A comparison of the effect of internet access on global life satisfaction and on specific domains of life satisfaction

ABSTRACT

I estimate the effect of internet access on global life satisfaction and examine whether this effect holds for the satisfaction with standard of living and the relational well-being domains of subjective well-being or whether internet access has contradictory outcomes on these domains. Internet access has been shown to play an important developmental role and it positively affects economic growth, education, health governance and social relationships. Therefore, it has become a high profile international goal to give all people internet access. The question arises whether internet access also positively affects subjective well-being and the domains of subjective well-being. To analyse the research questions I use a 2013 data set of the Gauteng City-Region Observatory (GCRO) on quality of life in Gauteng. I estimate global life satisfaction - satisfaction with standard of living - and relational well-being models, making use of ordered logit and OLS estimation techniques. This is the first research paper that analyses the effect of internet access on global subjective well-being in a developing country. It is also the first study, internationally, that compares the effect of internet access on subjective measures of material well-being and relational well-being. I find that internet access is statistically significant in explaining global life satisfaction and satisfaction with standard of living and is positively related to these variables but, contrary to expectations, is statistically not significant in explaining relational well-being.

Key words: internet, subjective well-being, life satisfaction, South Africa, material well-being, relational well-being

JEL classification codes: I31, O14, O15, O33

1. INTRODUCTION

This paper examines whether access to modern information and telecommunication technologies (ICTs), in particular the internet, has an effect on the global life satisfaction[1] of people and whether this effect is the same for different domains of subjective well-being, specifically for the material well-being and the relational well-being[2] domains.

ICT has been shown to be an important and positive contributing factor to the development of a country (United Nations, 2001b; Kuyoro et al., 2012; Dutta et al., 2015). The Human Development Report of 2001 (UN, 2001) notes that technological advances enhance human capabilities such as a healthy life, knowledge, creativity, and participation in the social, economic and political life of a community and impact on economic growth through productivity gains.

Based on the knowledge that ICT, and specifically internet access, enhances development, many high-profile initiatives have been undertaken to increase awareness of the benefits of ICT investment and to promote policy measures for the deployment of telecommunications infrastructure and the diffusion of ICT. Notable examples of these projects include the World Economic Forum (WEF), Global Digital Divide Initiative (GDDI) (2002) and the Digital Opportunities Task Force (DOT Force) (G-8, 2000), by the Eight Industrialised Countries (G-8) and the World Information Technology Forum (WITFOR) established by the International Federation of Information Processing (2003). These initiatives contributed to the establishment of the United Nations ICT Task Force (2001a), which to developing countries has a broader legitimisation than previous initiatives.

In South Africa the contribution of internet connectivity has also been recognised as is shown by the Electronic Communications Act, 2005 (Act No. 36 of 2005), through the implementation of South Africa's broadband policy, known as 'South Africa Connect', implemented in December 2013 (Republic of South Africa: Department of Communications, 2013). This policy gives expression to South Africa's vision in the National Development Plan (NDP) (National Planning Commission, 2012) of 'a seamless information infrastructure by 2030' (Republic of South Africa, 2011). 'South

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[1] In this paper the term 'subjective well-being' and 'life satisfaction' are used interchangeably.
[2] In this paper the term 'relational well-being' is used interchangeably with the term 'social relationships' and 'material well-being' is proxied by 'satisfaction with standard of living'.

Africa Connect' aims to provide 100% of South Africans access to broadband services that have a minimum speed of 10 Megabits per second by 2030.

However, the question arises whether internet access, although found to positively influence development, also improves the global subjective well-being of people and whether this positive effect is the same for different domains of subjective well-being. Research on the effect of internet access on subjective well-being is limited and focuses on developed countries. The results of the studies in developed countries show that internet access has a positive effect on global life satisfaction (Kavetsos & Koutroumpis, 2011; Graham & Nikolova, 2013; Pénard et al., 2013) and this finding also holds for material well-being (Sciadas et al., 2012; Kuyoro et al., 2012; Williams & Strusani, 2015). Conversely the empirical results on the effect of internet access on relational well-being is ambiguous (McKenna & Bargh, 2000). Some of the studies show that internet access gives an additional opportunity for people to communicate with their friends and family and therefore strengthens their social relationships (Franzen, 2003; Sey et al., 2013). Whereas other studies reveal that internet access tends to increase the social isolation of people suffering from social discomfort or people who have few friends (Kraut, et al., 1998). Engelbrecht and Sjöberg (2004) also find that frequent internet users tend to be lonely and lack social skills.

The current study contributes to the literature in three ways, namely by analysing the effect of internet access on the subjective well-being of people in a region of South Africa, a developing country, by comparing the effect of internet access across two different domains of subjective well-being and by using subjective measures to measure the domain material well-being. Thus this study is differentiated from previous studies that analysed the effect of internet access on objective measures of material well-being. As far as could be determined this is the first study of its kind in a developing country and also the first study internationally that uses subjective measures to compare the effect of internet access on different domains of subjective well-being.

To address the research aims I analyse a data set collected by the Gauteng City Region Observatory (GCRO) (2013) on the quality of life of people residing in the Gauteng Province, the economic centre of Africa (GCRO, 2011). I use regression analysis, including ordered logit and Ordinary Least Squares (OLS) to estimate global subjective well-being, subjectively measured material well-being (proxied by satisfaction with standard of living) and relational well-being functions.

Knowledge of the effect of internet access on the subjective well-being of people can inform governments on the progress made towards reaching the almost universal aim of countries: 'to increase the well-being and quality of life of people' (United Nations, 2001b). In the South African context this aim is set out in the Constitution of South Africa (Republic of South Africa, 1996).

The results show that internet access has a positive effect on the global subjective well-being of the people in Gauteng, and that these positive effects also hold for satisfaction with standard of living. However, I find internet access statistically not significant in explaining relational well-being. This means that internet access does not play a role in determining social relationships, measured as satisfaction with time spent with friends and family and satisfaction with marriage, in the Gauteng region. This finding contradicts previous research. The result is likely, since internet access in Gauteng is still very limited (36% of the respondents) (GCRO, 2013). Furthermore, the current study is restricted in its depth of analysis, since data on internet access only reveal whether people have access to the internet and not the specific purpose for which such internet access is used. It is likely that the people who access the internet, do so for purposes other than social networking, implying that internet access does not influence social relationships. It is also likely that, as more people get access to the internet in future, the effect of internet access on social relationships will be different.

The rest of the paper is structured as follows: Section 2 of the paper reviews literature related to subjective well-being and the effect of internet access on life satisfaction. Section 3 describes the data and the selection of the variables. Section 4 sets out the methodology. Section 5 reports the results and section 6 concludes.

2. LITERATURE REVIEW

In this section I briefly discuss the findings on the measurement and the determinants of subjective well-being. I also review the results found in the literature related to the effect of internet access on the three dependent variables investigated in this study namely: global life satisfaction, satisfaction with standard of living and relational well-being.

2.1 Subjective well-being (Life satisfaction)

In recent years there has been a proliferation of studies on subjective well-being focusing on the measurement and determinants of the concept (for a summary of findings in the subjective well-being literature see among other Larson (1987) and Helliwell (2003)). On the measurement of subjective well-being, the studies conclude that subjective assessments of subjective well-being (life satisfaction) are meaningful and valid indicators of well-being and that they provide a more holistic picture of welfare than traditional objective indicators, such as income or consumption (Frey & Stutzer, 2002; Diener & Seligman, 2004; Frey & Stutzer, 2010)

Regarding the determinants of subjective well-being, the results of the studies reveal a number of standard variables, seldom omitted in the estimation of life satisfaction functions, found to explain life satisfaction. These determinants hold across countries and across time. The variables include: health (Diener & Seligman, 2004), income (relative income) (Easterlin, 1974), marriage (Diener, et al. 1999), gender (Verme, 2009), age (Blanchflower & Oswald, 2007), employment (Verme, 2009), education (Witter, et al. 1994) and race (Fontaine & Yamada, 2014). In general the results show that being healthy, having a partner or being married, being female, being between the ages of 35 and 50 years, having higher levels of education, and being White, in the South African context (Posel & Casale, 2011), lead to higher levels of life satisfaction (Diener, et al. 1999).

Other variables that also frequently appear to be statistically significant in explaining life satisfaction are: the number of children in a household (there is no consensus on the relationship to life satisfaction), time spent with family and friends (positive), political ideology (higher levels of democracy increase life satisfaction), freedom of choice (positive), societal trust (positive) and religion (positive) (Helliwell, 2003; Bruni & Stanca, 2008; Verme, 2009). In this study the standard variables found to explain life satisfaction are used as control variables in the estimation of the life satisfaction, satisfaction with standard of living and relational well-being functions.

Except for global measures of subjective well-being that measure the satisfaction of a person with his life as a whole, literature has also explored satisfaction with specific domains of well-being. These specific domains, based on the analyses of Cummins (1996), are: material well-being (food and housing), health, productivity (work), safety (physical safety), intimacy (relationships with family and friends), community

(education, neighbourhood) and emotional well-being. In this paper the analyses focus on global subjective well-being as well as two specific domains of well-being, namely material well-being (proxied by satisfaction with standard of living) and intimacy (relational well-being).

In the next section I review the findings on the relationship between internet access and the three dependent variables estimated in the paper, namely global life satisfaction, satisfaction with standard of living and relational well-being.

2.2 Internet access and global life satisfaction

A limited number of studies have investigated the effect of internet access on global life satisfaction, that is satisfaction of a person with his/her life as a whole. The majority of these studies agree that internet access has positive effects on global life satisfaction. However there are a few recent studies that find ambiguous results if the purpose of the internet access is analysed.

The studies that find positive effects of internet access on life satisfaction include the folowing: Graham and Nikolova (2013), using data from the Gallup World Poll for 2009 to 2011, found that internet access increases subjective well-being. Kavetsos and Koutroumpis (2011) found similar results using a pooled cross-sectional data set for European countries. These results were also confirmed in a study by Penard et al. (2013) analysing Luxembourgish data extracted from the European Value Survey.

The studies that found ambiguous results on the effect of internet use on subjective well-being emphasise the need for specific rather than general internet research in which researchers distinguish between the specific uses of the internet when analysing the relationship between internet access and subjective well-being. Mitchell et al. (2011), studying a data set from the USA, found that the internet access used for gaming and entertainment has positive effects on subjective well-being; yet using the internet for mischievous activities, such as downloading information without payment or committing fraud, has negative effects on subjective well-being. In cases where internet use leads to addictive behaviour such as gambling, online gaming, and pornography, it negatively affects subjective well-being (Li & Chung, 2006). This finding is supported by Muusses et al. (2014) in a study on compulsive internet use and well-being.

Studies on the effect of internet use on subjective well-being in developing countries is very limited and only one study includes countries in sub-Sahara Africa. In this study by Graham and Nikolova (2013) (a study also mentioned in the discussion on the positive effects of internet access), using data from the Gallup World Poll, found that subjective well-being is higher in countries with higher levels of access to the internet and mobile banking than in countries with limited access. However, besides the positive effects, they also report increased levels of anger and frustration in the countries with higher levels of internet access (Graham & Nikolova, 2013).

2.3 Internet access and satisfaction with standard of living

As previously mentioned, we use satisfaction with standard of living (a subjective measure) as a proxy for the domain material well-being, as it has been found that subjective measures of well-being are valid indicators of well-being and more holistic than objective measures (Kahneman & Krueger, 2006). 'Standard of living' can be described as the level of wealth, comfort, material goods and necessities available to a certain socio-economic class (Sen, 1987). To the author's knowledge, no previous study has analysed the effect of internet access on subjective measures of material well-being. Nonetheless, there are a number of studies that analyse the effect of internet access on objective measures of material well-being (Sciadas et al., 2012; Kuyoro et al., 2012; Williams & Strusani, 2015). These studies show that internet access enhances material well-being via, among others, the ability to access services (banking services), searching and applying for jobs, internet sales and using the internet as a media to disperse information (marketing) (Williams & Strusani, 2015). It was also estimated by Williams and Strusani (2015) that extending internet access to developing countries can enhance productivity by as much as 25% in the long run, and increase economic growth, job creation and personal income. The positive relationship between internet access and material well-being is also confirmed by Sciadas et al. (2012), Kuyoro et al. (2012) and Graham and Nikolova (2013).

2.4 Internet access and relational well-being

Relational well-being has been found to be an important domain of global life satisfaction and in many cases contributes more to global life satisfaction than material well-being (Helliwell, 2003; Bruni & Stanca, 2008; Gui & Stanca 2010). This finding has been confirmed in developed and developing countries (Greyling & Tregenna 2014).

Internet access opens up new channels to communicate and develop social relationships, such as Facebook, Twitter and Instagram. Nevertheless, Flaherty et al. (1998) find that social media is not a functional alternative to face-to-face communication. This finding is supported by Lee et al. (2011). Their results show that only face-to-face communication increases subjective well-being and that computer-based communication cannot replace traditional forms of communication and socialisation (Lee, et al., 2011). In the same vein Nie et al. (2002) argue that time spent online reduces time available for face-to-face interaction with friends and family and negatively influences social relationships.

Researchers highlight the different effects social media have on different types of people. Kraut et al. (1998) show that internet access has a positive effect on those people rich in social capital, but for people who have few friends, internet access tends to increase social isolation. Similar results were found in a study on adolescents by Gross et al. (2002). According to Engelbrecht and Sjöberg (2004) the frequency of internet access influences social relationships, with frequent internet users tending to be lonely and to have a lack of social skills.

Contradicting these findings, Sey et al. (2013) using the Global Impact Study that includes developing countries, also South Africa, find that more than 50% of surveyed users report positive impacts of internet access on communication and social relationships. Positive effects of internet access on social relationships were also found by Penard et al. (2013) in a study on Luxembourg and by Franzen (2003) in a study on Switzerland.

3. DATA AND THE SELECTION OF THE VARIABLES

In this section I briefly describe the Gauteng region, the focus area of the study and thus the region that was surveyed. This is followed by a description of the data set used and lastly I explain the selection of the variables used in the analyses.

3.1 Gauteng

The study focuses on Gauteng, one of the nine provinces of South Africa. Gauteng was selected due to the socio-economic importance of the province, not only in South Africa, but also in Africa (OECD, 2011). In 2011 the province contributed 34.8% of the national gross domestic product (GDP) of South Africa and 7.7% of the GDP of Africa

(GCRO, 2015). Gauteng is home to 22% of the national population (12.3 million inhabitants) and is the most populous province in the country (GCRO, 2015). The province encompasses ten municipalities of which three are metropolitan municipalities and the other seven are divided into two district municipalities. These municipalities function as an integrated region. Gauteng includes some of the biggest cities in South Africa namely Johannesburg and the national capital of Tshwane (formerly Pretoria). The municipalities are further divided into 508 wards (GCRO, 2015).

3.2 Data and descriptive statistics

In my analysis I use a data set collected by the GCRO on the quality of life in Gauteng (GCRO, 2013). The survey includes both objective and subjective questions on the quality of life of the inhabitants of Gauteng, as well as questions on internet access.

To collect the data, the GCRO made use of a digital data collection instrument, which was administered on a tablet device (GCRO, 2015). Once a questionnaire was completed in the field, it was uploaded to a cloud server from where it could be accessed and downloaded online, using internet connectivity. This contributed to effective and prompt collection of data.

To maximise the population spread of the sample within the geographical region, a random sample of households of the population size found in the South African National Population Census of 2011 (StatsSA, 2011), was used. The questionnaires were administered per ward in each municipality. A required number of interviews per ward was calculated, although no less than a minimum of 30 interviews were conducted per ward. In total 27 490 respondents in the 508 wards in the ten municipalities of Gauteng were interviewed (Geospace International prepared for the GCRO, 2014).

Table 1 presents summary statistics of the variables used in the econometric analyses. The mean age of the respondents in the sample was 40 years with the biggest proportion (61%) of the respondents being between the ages of 20 and 44 years (GCRO, 2013). The sample includes approximately the same number of males and females. The majority of respondents (78.8%) were married or lived with a partner. Just more than half (51.4%) of the respondents had either matric or some kind of tertiary training. Approximately a third of the respondents (37%) reported to have

worked during the seven days before the interview. The biggest proportion of the sample was African (76.5%), followed by 16.6% being White and 6.8% representing, Asian, Indian and other race groups.

Regarding the variable of interest in the survey namely internet access, the survey included two questions. The first question covers the availability of internet at home and the second question enquires whether the respondent accessed the internet at any location during the four weeks prior to the interview. For the purposes of this study, I concentrated on the second question, since access to the internet is the main concern of the study and not whether the internet was accessed from home.

Table 1: Descriptive statistics of the variables used in the analyses

	Variable	Description	% of sample	Mean	Std. deviation
	Independent				
1	Gender	Male	50.5	0.505	-
2	Married	Married or with a partner	78.8	0.788	-
3	Employed	Did any type of work in the past 7 days?	37.0	0.370	-
4	Health	Does your health status prevent you from doing daily work?		-	-
		Always	3.2	-	-
		Some of the time	17.8	-	-
		Hardly Ever	20.3	-	-
		Never	58.7	-	-
5	Race Minority	Coloured, Indian, Asian, Other	6.8	-	-
6	Race White	White	16.6	-	-
7	Education	Highest level of education completed		12.780	3.246
8	Satisfaction with money	Satisfaction: money available to respondent personally		-	-
		Very Dissatisfied	17.3	-	-
		Dissatisfied	45.6	-	-
		Neutral	7.1	-	-
		Satisfied	27.3	-	-
		Very satisfied	2.7	-	-
9	Age^2	Age of respondent squared		173.877	71.553
10	Internet Access	Accessed internet in the past 4 weeks	36.1	0.36	-
	Dependent				
1	Global life satisfaction	Satisfaction with life as a whole	See fig. 1	-	-
2	Satisfaction with standard of living	Satisfaction with standard of living	See fig. 2	-	-
3	Relational well-being	Composite index of relational variables	See fig. 3	-	-

Source: Author's calculations using the Quality of Life Survey of the GCRO (2013).

Of the sample, 19.1% indicated that they did have internet access at home, but a far bigger portion (36.1%) reported to have accessed the internet during the four weeks

prior to the interview (GCRO, 2013). Of those respondents that did access the internet, the majority indicated that they had accessed it via mobile phones (45,6%), followed by 24,4% from home, 16,8% from work, 7% from internet cafes, 4% from schools, colleges or universities and only 2% from community centres or libraries. The majority of the respondents that did access the internet had an education level of matric or more (80.9%), were between the ages of 20 and 39 (61.3%), were male (55.2%) and were African (61.3%) (GCRO, 2013). Based on the aforementioned, the majority of the current internet users in Gauteng can be described as young, educated, African respondents, with little to choose among the genders. It should also be noted that, within the race groups, the majority of Asians (59.4%) and Whites (64.9%) did access the internet, whereas only 28.7% of the Africans reported to have accessed the internet (GCRO, 2013).

3.3 Selection of the variables

3.3.1 Dependent variables

As the study analyses the effect of internet access on three different variables, namely global life satisfaction, satisfaction with standard of living and relational well-being, I estimated three models. In the next section I briefly describe the selection of these three dependent variables.

In the first model, estimating global life satisfaction, I used the only question in the survey related to global life satisfaction, namely: "How satisfied are you with your life as a whole these days?". The respondents were given five options from which they had to choose, ranging from very satisfied to very dissatisfied. I reversed the coding of all the variables related to life satisfaction (global and domain specific) so that one indicated the lowest level of satisfaction and five the highest level of satisfaction. See figure 1 for the distribution of the variable 'life satisfaction'. The distribution is relatively skewed with the majority (70,5%) of the sample indicating that they were satisfied or very satisfied with life and only 19,7% of the sample showing that they were not satisfied (dissatisfied or very dissatisfied).
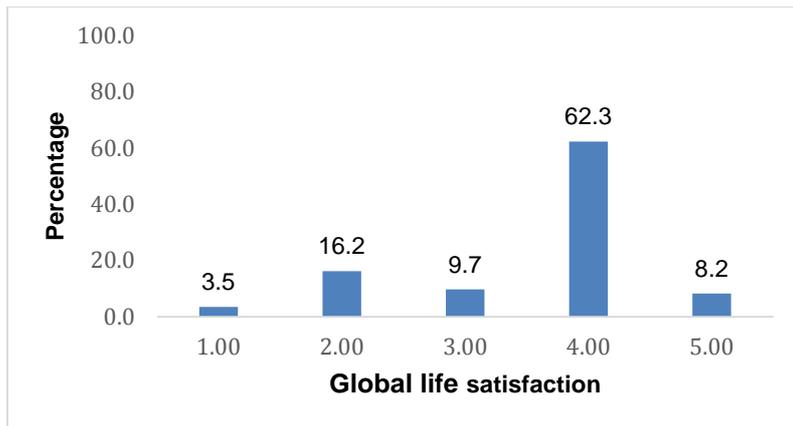
Figure 1: Global life satisfaction

Source: Author's calculations using the GCRO Quality of Life Survey (2013)

To estimate the second model related to the satisfaction of the respondents with their standard of living, I used the question: 'How satisfied are you with your standard of living?' (GCRO, 2013). The response options to the question were the same as for the life satisfaction question, ranging from very satisfied to very dissatisfied. Almost two thirds of the respondents indicated that they were satisfied or very satisfied with their standard of living (64.0%), as opposed to 27.9% who reported to being dissatisfied (dissatisfied or very dissatisfied). This finding shows that, although many respondents are satisfied with their lives as a whole, it is likely that they are not satisfied with their standard of living as such.

To estimate the third model on relational well-being, I constructed a composite index to be used as the dependent variable. The survey included three traditionally used measures (questions) of social relationships (see Stiglitz et al., 2009). The three questions are 'satisfaction with time with friends', 'satisfaction with time with family' and 'satisfaction with marriage'. The response categories to all three the questions are the same as in the previous questions used on life satisfaction and satisfaction with standard of living, ranging from very satisfied to very dissatisfied.
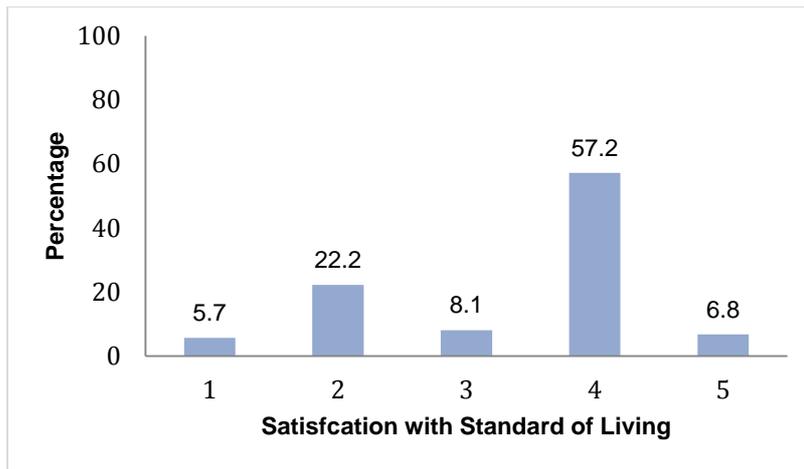
Figure 2: Satisfaction with standard of living
Source: Author's calculations using the GCRO Quality of Life Survey (2013)

To construct the composite index, I used Principal Component Analysis and derived the composite index from the factor loadings of the first extracted component (see the Handbook on the Constructing of Composite Indicators for a more detailed description (OECD, 2008)). As the factor loadings on the components in PCA are standardised, being derived from a correlation matrix, the mean of the composite index was 0 and the standard deviation was 1. The minimum value of the composite index was -4.4 and the maximum value was 1.9. The median was 0.3 showing that the variable is somewhat skewed to the left.

To have a dependent variable comparable to those used in the first and second model, I derived an ordinal variable from the composite index with five categories and named the variable 'relational well-being'. See figure 3 for the distribution of the relational well-being variable. Of the sample 76.9% indicated that they were satisfied or very satisfied with their social relationships with their family, friends and partners and less than 10% indicated the opposite. This finding shows that the people in Gauteng are generally satisfied with their social relationships. This finding is supported by previous studies on the region (Greyling & Tregenna, 2014).
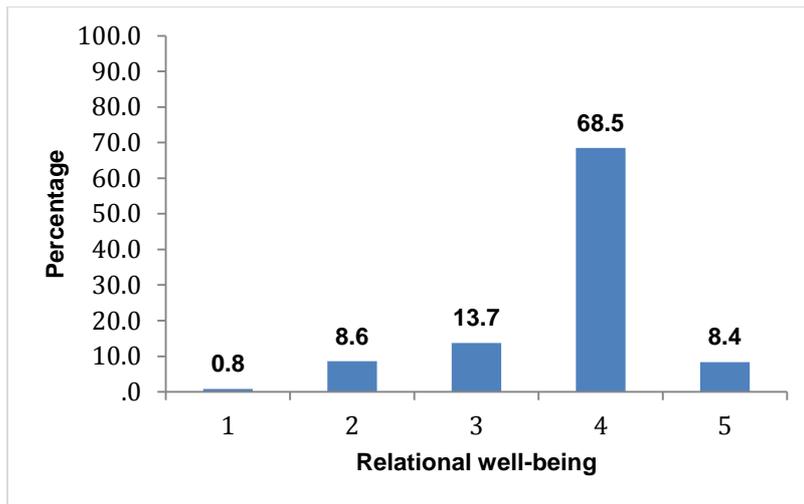
Figure 3: Relational well-being
Source: Author's calculations using the GCRO Quality of Life Survey (2013)

Looking at the individual variables included in the composite index of relational well-being, a similar distribution of the variables is revealed as that of the composite index. However, the dissatisfaction with time with family was slightly higher (11.1%) than that revealed by the other two variables (7.7% for time with friends and 8.1% for dissatisfaction with their marriage) (GCRO, 2013). The higher level of dissatisfaction with time with family might be indicative of the high proportion of migrant labourers in Gauteng (Greyling, 2015), who often do not reside with their families.

3.3.2 Explanatory variables

The variable of interest, the internet access variable, indicates whether a respondent has had access to the internet in the past four weeks. This variable only gives an indication of internet access, but does not give information on the frequency of, or the purpose for which the internet was accessed. Therefore, an in-depth analysis of internet use on life satisfaction, satisfaction with standard of living and relational well-being is restricted in this study and more detailed data is needed in future studies.

The selection of the control variables were based on the standard variables found in the literature to explain subjective well-being (see section 2.1). The same set of control variables are used in all the estimated equations to form a basis of comparison.

The socio-demographic variables included as control variables are gender, race, age squared (to control for non-linear effects of age on the dependent variables), being

married or living with a partner, education and health. The economic variables include employment status and satisfaction with money.

The gender variable is a dummy variable with one indicating being male and zero indicating being female. Previous literature has found that females in general report higher levels of life satisfaction than males, but this result is not always robust (Alesina et al., 2004),

The race variable is measured using two dummy variables, with Africans the non-coded variable as Africans constitute the biggest proportion (77.6%) of the sample. The coded races are the minority race groups including Coloureds, Asians, Indians and other races, and Whites. In previous studies it has been shown that race is statistically significant in explaining life satisfaction (Fontaine & Yamada, 2014) and that in South Africa often Africans are less satisfied with their lives than other race groups (Greyling & Tregenna, 2014).

Previous literature has shown that there is a U-shaped relationship between age and life satisfaction, with life satisfaction tending to decrease until it reaches a minimum at an age of about 40 years and increasing again thereafter (Blanchflower & Oswald, 2007). Based on these findings the age variable is squared to control for the non-linear effects of age on life satisfaction (Blanchflower & Oswald, 2007).

Married is a dummy variable with one indicating a respondent who is married or living with a partner and zero the alternative. The literature shows that being married or living with a partner is positively related to life satisfaction (Helliwell, 2003).

Education is a discrete variable that takes a value of one if the respondent has no education, two if the respondent has one year of education up to 18 if the respondent's highest level of education is a post graduate degree. The effect of education on life satisfaction is not clear and often not statistically significant in explaining life satisfaction in empirical studies when controlling for health and income (Blanchflower & Oswald, 2004). However, some studies find a positive effect of higher education on life satisfaction (Witter, et al., 1994).

Health is an ordinal variable, taking a value of one if a respondent's health always keeps him/her from going to work and four if his/her health never keeps him/her from going to work. Interesting to note that by far the majority of the respondents indicated

that their health seldom kept them from going to work even if their life satisfaction as a whole was relatively low. Findings on the life satisfaction of South Africans showed that health is not a statistically significant predictor of life satisfaction (Blaauw & Pretorius, 2013), contrary to the results found in studies in developed countries (Helliwell, 2003; Diener & Seligman, 2004).

The selected economic variables I included in the model, as mentioned earlier, are employment status and satisfaction with money. Employed is a dummy variable taking the value of one if the person has done any type of work seven days prior to the interview and zero in the alternative. Being unemployed has been shown to be negatively correlated to life satisfaction (Clark & Oswald, 1998; Frey & Stutzer, 2002; Helliwell, 2003; Clark & Oswald, 1994).

I selected satisfaction with money as a proxy variable for material well-being. It has been shown that subjective measures of material well-being, that reveal the perceived judgement of a person, are often a better measure than objective measures (Kahneman & Krueger, 2006). People are more willing to answer subjective questions related to income and material well-being than objective questions. Therefore, the percentage of missingness of subjective measures of material well-being is much lower than for their objective counterparts. I found, after cross-tabulating income and satisfaction with money, that respondents in the lower income categories are often either dissatisfied or very dissatisfied with the money available to spend; whereas respondents in higher income categories are on average either satisfied or very satisfied with the amount of money they had available to spend. Therefore, it seems that satisfaction with money gives a robust estimate of material well-being.

Before the final selection of the variables, bivariate correlation analyses between all variables were undertaken (see Table A in Appendix A). The results of the correlation analyses did not reveal any strong correlations between the explanatory variables[3] and moderate correlation between the explanatory variables and the dependent variables. Therefore based on the results of the correlation analyses all mentioned dependent and independent variables were used in further statistical analyses.

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[3] This indicates a lack of multicollinearity.

4. METHODOLOGY

In the next section I present a generic model which is used to estimate the effect of internet access on global life satisfaction, satisfaction with standard of living and relational well-being.

The model is represented as follows:

$$Y_i = \beta_0 + \beta_1 Internet_i + \lambda_1 X_i + \lambda_2 Ei + \acute{\varepsilon}_i \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots.. 1$$

Where Y_i represents the dependent variable estimated for individual *i,* in each model, as predicted by his/her access to the internet *(Internet_i),* and certain standard demographic *(X_i),* and economic variables *(E_i)* (see section 3)*,* with $\acute{\varepsilon}_i$ the error term capturing all variances in the dependent variable not explained by the model.

As the dependent variables in these models are ordinal of nature, the standard choice of method to estimate these types of functions is ordered discrete models using either an ordered probit or an ordered logit model (see Praag et al. 2003; Graham et al. 2004; Alesina et al. 2004; Ferrer-i-Carbonell & Frijter, 2004; Kingdon & Knight, 2007; Di Tella & MacCulloch, 2008; Frijters et al. 2012).

In this study I use ordered logit[4] to estimate the functions, although I also estimate the functions using Ordinary Least Square (OLS). The results obtained from the two methods are similar; yet OLS estimations of the coefficients have the advantage of being directly interpretable, which is not the case when using ordered logit estimations. Logit estimated coefficients predict the probability (derived from the computed odd ratios) that the dependent variable is in a specific category. However often the interpretation of logit coefficients is not as accurate as using OLS estimations. (Ferrer-i-Carbonell & Frijter, 2004; Blaauw & Pretorius, 2013). Therefore in this study I mostly interpret the coefficients estimated using OLS, except where the results on the signs

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[4] Ordered logit rather then ordered probit estimation techniques are used as the ordered logit function has a cumulative standard logistic distribution (*F*), whereas the ordered probit has a cumulative standard normal distribution (Φ).

and significance of the estimated coefficients differ between the two models, in which case I interpret the ordered logit results.

I use the standardised OLS coefficients to compare the contribution of each independent variable in explaining the dependent variables. Such a comparison can only been drawn if the measuring scale of the explanatory variables is standardised. To standardise the measuring scale I convert the variables making use of the mean and standard deviation of the variables[5].

5. RESULTS

In this section I discuss the results pertaining to the first research question, asking if internet access predicts the global life satisfaction of respondents staying in Gauteng. Then I discuss the results of the second and third estimated models to address the second research question, which compares the effect of internet connection on the life satisfaction domains, material well-being (proxied by satisfaction with standard of living) and relational well-being.

Table 2 includes the regression results of the three estimated models with the dependent variables life satisfaction, satisfaction with standard of living and relational well-being. Each model was estimated using ordered logit and OLS models. The coefficients and level of statistical significance of each explanatory variable are given for the ordered logit estimations, the OLS estimations and the standardised OLS estimations.

Considering the estimated coefficients using ordered logit and the OLS method, the results are very similar, with no differences in the signs of the estimated coefficients and very little difference in the levels of statistical significance. The value of the logit estimated coefficients, after adjusting by the corresponding correction factor, is comparable to that of the estimated OLS coefficients.

Based on the similarity of the results of the ordered logit and the OLS estimations, I follow the practice of previous researchers (see Ferrer-i-Carconell & Frijters, 2004; Bartram, 2012, Stevenson & Wolfers, 2009; Blaaw & Pretorius, 2012) by interpreting the OLS results, except in the single case (see section 5) in which the statistical

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[5] For a detailed description of the standardisation of variables, see Tabachnick & Fidell (2007).

significance of the estimated coefficients between the two models differ, in which case I interpret the results of the ordered logit model.

Table 2: Results of ordered logit and OLS estimations

	Life satisfaction			Satisfaction with standard of living			Relational well-being		
	Logit	OLS		Logit	OLS		Logit	OLS	
		Unstand	Stand		Unstand	Stand		Unstand	Stand
Determinants									
Gender	-.083**(.025)	-.042***(.011)	-.022***	-.105***(.025)	-.054***(.012)	-.025***	-0.001664	-0.000162	-.012*
Married	.141***(.031)	.067***(.014)	.028***	.192***(.030)	.096***(.015)	.036***	.529***(.032)	.164***(.011)	.088***
Employed	.086**(.027)	.053***(.012)	.026***	.082**(.026)	.050***(.013)	.023***	-.255***(.028)	-.090***(.010)	-.058***
Health	-.086***(.015)	-.037***(.007)	-.033***	-.002(.015)	-.004(.007)	-0.003	-.083***(.016)	-.028***(.005)	-.033***
Race minorities	.199***(.051)	.091***(.022)	.024***	.356***(.050)	.170***(.024)	.040***	.080(.053)	.009(.018)	0.003
Race white	0.514***(.042)	.0205***(.018)	.078***	.610***(.042)	.263***(.019)	.091***	.049(.042)	-.009(.015)	-0.004
Education	.033***(.005)	.016***(.002)	.053***	.037***(.005)	.018***(.002)	.055***	.016**(.005)	.006**(.002)	.025**
Satisfaction with money	.527***(.012)	.224***(.005)	.262***	.754***(.013)	0.335***(.005)	.356***	.171***(.012)	.060***(.004)	.090***
Age^2	.000***(.000)	.000***(.000)	.103***	.000***(.000)	0.000***(.000)	.093***	.000(.000)	.000*(.000)	.019*
Internet access	.680***(.071)	.322***(.032)	.032***	.621***(0.70)	.305***(.034)	.137***	.073(.074)	.050*(.026)	.032*
Internet*age	-.012***(.002)	-.006***(.001)	-.111***	-.011***(.002)	-.005***(.001)	-.090***	.003(.002)	.000(.001)	0.007
Chi-Square/ Adj.R squared	80620.941	.121	-	91435	.193	-	77108.98	.024	-
Df	74377	-	-	74377	-	-	74377	-	-
Significance	.000	.000	-	.000	.000	-	.000	.000	-
Psuedo R-squared	.138	-	-	.220	-	-	.033	-	-

Source: Author's calculations using the Quality of Life Survey of the GCRO (2013)
Notes to Table 2: Standard errors are in parentheses. Unstand = unstandardised. Stand = standardised. Levels of statistical significance are indicated by *. The value of the Nagelkerke statistic is reported under Pseudo R-squared.

5.1 Results of the first estimated model

In the first model estimating life satisfaction (see Table 2), I find the model statistically significant (R-$squared$ = .121 (.913) (F-$stat$ = 341.82), p = .000 and *Psuedo R-squared* (Nagelkerke) = *.138*). Although the *R-squared* is relatively low with only 12% of the variance in the dependent variable explained by the explanatory variables, this is an acceptable level of explained variance in the estimation of subjective well-being models (for comparable results see Ferrer-i-Carconell & Frijters, 2004; Stevenson & Wolfers, 2009; Bartram, 2012; Blaauw & Pretorius, 2012)[6].

I find that the variable of interest, internet access, is statistically significant at the one percent level and positively related to life satisfaction, with people who have internet access being more satisfied with their lives than those without. Considering the size of the standardised coefficient of the internet access variable (0.159) relative to the size of the coefficients of the other explanatory variables, it seems that internet access has a considerable effect on the life satisfaction of those people that have internet access. Only satisfaction with money has a bigger effect on life satisfaction than internet access. Thus, internet access may be an important contributor to the global life satisfaction of all people in Gauteng.

This finding supports the South African policy initiative, South Africa Connect, which aims to supply internet access to all people in the country by 2030 (Department of Communications, 2013). The finding is also in line with the findings of Graham and Nikolova (2013), Kavetsos and Koutroumpis (2011) and Penard et al. (2013), which show that internet access has a positive influence on life satisfaction.

Considering the other control variables, all the standard variables found in the literature to explain life satisfaction were found to be statistically significant at the one percent level and to explain the global life satisfaction of the respondents. However, not all the explanatory variables revealed the expected signs. I briefly discuss the results on the control variables below.

The gender coefficient is statistically significant and negatively related to the life satisfaction variable. This shows that, in the sample, males have lower levels of life satisfaction than females. This finding agrees with the findings in previous studies,

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[6] I found the residual of the regression normally distributed within the five categories defined in the dependent variable. Tests for multicollinearity showed that the tolerance and the variance inflation factor were within acceptable ranges.

showing that females in general have a higher level of life satisfaction than males (Verme, 2009).

The variable health in which the question is posed: 'How often does your health keep you from going to work?' with responses varying in a range from always to never was found to be negatively related to global life satisfaction. This finding contradicts previous findings in the developed world on a positive relationship between health and life satisfaction. Thus, the healthier a person is, the higher her/his life satisfaction will be (Diener & Seligman, 2004). When cross-tabulating the health and life satisfaction variables, it shows that respondents who report that their health often keeps them from going to work also report that they are satisfied with life overall. This might reflect people's resilience and people's acceptance of poor health in a poorer society, where poor health is more widespread than in developed countries (UNDP, 2013).

Both the variables race minorities and race white, are positively and statistically significant related to the life satisfaction variable, indicating that these race groups are more satisfied with their lives than African (uncoded) respondents. This might partly be explained by a policy which negatively affected the development of African people before the 1994 democratic elections of the South African government. Poverty among African people in South Africa is still widespread (GCRO, 2015).

The satisfaction with money variable is positively related to life satisfaction and, judging from the estimated standardised OLS coefficient (0.262) of the satisfaction with money variable, it has the biggest effect on global life satisfaction, ceteris paribus. This finding reflects previous empirical findings that income (money) also measured subjectively, is positively related to life satisfaction especially at lower income levels (Easterlin, 1974). As income increases this relationship becomes weaker (Easterlin, 1974). The majority of the sample, almost 40%, reported earning a monthly household income of between R800 ($64)[7] and R6 400 ($512) per month (GCRO, 2013). In view of the upper bound poverty line[8], adjusted for this sample, of R2 929 per household per month (based on StatsSA's estimations), the average household in Gauteng's income is close to the poverty line (StatsSA, 2015).

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[7] Calculated at an exchange rate of $1=R12.50 as reported on 24 July 2015.
[8] The upper bound poverty line as estimated by StatsSA (2015) is R779 ($62.32) per month per person and the average household size of the sample is 3.76 people (GCRO, 2013), thus the upper bound household poverty line calculated for this sample is R2 929.

The age squared variable is positively related to the global life satisfaction variable, reflecting the non-linear relationships between age and global life satisfaction, similar to that found in previous studies (Blanchflower & Oswald, 2007). I also entered age as a variable but it was not statistically significant and, when left out of the model, it made no difference in the amount of explained variance of the dependent variable. Therefore I decided to exclude it from the final model.

It is often argued that internet access could have different effects on life satisfaction depending on the age of the respondents, with younger respondents getting higher levels of life satisfaction from internet access than older respondents (Pénard, et al., 2013). To test this hypothesis I constructed an interaction variable namely internet with age.

I find a negative statistically significant estimated coefficient for the internet with age variable, meaning that the positive impact of internet access on life satisfaction is stronger for younger generations than for older age groups. This was confirmed by cross-tabulating the internet access and age variable. The rate of access decreases steadily for the ages from 20 to 65. Respondents in the age group between 18 and 20 indicated that 64% of the group accessed the internet over the past four weeks, whereas only 12% of the people over the age of 60 indicated that they had accessed the internet in the same period. This reveals that the benefits of access to the internet are definitely stronger for the young and that attempts to give internet access to all should prioritise younger citizens rather than older citizens. This finding agrees with the findings of Penard et al. (2013), which showed that the positive influence of internet access is stronger for the younger respondents than for older respondents.

5.2 Results on the second and third estimated models

Turning to the second research question, namely testing whether the positive effects of internet access on life satisfaction also hold for specific domains of subjective well-being, namely for the satisfaction with standard of living and relational well-being domains, I find the following:

Considering the satisfaction with standard of living model, I find the model statistically significant (*R- squared* = .193 (.913) (*F-stat* =.967), *p* = .000 and *Psuedo R-squared* (Nagelkerke) = *.220*). The *R-squared* is relatively low, but somewhat higher than for the first model estimating global life satisfaction.

The variable of interest, namely internet access, was statistically significant at the one percent level and positively related to satisfaction with standard of living, meaning that people who have internet access are likely to be more satisfied with their standard of living than those without internet access. Interesting to find the same negative relationship between the internet with age interaction variable as was found in the first model. This shows that internet access is stronger related to satisfaction with standard of living of younger respondents than to older respondents.

Considering the effect of the standard variables of subjective well-being on satisfaction with standard of living, I found the results very similar to those found in regressing the standard variables on global life satisfaction. This finding reflects the positive relationships between global life satisfaction and satisfaction with standard of living in the Gauteng region (r = .497 (Pearson's correlation coefficient)) (GCRO, 2013).

The only difference found in the results between the effect of the standard variables of subjective well-being on the dependent variables, global life satisfaction and satisfaction with standard of living, was the health variable which was not statistically significant in the latter case. After cross-tabulating the health variable and the satisfaction with standard of living variable I found that, even if respondents reported that health often prevented them from going to work, they did not report that it negatively affected their satisfaction with standard of living. A possible reason for this finding is that the social welfare system in South Africa provides sufficiently for those people who have poor health and does not affect their satisfaction with their standard of living. It could also be that people who suffer from poor health reside in households in which other members are the primary income earners. Thus not being healthy and not being able to work does not have a significant effect on a person's satisfaction with their standard of living.

Turning to the last estimated model, which estimates relational well-being, I find the explanatory value of the model as a whole to be very low, though statistically significant (R- squared = .024 (.748) (F-stat = 60.649), p = .000 and *Psuedo R-squared* (Nagelkerke) = .033). The low level of the explained variance of the dependent variable (relational well-being) by the explanatory variables might reflect the underlying differences between the domains of satisfaction with standard of living and relational well-being. It is likely that very different explanatory variables predict relational well-being than those found to predict global life satisfaction and satisfaction with standard

of living. However, as the aim of this paper was to determine if internet access has similar effects on global life satisfaction and the domains of life satisfaction (satisfaction with standard of living and relational well-being), I was constrained to use the same set of explanatory variables in the estimation of the models.

Looking at the variable of interest, internet access, I find that the results of the ordered logit and the OLS differ, with the ordered logit results showing that the variable is not statistically significant and the OLS results indicating statistical significance only at the 10% level. In this case I rely on the ordered logit results, seeing that ordered logit is the preferred method of estimation using an ordered dependent variable. To test the robustness of this decision I also ran two separate regressions, using OLS, including only young respondents in the one and only educated respondents in the other. Both these regressions revealed statistically not significant effects of internet access on relational well-being[9]. The finding of internet access not to be statistically significant differs from previous findings in which it was shown that internet access is mostly a statistically significant predictor of relational well-being, although the directions of the relationships in these studies do not always agree. In certain studies it was shown that internet access negatively affects relational well-being (Flaherty et al. 1998; Nie et al. 2002; Lee et al. 2011) and in others the opposite was found (Franzen, 2003; Sey et al. 2013; Penard et al. 2013).

A reason for internet access not being statistically significant in this sample might be the relatively limited use of social media in Gauteng, as internet access is restricted to only 36% of the population according to this sample (GCRO, 2013). Of the 36% respondents that did have internet access (GCRO, 2013), it is uncertain for which purpose they accessed the internet. According to studies in the developed world it seems that people in general allocate 30% of their time, of the total time spent on internet, to social media (Mander, 2015). Thus if we assume that the time spent on social media in Gauteng is similar to that found in other countries, we can deduce that the use of the internet to socialise is very limited. It might be that, as internet access increases in Gauteng, the use of the internet to build social relationships will also increase and that over time the results found in this study will look different.

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[9] In the selecting the data sets, one only including young respondents and the other only educated respondents, to test the robustness of the results of internet access on relational well-being, it was argued that these two groups are most likely to reveal statistically significant effects of internet access on relational well-being.

The standard life satisfaction variables found to be statistically significant in explaining relational well-being are: married, employed, health, education level, and satisfaction with money. Variables found not to be statistically significant are gender, race, age squared, internet access and internet access with age.

Only looking at non-expected results, I find employed to be statistically significant, but contrary to the first and second estimated models, I find it negatively relates to the dependent variable. This shows that respondents who are employed most likely have poorer relational well-being than those who are not employed. A number of possible reasons can be mentioned to support this finding. Many of the people in Gauteng (45%) are migrants, thus they migrate to Gauteng looking for work and leave their families and friends in the sending region or country (Greyling, 2015). Being employed also limits the time people have available to spend with their families, friends, spouses or partners, which might have a negative effect on these relationships.

Race minority and race white were found to be statistically not significant in explaining social relationships, meaning that race is not a predictor of the time available to spend with friends, family, and a person's spouse or partner.

Age squared was also found to be statistically not significant. Therefore age is not a determinant of social relationships, implying that the U-shaped relationship detected between the previous two dependent variables (life satisfaction and satisfaction with standard of living) and age squared does not hold in this model. This means that age, either being young or old, does not affect the time you spend with your family, friends and partner.

The interaction variable age with internet was found to be statistically not significant. This may be expected, as neither age nor internet access is a predictor of relational well-being.

To summarise: Internet access was found to be statistically significant in explaining global life satisfaction and satisfaction with standard of living, but not relational well-being. Although internet access contributes to global life satisfaction and satisfaction with standard of living, the results of this study do not show that internet access predicts relational well-being, contrary to previous findings in the literature.

6. CONCLUSION

To provide internet access to all people in the world has become an important development goal, as set out in the Human Development Report of 2001 (United Nations, 2001b), which is pursued by most countries including South Africa (Department of Communications, 2013). It has been shown that internet access positively affects the majority of subjective well-being domains, including material well-being, education, health and governance. However the findings on the effect of internet access on relational well-being are inconsistent with some of the studies showing positive effects and other negative effects.

In this paper I analysed the effect of internet access on global life satisfaction and also compared the effects of internet access on two domains of life satisfaction, namely satisfaction with standard of living and relational well-being. The explanatory variables included in the estimated models were internet access and the standard variables found in the literature to explain life satisfaction. In the analyses I made use of a data set on quality of life of the GCRO (2013). I used ordered logit and OLS to estimate the models.

I found internet access to be statistically significant and positively related to life satisfaction and satisfaction with standard of living, but statistically not significant in explaining relational well-being. The finding on relational well-being contradicts previous results which find internet access statistically significant, although there is no agreement on the direction of the relationship. A number of studies show that internet access enhances social relationships via social media (Franzen, 2003; Pénard et al., 2013), while others find that only face-to-face contact enhances social relationships (Lee, et al., 2011).

The finding of this study might be ascribed to the limited internet access of people in Gauteng, which restricts their exposure to social media. Once the goal of South Africa's Broadband Policy (Department of Communications, 2013) is achieved, namely to give all people internet access by 2013, the results of this study might be very different.

This study is also limited by the lack of data on the frequency of internet use and the purpose for which the internet was accessed. The internet variable used in this study only determines whether a respondent had accessed the internet in the past four weeks, which limits the analytical power of the study. Data on the frequency and the

specific use of internet in South Africa is needed for an exhaustive analysis of the impact of internet access on the domains of subjective well-being.

The results of the study also showed that internet access has different effects on global life satisfaction and satisfaction with standard of living, depending on the age of the respondents. Younger respondents got higher returns from internet access on life satisfaction and satisfaction with standard of living than older respondents. This result agrees with previous findings in the literature (Pénard, et al., 2013). The most likely explanation for this finding is that younger respondents are more skilled in using ICT than older respondents. Their higher skill levels thus enable them to derive the full potential from internet access. This finding has two policy implications: Firstly, internet access should be prioritised to younger people, as internet access benefits them more than older people. This can be achieved by increasing internet access at schools and tertiary educational institutions. Secondly, the skill levels of older people should be improved so that they can fully benefit from internet access. This goal can be met by introducing training programmes for older people.

In general, the results of this paper highlight the importance of internet access not only for the development of a country, but also for the subjective well-being of a country's population and supports the goals of the South Africa Connect Policy to deploy telecommunications infrastructure and to diffuse ICT to all people in the country. However, policy makers should be aware of the likelihood of negative effects of internet access on relational well-being due to obsessive or undesired internet use.

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APPENDIX A

Table A: Correlation matrix of variables included in analyses (excluding dummy variables)

	Life satisfaction	Satisfaction with standard of living	Relational well-being	Health	Education	Satisfaction with money	Age with internet
Life satisfaction	1	.497**	.211**	-.040**	.108**	.310**	.136**
Satisfaction with standard of living	.497**	1	.184**	-.008	.137**	.407**	.164**
Relational well-being	.211**	.184**	1	-.028**	.084**	.121**	.090**
Health	-.040**	-.008	-.028**	1	.167**	.016**	.073**
Education	.108**	.137**	.084**	.167**	1	.149**	.426**
Satisfaction with money	.310**	.407**	.121**	.016**	.149**	1	.186**
Age * internet	.136**	.164**	.090**	.073**	.426**	.186**	1

Source: Author's calculations using the Quality of Life Survey of the GCRO (2009)
Notes to Table A: Levels of statistical significance is indicated by*