matrices are based on the individual items and not on the theoretical constructs or genres of use which group the different items together and which some might consider more robust. This is why most researchers create composite scales on the basis of different items in the first place.

The premise of this paper is that direct comparisons of the numbers in Table 2 should not be made without considering whether the factor structures are valid in all the different countries.

--Table 2 about here---

However, if we were to follow the common strategy of cross-national comparisons and examined the data in Table 2, we might conclude that there is no national pattern to the frequency with which Internet users in different countries undertake different classes of activities. The frequencies of use paint a different picture than that based on whether Internet users undertake the activity at all. While the US leads in frequency of Communication uses, their Internet users are not more active in other areas. The most frequent users of Entertainment content are the New Zealanders, the Australians and the Swedes, while Finance is led by the Colombians, Chinese, and Hungarians and Information by the Britons, Singaporeans and Colombians. It is interesting to note that the countries that had the smallest number of people participating in individual activities had the highest frequency users of related categories, especially for finance related activities. This could mean that in countries with low penetration of certain activities the

people that do use the Internet for these purposes are very active indeed. This could also indicate that the Internet using populations of different countries vary, some countries might have Internet using populations that consist largely of early adopters, in other countries where more people are online they will represent the general population more.

Factor model fit for individual countries (configural invariance)

However, to test if underlying concepts are valid in different countries – and if the factors can actually be compared – further analysis of the factor structures is required. This is something that should in principle be done before the comparison of data such as that presented in Table 2. If the proposed structure with entertainment, communication, information, and finance uses has a good fit overall and in the different countries then at least we can say that in each country the items can be organized into these four genres.

---Table 3 about here---

Table 3 shows that the factor model as specified had different levels of fit in the different countries. In most countries the model fit was good (i.e. CFI >.90, RMSEA <0.08 and RMSEA C.I. <.10)[5,6]. The exceptions were China and Columbia where the CFI scores dropped to .83 and .89 respectively, but the RMSEA indices were all reasonable even for China (RMSEA=.08, C.I..08-.09) and Columbia (RMSEA=.06, C.I .05-.07). The fit of the model was also good for all countries combined (CFI=.94; RMSEA=.05, C.I..05-.05). These descriptive analyses suggest that the general categorization of Internet use variables into entertainment, information, communication, and finance uses is appropriate across countries.

Comparison factor loadings (metric invariance)

What is of more interest than whether the data can be distributed across the four general categories within the different countries is whether or not the factor structures hold across different countries. That is, it is important to understand whether communication, for example, has the same relative importance in Sweden as it does in Britain. In statistical terms, this implies testing if factor loadings are similar across countries. This can be examined through metric invariance testing with multi-group analysis.

---Table 4 about here---

Tests for configural invariance confirm that overall the factor structure had a good fit. The same items load on the underlying entertainment, communication, finance, and information constructs. However, while the fit of the unconstrained model was relatively good (CFI = 0.92; RMSEA = 0.02, C.I. = 0.02 - 0.02), Table 4 shows that constraining the loadings to be equal across all countries significantly reduced the fit of the model ($\Delta \chi^2_{(143)}=1428$, $p<.001$, $\Delta CFI=0.03$)[7]. This means that the way in which the different items load on the different types of Internet use (entertainment, communication, information, and finance) varies significantly between countries. The fit drops less strongly when comparing the fit in only European ($\Delta CFI=0.02$) or in only English-speaking countries ($\Delta CFI=0.01$). Even though the chi-square difference is significant for the model comparison between English-speaking countries and between EU countries (not surprising given the large sample sizes), the RMSEA statistics still show a good fit ($\Delta RMSEA=0$ for both groups). The CFI, which is argued to be a better indicator (Hu & Bentler, 1998) for studies with large sample sizes and complex models, shows less consistency. Among European countries the CFI of the constrained model drops

significantly, while among English-speaking countries it drops from 0.93 to 0.92, which is within the margins of non-significance.

According to the earlier detailed criteria, this means that among the geographically proximate EU countries there was measurement non-invariance based on the CFI indicator (although RMSEA suggests there was invariance), while for the English-speaking countries measurement invariance was supported by the RMSEA criteria and the CFI criteria.

In the following we will provide some examples of how factor structures vary across countries. To understand differences in factor structures, factor loadings and how they vary from one country to another can be examined. For example, in all countries except China, checking a fact or the definition of a word are the most important items loading on the information factor. In China the loading for news is more than twice as high as all other loadings. This suggests that in China people's use of information is determined to a greater extent than in other countries by reading of news. In other words, in China the differences amongst Internet information users are mostly found between those who read the news and those who do not, while in other countries the informational function of the Internet differs more with uses such as checking a fact or the definition of a word. Another example is that of the finance function: in most countries purchasing products has the highest loading, but in Colombia and Hungary searching products contributes more to differentiating finance uses. In the case of the entertainment function, humor seems to be the item that discriminates the most between people when it comes to

entertainment. Yet in Singapore, the Czech Republic, Hungary and China, playing games is more important. It is notable that for the communication factor these differences were not as easily observed. Explanations related to social capital or other differences between individuals within countries (Valkenburg et al 2005; Wellman et al 2002) are less likely to be behind country differences. While analyzing factor loadings provides some information on the relative importance of each item for each Internet use type, qualitative research is more appropriate to further understanding about the meanings that people assign to these different uses and how relevant each of these are when it comes to their use of the Internet for the different functions as identified by the U&G framework.

Discussion

This paper set out to test whether types of Internet use, as often defined in Uses and Gratifications (U&G) research, are interpreted in the same way across countries. It used the cross-national comparative dataset of the World Internet Project (WIP) to examine whether there was worldwide similarity or, if this was not the case, whether geographical or linguistic proximity between countries led to a similar valence of Internet use types. Descriptive findings showed that rankings of the most popular individual activities were very similar across all countries. This suggests that national differences matter little when it comes to comparisons at an item level. There were a few exceptions but in general it was the level of overall engagement and not the popularity ranking of activities that differed between countries, confirming Wellman et al's (2002) findings. However, these descriptive analyses could not answer our research question that interrogated the common practice of using general media use classifications (information, entertainment,

communication, and finance) and comparing these uncritically across different countries. We tested configural and metric invariance to examine the hypothesis that these use categories are similarly structured across countries (see Figure 1). For measurement invariance testing it is important to have an a priori framework which classifies groups or countries. In this paper we chose two different cultural proximity indicators because culture is often used as an ad hoc explanation. To test if measurement invariance could be observed for countries that share a geographic proximity (i.e. European countries) or for countries that share a linguistic proximity (i.e. English-speaking countries), we also tested configural and metric invariance among specific groups of countries. There was evidence that a four-factor structure worked across all countries (as in Figure 1a). However, evidence for similar factor loadings in all countries was limited.

The answer to the general research question posed at the beginning of this paper is thus that in all countries general categories of communication, entertainment, finance, and information uses seemed to exist but that their factor structure was not the same across contexts. This suggests that at a very general level, that of identifying broad categories of engagement with the Internet, U&G classifications can be applied globally and that would reduce the complexity of cross-national comparisons and limit the need for contextualization based on each country's individual context. It, however, does not mean that the comparison of averages on these general types of uses based on composite scales can be conducted without further ado. The hypothesis could not be rejected when it came to the factor loadings of these constructs in the different countries. When factor loadings were compared (Figure 1b), the findings suggested that linguistic proximity in particular

and geographic closeness to a lesser extent were pre-requisites for similar factor loadings on Internet use constructs. Perhaps the old historical, cultural, and economic links of the English-speaking countries offer a more appropriate explanatory framework than spatial proximity for a new cross-border medium such as the Internet where language still plays an important role.

However, given the limited number of countries considered in this study, it is not possible to determine which factors associated with linguistic and geographic proximity increased measurement invariance. For example, the fact that English speaking countries were more alike can be due to at least four related explanations: a) there are almost no translation problems, b) these countries share a similar historical and cultural background, c) they have similar socio-political systems, and d) they have similar educational systems and level of economic development. Future research should build an explanatory framework and separate these effects through separate tests of invariance. Differences between non-English speaking countries might also be explained by differences in Internet using populations (e.g. there might be differences in the age, gender composition, and experience of those who use the Internet). These differences might to some degree be explained by earlier mentioned country characteristics. In countries where fewer people are online, the country characteristics can be quite different from those of the Internet using population. Further research that classifies countries by their Internet using population would be useful in this context.

Thus, while cross-nationally the same categories of Internet use can be identified and are useful from a social science point of view, the way in which they are constructed needs to be adjusted to a local context and researchers need to be aware of the social, cultural, and historical contexts that can influence the way in which they are structured. For example, this study suggests that when researchers compare general information uses across countries based on composite variables derived from factor analysis, they need to be aware that they might in practice be comparing news seeking in China with fact checking in the rest of the world. Researchers interested in cross-national comparisons on the broader categories of use should make sure that their scales are based on a range of indicators that incorporate the different emphases within general use categories across countries. This strategy should be accompanied by researchers explicitly addressing the subsequent subtle but important differences when they interpret their findings. It is beyond the scope of this paper to describe more extensively how factor structures of instrumental, ritual, social, and economic uses differed between the different regions. A deeper understanding of the difference in weight that certain activities carry within broader categories of use across different regions and the development of a theoretical explanatory framework for these differences is clearly the next step for research in this area.

It is important to look at within country measurement differences between groups such as those differences based on gender, age, and socio-economic level. There is evidence that members of different groups (e.g. men and women) do different things on the Internet (Hargittai & Walejko, 2008; Helsper, in press; Selwyn, 2007; Whitaker, 2007). There is

a need to go one step further and look at whether there is measurement invariance in these different groups as well. Whitaker's (2007) research suggests that at least for different gender groups they do not. However, this study needs to be replicated in different national context to see whether this is a US based result or can be generalized. For both the between and within country classifications qualitative research will need to be combined with quantitative research such as that presented here.

A number of large scale international projects on Internet use are starting to think about the most valid and efficient ways of analyzing and presenting cross-national comparative research in the area of Internet use (e.g. Haddon, 2009; Hasebrink, Ólafsson, & Stetka, 2010). Within this context, the above-discussed findings are likely to be opportune.

Conclusion

To conclude this paper it is useful to return to a metaphor used earlier in this paper. The research presented here shows that comparing factors of Internet use across countries on a global level is not akin to comparing apples with oranges. In every country 'Internet apples and oranges' (e.g. information and communication uses) can be clearly identified as separate fruits (i.e. types of use). That is, in each country a classification of four uses worked well. However, how the different components that make up these Internet apples and oranges are distributed differs between countries. The encouraging news is that a common language makes similar 'tastes' of these different types more likely perhaps because of socio-cultural similarities or because translation was not required so that there were no cultural variations in the constructed meanings of Internet use or item

interpretation differences. Therefore comparisons of the consumption levels of the same 'Internet fruits' in countries that share a common language make sense. That is, these countries showed similarities in the factor loadings of their Internet use. On the other hand, comparing, for example, averages of information use across countries which are geographically closer, such as the European countries, is not appropriate. This is because the different elements that make up these different uses have different weights in different countries. Or, to continue with the analogy, British Internet apples taste different from Hungarian Internet apples even though they are both apples. Therefore further research is needed to understand how people from different countries interpret different items and types of Internet use and how relevant each of these are when it comes to defining broader categories of Internet use. Qualitative research, such as that done on mobile phones in the UK, US, and Japan by Ito, Okabe and Anderson (2009), would be helpful to increase our understanding of the meanings that people assign to different Internet uses. But this goes beyond the aim of this paper. Quantitative survey research like that done by Katz and Aakhus (2002) and by Campbell (2007) that asks not about gratifications or uses in relation to the Internet but about the ways in which people perceive the device or medium could offer a different perspective in understanding cultural differences in Internet use. Nevertheless, the same issues with invariance would apply to these types of studies.

Recommendations

This paper makes the case for the importance of multi-group invariance testing when comparing Internet use factors across different groups. It focused on cross-national comparisons but the same issues might occur when comparing different socio-

demographic groups within a country. While research in other areas suggests that measurement is less invariant when it comes to comparing groups within one national boundary (e.g. Lai & Li, 2005; Teo, 2010), it cannot be assumed that the same is true for Internet use.

Since finding measurement equivalence seems to be the exception rather than the rule, we want to finish by discussing a few steps that can be taken to avoid this problem or solve it when it arises. First, when designing surveys that will be conducted in different countries, Stares (2009) recommends paying attention to those items that can hold different meanings depending on the context. Future studies should thus consider whether the same Internet use concepts are inadvertently operationalized differently in different national contexts. More research is needed to design theoretical frameworks that can explain these unintentional differences in operationalization. Even where researchers have done their utmost to make individual items comparable, comparisons should be done with caution and full awareness that there might be validity issues. Second, Heath et al (2009) recommend dropping of countries from the analysis for which there is no measurement equivalence. The problem with this approach is that the resulting studies are likely to end up considering homogenous sets of countries. A third option is to examine partial measurement invariance, in which case at least one item needs to be invariant in each factor (Byrne et al., 1989). The fit of the model can be improved by allowing some of the loadings to vary from one country to the other (Stares, 2009).

The finding that the English speaking countries are similar to each other in the way Internet uses are structured might not be surprising. However, the study does have a more

surprising and positive message for those aiming to do cross-national comparisons of Internet use across countries with different cultural and historical backgrounds. It seems that the general Uses and Gratifications classification of Internet uses in information, entertainment, social and financial functions holds across national boundaries. In future research, it means taking into account subtle but important differences in the ways in which different items contribute to each type of Internet use in different countries and to avoid direct comparisons at the item level.

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Endnotes

[1] There have been several critiques of the empirical difficulties in distinguishing gratifications sought and obtained using survey measures and finds that they are often conflated (see Levy et al 1984; Lichtenstein & Rosenfeld, 1983; Palmgreen et al, 1980).

[2] The debate on how culture should be measured is discussed extensively elsewhere (Hoffstede, 2001; Shenkar, 2001).

[3] While there are more indicators of cultural proximity in this paper the data available lent themselves most towards analysis based on geographical and linguistic proximity.

[4] In a previous study an exploratory factor analysis was conducted on WIP data which showed that the general categories identified by the U&G framework also apply to the full set of countries in this particular project (Helsper & Galacz, 2009).

[5] For a justification of criteria please see Kline (2005).

[6] All confirmatory factor analyses were conducted using AMOS 6 multi-group analysis.

[7] A Δ CFI >.01 is considered too large (Hu & Bentler, 1998).