Title

Explaining engagement patterns in independent, proxy, and supported internet use and problem solving drawing from digital divide theory and social-cognitive theory

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Abstract

Research on functional internet use and problem solving related to, for example, online banking or interacting with governmental websites, has separately investigated independent use, proxy use (i.e., use through others) and supported use (i.e., use with support of others), while in fact it is rare that people solely engage in one use type. In addition, following digital divide theory varying socio-demographic variables have been identified as explaining factors of these use types, while less is known about the influence of technological variables, such as internet attitudes, access, and skills. Hence, drawing from social-cognitive perspective, the present study explores whether engagement patterns in independent, proxy and supported internet use and problem solving can also be explained by people's internet attitudes, access, and skills. Results of a cross-sectional survey (n = 704, 58.7% women, M_{age} = 53.50) point to three distinct engagement patterns. First, those who highly engage in independent internet use and independent problem solving. Second, those who engage in independent internet use and adaptively engage in independent, proxy, and supported problem solving. Third, those who moderately engage in all types of internet use and frequently engage in proxy and supported problem solving. These three engagement patterns were explained to different extents by socio-demographics, internet attitudes, access, and skills. Our empirical results contribute to the literature as we demonstrate that technological variables may be at least as important as socio-demographic variables in explaining the likelihood of people's engagement in independent, proxy, and supported internet use and problem solving. Implications for future research and policy are discussed.

Keywords: Internet use, Problem solving, Proxy internet use, Social Support, Digital divide, Social-cognitive theory

Introduction and Background

In developed and emerging countries, using internet to reach functional needs, such as using internet for online banking, buying products, information seeking and interacting with governmental or private services, has become common practice and have been stimulated by the products and services of public and private organizations (Allmann & Blank, 2021; Schou & Pors, 2019). Indeed, the European Commission published that 72% of European citizens consumes news through the internet, 66% uses the internet for online banking, 71% buys products online, and 67% submitted an online form to public authorities through the internet in the past six months (European Commission, 2020).

However, not everyone is able or interested to use the internet (Anrijs et al., 2020; Grošelj et al., 2019). In Europe, on average, 9.5% of citizens reported to have never used the internet. This figure varies across countries, for example, Sweden and the Netherlands have less than 3% of non-users, while Bulgaria and Greece have 24% and 22% of non-users (European Commission, 2020). In an Australian study, absolute internet non-users were found to be rare (Selwyn et al., 2016). More often it turned out that people use the internet indirect or mediated through others, denoted as proxy use. Proxy use is the use of ICTs not by oneself, but by asking other people to use ICTs or the internet on one's behalf (Dolničar et al., 2018). In the past, it has been estimated that between 20% and 44% of internet non-users have asked someone to go online on their behalf (Blank, 2013; Friemel, 2016). Recently it was found in a representative Slovenian sample, that of 24% of respondents who have never used the internet, 47% engage in proxy internet use (Grošelj et al., 2019). Identified reasons for non-use and proxy use are lack of interest, no need, being too old, no time, insufficient skills, no access, high costs, safety and privacy concerns, feelings of anxiety or discomfort, and health problems (Grošelj et al., 2019; Helsper & Reisdorf, 2013; Reisdorf et al., 2016; A. J. van Deursen & Helsper, 2015).

Another form of mediated internet use is supported use. Similar to proxy use, supported use has not been extensively studied (e.g., Asmar et al., 2020; Correa et al., 2019; Courtois & Verdegem, 2016; Helsper & van Deursen, 2017; Micheli et al., 2020; A. J. A. M. van Deursen et al., 2014). Supported use can be defined as asking for help or aid in using ICTs, it is the instrumental support provided as information, guidance, advice or feedback in using ICTs people receive from others (Asmar et al., 2020; Helsper & van Deursen, 2017). Based on convenience samples, Courtois and Verdegem (2016) found that 77% of their respondents often ask others for help with computer or internet problems, while Helsper and Van Deursen (2017) found that in the past three months 41% of their respondents did ask for help when using the internet. Correa et al. (2019) found that 25% of internet users received support from their children in learning how to use the internet. These large differences in findings can be explained, on the one hand, by the use of convenience samples, and on the other hand, by the difference in how support was operationalized, while Courtois and Verdegem (2016) investigated support for ICT problems, Helsper and van Deursen (2017) examined support for using the internet in general, and Correa et al. (2019) evaluated whether respondents learned to use the internet from their children, which are different applications of supported use. Reasons why people rely on supported internet use are rather unexplored until know. Although it seems likely that people rely on supported use when having insufficient ICT skills themselves (Asmar et al., 2020), other reasons could be, in line with proxy use, that people are not interested or experience feelings of discomfort, fatigue, anxiety or stress when using ICTs (Grošelj et al., 2019; Reisdorf et al., 2016).

When reviewing the literature, two research gaps can be identified. First, until now research has separately studied independent, proxy and supported use. Empirical studies on independent use does not consider proxy or supported use (e.g., Reisdorf & Groselj, 2017; Schehl et al., 2019), research on proxy use has mainly focused on non-user populations (e.g.,

Dolničar et al., 2018; Grošelj et al., 2019; Reisdorf et al., 2016), and studies on supported use has rarely considered to which extent people also engage in independent or proxy use. Instead independent use is only considered as the inverse of supported use, i.e., not relying on others for support, but relying on oneself for support (e.g., Asmar et al., 2020; Courtois & Verdegem, 2016). A second research gap is that studies on proxy and supported use seem to assume that proxy use is solely applied for internet use (e.g., online banking), and supported use is mainly applied for problem solving (e.g., solving problems with WiFi connection or entering recipients' data necessary for online banking), however Helsper and van Deursen (2017) already empirically demonstrated that supported use is also applied by people for internet use in general and not only for problem solving. The present study aims to investigate both internet use and problem solving as two separate behaviors for which people can engage in independent, proxy and supported use. While previous studies have investigated independent, proxy and supported use as distinct and exclusive behaviors, we suggest that these are complementary behaviors as people can engage in independent, proxy and supported use simultaneously, sequentially or alternating. By doing so, this study adds to the existing literature with a nuanced understanding of these different use types. This study is also of interest for governments and organizations as it might show them the importance of each type of use so that all citizens can make use of their digital services, either by independent, proxy, or supported use. Consequently, the first two research questions (RQ) that will be explored in the present study are:

RQ1: To what extent do respondents engage in independent, proxy, and supported internet use and problem solving?

RQ2: Can we distinguish distinct groups of respondents with similar engagement patterns in independent, proxy, and supported internet use and problem solving?

Understanding Engagement in Independent, Proxy and Supported Internet Use and Problem Solving Drawing from Digital Divide Theory and Social-Cognitive Theory

Some studies have already investigated which socio-demographic variables (e.g., gender, education, income, health status) explain engagement in independent, proxy, and supported internet use and problem solving (Büchi et al., 2016; Courtois & Verdegem, 2016; Dolničar et al., 2018; Reisdorf & Groselj, 2017; Scheerder et al., 2017). Following a digital divide perspective - which examines the distribution and use of ICTs among populations and whether differences can be identified between population groups based on their socio-demographic characteristics – concerns have then been put forward that inequalities exists in the extents that people engage in independent, proxy, and supported use. More specifically, researchers have pointed out that those who use the internet for functional needs more frequently themselves are those who already have stronger socio-economic positions than those who do not or less frequently engage in functional internet use. For example, it has been demonstrated that internet use for commercial transactions, information searching or news consumption, is performed more often by men, younger people, higher educated people, and people with higher income (Van Deursen et al., 2015). Other studies found similar results with regard to functional internet use in that individuals or families with lower educational attainment or lower household income less frequently use the internet for information searching on health, education and childcare (Laeeq Khan et al., 2020; Wang et al., 2014). Based on these findings and drawing from digital divide theory researchers then concluded that offline social inequalities (e.g., lower education, lower income or smaller social network) are reflected in online digital inequalities (e.g., lower use of internet) (Büchi et al., 2016; Laeeq Khan et al., 2020; Scheerder et al., 2017).

Proxy use has also been studied from a digital divide perspective by linking socio-demographics to this type of use. Research has demonstrated that within non-users proxy use

is more common among persons with (grand-)children, younger people, more educated people and those who live in urban areas. Researchers concluded that these differences based on socio-demographics, again point to inequalities among non-users who engage and non-users who do not engage in proxy use (Dolničar et al., 2018; Grošelj et al., 2019).

Considering supported use, it has also been inferred that digital inequalities exists. Although it was found that no real differences in quantity of available and used support exist, the quality of the provided support has found to be unequally distributed in that women and adolescents with lower educated parents more often rely on informal support sources (i.e., family or friends) or that those who experience most problems in using the internet also seem to have the most difficulty obtaining high-quality support (Asmar et al., 2020; Helsper & van Deursen, 2017; Micheli et al., 2020). Informal support sources are considered as lower-quality sources based on the concept of homophily or the idea that friends and family of people with low digital skills are likely to also have low digital skills. Another explanation for this disadvantage is because family members may be unavailable, reluctant and impatient to help (Asmar et al., 2020). Courtois and Verdegem (2016) made a similar conclusion in that those who are self-reliant in support and those who rely on non-domestic support sources for computer/internet problems (e.g., peer or workplace support) are advantaged compared to those who rely on domestically networked support (e.g., family and friend support). The latter was significantly associated with being female, older in age, and unemployed (Courtois & Verdegem, 2016).

From a digital divide perspective, linking socio-demographic variables (e.g., education, income, health status) to independent, proxy, and supported use provides insights on whether socially vulnerable groups are disadvantaged in their internet use, compared to socially non-vulnerable groups who more often rely on independent use (Büchi, 2021; Stern et al., 2009). As such independent use is put forward as the preferred use over indirect uses,

such as proxy or supported use, and has been considered as the end goal. The idea that independent use is the end goal or that the diffusion of technologies happens in the total population and ends when every individual has adopted the technology him- or herself has its roots in economic contagion models (Billon et al., 2021). However, it could be questioned whether independent use is the preferred type of use for everyone. If people reach their functional goals through proxy or supported use, these use types may be an equally valuable use type as independent use. Taking this remark in account, the present study aims to explore the role of people's evaluation of their internet attitudes, access, and skills in their engagement in independent, proxy and supported use. More specifically, the present study questions whether social-cognitive theory may also point out interesting variables in explaining engagement in independent, proxy and supported internet use and problem solving, besides socio-demographics suggested by digital divide research.

Social-cognitive theory explains people's behavior as the result of the reciprocal relations between individuals' cognitions, their environmental resources and demands, and their behaviors (Bandura, 1989). By means of evaluations of personal experiences and self-assessments thoughts, individuals employ a self-reflective capability to understand their cognitions, their environments and variations in situational demands and intentionally adapt their behavior to it (Bandura, 1989; Larose et al., 2001) Hence, we argue that engagement in independent, proxy and supported internet use and problem solving may be adaptive behaviors people employ based on the evaluation of their (lack of) internet interest, access or skills. In other words, this study suggests that engagement in independent, proxy and supported use is a behavioral choice based on people's cognitive assessment of their attitudes, access, and skills, besides the result of inequality processes based on socio-demographic characteristics.

Although not explicitly linked to social-cognitive perspective, previous studies have examined the associations between internet attitudes, access, and skills on the one hand, and independent, proxy or supported use on the other hand (Scheerder et al., 2017; Schehl et al., 2019; A. J. van Deursen & Helsper, 2015). For example, internet attitudes (Reisdorf & Groselj, 2017; Schehl et al., 2019; A. J. van Deursen & Helsper, 2015) and internet access (Laeeq Khan et al., 2020) were found to be significantly associated with independent internet use. With regard to proxy use, research demonstrated that people with lower access and lower skills are more likely to engage in proxy use (Grošelj et al., 2019). Also, internet skills were found to be significantly associated with social support for internet problem solving (Courtois & Verdegem, 2016) and social support for internet use in general (Helsper & van Deursen, 2017). Considering these empirical findings that both socio-demographic variables as well as technological attitudes, access and skills are associated with independent, proxy, and supported internet use and problem solving and drawing from digital divide theory and social-cognitive theory, the present study will address the following research question (RQ):

RQ3: Which socio-demographics, internet attitudes, access, and skills are significant determinants of engagement patterns in independent, proxy, and supported internet use and problem solving?

As such this study will increase our understanding on factors that explain engagement in independent, proxy, and supported internet use and problem solving behavior.

Method

Procedure

This study is based on survey responses gathered between January 2021 and May 2021 in Flanders (= the Dutch speaking part of Belgium). The survey questions were proofread and adapted by a professional organization for simple and plain language and could

be completed in Dutch, French, English and Turkish. Inclusion criteria to participate were: (1) being 18 years or older, and (2) not being a student. Ethical approval for this survey study was granted by the ethical board of the faculty of Social Sciences from [name of university blinded for purpose of review].

A heterogeneous sample was pursued during three recruitment phases. First, vulnerable people were recruited via gatekeeping organizations. In total, eleven socio-economic organizations, three centres for adult basic education, and five e-inclusion initiatives helped us with the recruitment of vulnerable respondents, such as low-income people, elderly, persons with low digital skills, unemployed people. Second, two students were involved in the data collection as part of their master thesis. Both students recruited respondents in their own network. One student recruited in a rural area with a majority of higher-educated people, while the other student recruited in an urban area with a majority of lower-educated people. Third, a Facebook add was used and directed to men between 18 and 64 years old, people with a lower educational degree or a blue-colour worker function, and people with a migration background, as these groups are often underrepresented in survey studies (Mariën & Courtois, 2012). Both in phase one and two survey completion could be realized either via paper-and-pencil questionnaires or on a computer from the recruiting organization, in phase three only computer survey completion was possible via a weblink.

In total, 868 respondents were reached through our three-phase sampling strategy. Removal of respondents who did not give informed consent to use their data (n = 21), and respondents with partial responses on the study variables (n = 143), resulted in 704 eligible cases for analysis.

Measures

Independent, Proxy and Supported Internet Use and Problem Solving

Our main study variables are independent, proxy, and supported internet use and problem solving related to reaching functional needs.

Internet use. We asked how often respondents used the internet for functional needs (e.g., paying bills, buying products, searching health information) in the past six months themselves (= independent use), how often they ask someone to use the internet for them (= proxy use), and how often they ask someone to help them to use the internet by showing or explaining something (= supported use). A five-point response scale was used with 1 = never, 2 = a few times, but less than monthly, 3 = monthly, 4 = weekly, and 5 = daily.

Problem solving. Solving problems related to functional internet use was measured as follows: "What do you do when you have problems with using the internet for functional needs (for example, you do know how to change a website setting or where to find an online form)? In case you never have problems, try to imagine what you would answer if you did. Think about the past six months." Respondents indicated how often they (try to) solve the problem themselves (= independent use), how often they ask others to solve the problem for them (= proxy use) and how often they ask someone to help them to solve the problem by showing or explaining how to do it (= supported use). A five-point response scale was used with 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = always.

Socio-Demographic Variables

Input on eight variables was collected that have previously been studied in association with independent, proxy, and supported use: gender, age, educational degree, employment status, adolescent and adult children, migration background, health condition, and financial hardship. Gender and age were inventoried by asking respondents' sex and year of birth.

Educational degree and employment status were measured with a list of categories that aligns with the relevant situations in Flanders. From this list we derived three levels of educational degrees: (1) low educational degree = no degree, degree in primary or lower secondary education, (2) mid-high educational degree = degree in secondary education, and (3) high educational degree = degree in higher education, and two employment statuses: (1) employed (fulltime or part time), and (2) unemployed (e.g., being retired, being on long-term sickness absence, staying home for family care). Further we were interested whether or not respondents have adolescent or adult children, therefore we asked how many children of 14 years and older respondents have, we explicitly mentioned that both children who live inside and outside the household should be counted (Galperin & Arcidiacono, 2019). Migration background was measured as "Did your mother had the Belgian nationality at her birth?". Health condition was measured by asking respondents whether they suffer from a disability, chronic illness or other health problem (Tafforeau et al., 2019). We measured respondents' financial hardship by asking to what extent they agree with three items inquiring perceived financial stress (e.g., "It is difficult to afford much more than the basics with our current income.") (Ponnet, 2014). Descriptive statistics of the socio-demographic variables are presented in Table 1.

*** INSERT TABLES 1 AND 2 ABOUT HERE ***

Internet Attitudes, Access, and Skills

Table 2 presents the descriptive statistics and reliability scores for the internet attitudes, access, and skills constructs, below we elaborate on the scales that were used.

Attitudes. We used two subscales from the Technology Readiness Index developed by Parasuraman and Colby (2015) to measure respondents internet attitudes. The first scale we used was Technology Optimism, which measures how beneficial respondents perceive technology in general (e.g., "Technology makes me more productive in my personal life").

Second, we used the Technology Discomfort scale to measure respondents' negative feelings associated with technology use (e.g., Sometimes, I think that technology is not designed for use by ordinary people). Responses could be scored along a five-point Likert scale ranging from 1 = disagree to 5 = agree.

Access. We used two indicators to measure respondents' internet access at home. The first indicator is the sum of all the devices through which users can access internet at home, i.e., personal computer, laptop, desktop, smartphone. This indicator measures access opportunities regardless of one's use frequency (Hargittai & Hinnant, 2008). For the second indicator of internet access, we asked respondents to rate the quality of their internet connection at home. We used a five-point response scale with 0 = I do not have an internet connection at home, 1 = bad, 2 = rather bad, 3 = rather good, and 4 = good (Anrijs et al., 2021).

Skills. We asked respondents to assess their perceived competence on two internet skills. We used three items from a subscale of the Web User Self-Efficacy Scale (WUSE) from Eachus and Cassidy (2006) to measure respondents' internet searching competence (e.g., "Searching for information with Google, Yahoo or any other search engine is difficult for me" (reversed)). Second, we adapted three items from the ICT problem solving scale of Anrijs et al. (2021) to measure respondents' competence in coping with internet and computer problems (e.g., "I need help when trying something new"). Items on both scales were scored along a five-point Likert scale ranging from 1 = disagree to 5 = agree.

Data Analysis

Our data analysis consisted of three steps, each step is devoted to answering a research question. To answer RQ1, we started our data analysis with descriptive analysis of independent, proxy, and supported internet use and problem solving. Thereafter, we performed latent class analysis to assess whether distinct groups of respondents can be

identified based on similar engagement patterns in independent, proxy, and support internet use and problem solving (= RQ2). To answer RQ3, we conducted a hierarchical multiple regression analysis with class membership probability as outcomes and socio-demographics, internet attitudes, access, and skills as explaining variables. To understand the added value of both socio-demographic and technological variables (i.e., internet attitudes, access, and skills) in explaining engagement patterns in independent, proxy, and supported internet use and problem solving, three sets of regressions were conducted. In the first set, we solely introduced the socio-demographic variables as determinants of class membership probabilities. Second, a set of regressions was conducted with internet attitudes, access, and skills as explaining variables of class probability. In the third and final set of regressions, both socio-demographic and technological variables were inserted as explaining variables. Statistical significance was set at $p < .01$.

Results

Descriptive Analysis

Descriptive analyses were conducted on the survey items measuring independent, proxy, and supported internet use and problem solving. Table 3 demonstrates that the majority of respondents are highly independent in internet use, while only a small number of respondents frequently rely on others for internet use. This is articulated for independent internet use in 84.8% of respondents who used the internet themselves on a daily or weekly basis in the past six months, against 5.5% of respondents who did not use the internet themselves in the past six months. Regarding proxy and supported internet use, proxy use is more frequently applied by respondents than supported use in that 10.7% of respondents asked others to use the internet for them on a daily or weekly basis in the past six months, while 5.1% of respondents asked support for internet use on a weekly or daily basis. In total, 28.3% relied on proxy internet use and 23.2% relied on supported internet use in the past six

months With regard to independent, proxy and supported problem solving, the frequencies demonstrate that 73.6% of respondents (try to) solve problems themselves often or always, and only 3.1% did not try to solve any internet problem in the past six months. When looking at the items measuring proxy and supported problem solving, 25.1% of respondents often or always rely on others by proxy and 23.7% often or always asks support for ICT problems, while 18.0% and 17.2% did not at all rely on others for problem solving by proxy and by support respectively.

INSERT TABLE 3 ABOUT HERE

Cluster Analysis

To answer RQ2, (i.e. investigating whether distinct groups can be identified with similar engagement patterns in independent, proxy and supported internet use and problem solving) we conducted a latent class cluster analysis. Evaluating multiple latent class models and their model fit indices (see Figure 1), a three-cluster model was identified as the preferred solution as it had the smallest Bayesian information criterion (BIC) which is a common measure for model evaluation. For each model, we compared BIC and AIC, where lower values indicate better fit. While BIC is generally viewed as a robust indicator of fit (Nylund et al., 2007), AIC suffers from lower accuracy rates (Yang, 2006). Given this, we give a preference to BIC, which proposes a three class solution (see table 4).

INSERT FIGURE 1 AND TABLE 4 ABOUT HERE

INSERT FIGURE 2 ABOUT HERE

The three-class model revealed delineated profiles regarding their engagement patterns in independent, proxy and supported internet use and problem solving (see Figure 2). The first group is the "*self-reliant user*" (n = 275; 39.1%), referring to the high probabilities for scores indicating frequent independent internet use and problem solving and low probabilities for

scores indicating frequent engagement in proxy and supported internet use and problem solving. Respondents in this group are both highly independent on others to use the internet for functional needs, as well as for solving problems related to internet use, they ask others seldomly or never for help by proxy neither by support both about internet use and problem solving. The second identified group is the "*convenience user*" (n = 315; 44.7%) referring especially to the group's regular engagement in all three problem solving behaviors. Respondents in this group resemble the previous group in that they have, high probabilities for scores indicating frequent independent internet use, and low probabilities for scores indicating frequent proxy and supported internet use. However, they distinguish themselves with their staggered probabilities regarding all three problem solving behaviors. They solve problems independently on a regularly basis, as well as rely on others by proxy or by support from time to time. They seem to adapt their problem solving behavior depending on the situation or sort of problem they encounter. Finally, the third group can be defined as the "*assisted (moderate) user*" (n = 114; 16.2%). This group is characterized by the scattered answer probabilities regarding the three internet use behaviors and higher probabilities for scores indicating less frequent independent problem solving and frequent proxy and supported problem solving. Respondents in this group could be either intensive or not intensive internet users both by independent use or by relying on others through proxy and supported use. With regard to problem solving, respondents in this group seem more likely to rely on others by proxy or by support than to solve the ICT problem themselves, although from time to time they will try to do so.

Regression Analysis

To understand socio-demographic and technological variables that explain class membership of our three identified classes, we performed three hierarchical multiple regression analyses with probability of class membership acting as outcome variable. This

approach to take class membership probability as regression outcome is in line with the research of Courtois and Verdegem (2016). In a first step, we included the socio-demographic variables. then we included our technological variables, and finally we performed a regression analysis by including both socio-demographic and technological variables. Our models are presented in Table 5. Starting with considering the regressions on class membership probability of the *self-reliant user*, the results indicate that membership of this group is both significantly explained by socio-demographic variables (model 1: R^2 = .140; significant beta-values for gender β = -.32 and health status β = -.11) and technological variables (model 2, R^2 = .292; significant beta-values for technology optimism β = .09 and ICT problem solving β = .43), with technological variables explaining twice as much variance in being a self-reliant user than socio-demographic variables. When considering socio-demographic and technological variables together in one model (model 3, R^2 = .358), the results show that being a self-reliant user is explained by being male (β = -.18), encountering financial hardship (β = .10), having optimistic internet attitudes (β = .10), having a higher number of internet devices at home (β = .11) and score high on ICT problem solving skills (β = .41). The full model, explained the highest amount of variance.

INSERT TABLE 5 ABOUT HERE

Second, looking to class membership probability of the *convenience user* group, considering the partial models, we now conclude that the socio-demographic model explained more than twice as much variance (model 1: R^2 = .092; significant beta-values for gender β = .22) compared to the technological model (model 2: R^2 = .044; significant beta-values for internet searching skills β = .26). Interpreting the full model (model 3), it turned out that being a convenience user is mainly explained by socio-demographic variables, but marginally by technological variables. We found only two significant factors in the final model explaining 12.1% of total variance. More specifically, being female (β = .18) and having higher internet

searching skills (β = .16) significantly contribute to explaining class membership probability of the convenience user, no other significant predictors were identified. Again the full model explained the highest amount of variance, although the explained variance in all three models is smaller than when explaining class membership probability of the self-reliant user.

Finally, with regard to the regressions on class membership probability of the *assisted (moderate) user* group, the socio-demographic model (model 1: R^2 = .253) reveals five significant predictors, namely, being female (β = .14), having a lower degree of education (β = .22), being unemployed (β = .12), having migration background (β = .15) and encountering financial hardship (β = .20) The technological model (model 2) is able to explain a large amount of variance (R^2 = .506) with internet searching skills (β = -.30) and ICT problem solving skills (β = -.42) as the two significant predictors in the technological model. The full model then revealed two significant variables which accounts for 51.9% of explained variance (model 3). More specifically, being an assisted (moderate) user is largely explained by having low internet searching skills (β = -.27) and having low ICT problem solving skills (β = -.40). When looking at the full model, it is remarkable that all significant socio-demographic variables of model 1 become non-significant in the full model and that the technological model is able to explain a similar amount of variance as the full model.

Discussion

This article investigated independent, proxy and supported internet use and problem solving as complementary ICT behaviors, while previous studies have studied these behaviors separately. We argued that these behaviors are not exclusively used and empirically demonstrated that people can indeed engage both in independent, proxy and supported use. Furthermore, we investigated which socio-demographic and technological variables explain different engagement patterns in independent, proxy, and supported use drawing both from digital divide theory and social-cognitive theory. Indeed, we argued that engagement in

independent, proxy or supported use could be seen as a way of adaptive behavior based on one's evaluation of internet attitudes, access and skills, in addition to being the result of inequality processes induced by socio-demographic characteristics. This study adds to the existing literature with a nuanced understanding of engagement in independent, proxy, and supported internet use and problem solving. This section further elaborates on the main findings, limitations, and suggestions for future research and policy.

A first important finding of this study is that we identified three distinct engagement patterns in independent, proxy and supported internet use and problem solving. First, the self-reliant user (39.1%) or those who highly engage in independent internet use and independent problem solving. Second, the convenience user (44.7%) or those who engage in independent internet use and adaptively engage in independent, proxy, and supported problem solving. Third, the assisted (moderate) user (16.2%) or those who moderately engage in all types of internet use and frequently engage in proxy and supported problem solving. Our results are somewhat similar with existing quantitative (Courtois & Verdegem, 2016) and qualitative (Asmar et al., 2020) research that have distinguished different profiles based on the purposes and the sources people rely on for support with internet use, in that both studies identified a group of self-reliant or self-supported people. In contrast with our finding, Courtois and Verdegem (2016), found that only 13.0% of their population was a self-reliant problem solver. One possible explanation is that the study of Courtois and Verdegem (2016) have been conducted five years ago, and that over time, people have become more self-reliant. Future representative longitudinal studies are needed to gather reliable proportions of people who rely on their self or rely on others, either by proxy or by support.

Another result that prompt some attention is that of all socio-demographics gender is the only significant predictor both in partial and full models, showing its dominance as explaining variable. More specifically, being a self-reliant user is significantly explained by

being a male, while being a convenience user is significantly explained by being a female. For the assisted (moderate) user, we initially find a significant effect for gender, education, migration status and financial hardship. However, after inclusion of our technological variables, no sociodemographic variable remains significant, suggesting that membership of this class is most prominently predicted by having technological skills, with sociodemographic factors playing no significant role when assessed in combination with technological skills. It has been found by other researchers that associations between socio-demographics and internet use decreased, disappeared or reversed, when taking into account someone's internet skills (Dodel & Mesch, 2018; Durndell & Haag, 2002). This could suggest that socio-demographic differences in internet uses are partly explained by differences in internet skills between men and women, between lower-educated and higher-educated people, and between persons with and without financial hardship, as we also found in explaining membership of the assisted (moderate) user.

Still, when explaining membership of the self-reliant user and the convenience user, gender differences stay stable in that men are more dominantly present in the self-reliant user class, and women are more dominantly present in the convenience user class, even after taking into account internet skills. These classes are both characterized by high engagement in independent internet use, and differs from each other in the way ICT problems are handled, i.e., the self-reliant user class relies on themselves to solve problems, while the convenience user class adaptively relies on themselves and on others by proxy or support. This finding raises the question why men are more likely to be a self-reliant user and women are more likely to be a convenience user. Internet attitudes, access and skills are often granted as an explanation for gender differences (Dodel & Mesch, 2018; Heponiemi et al., 2021), but our models showed this is not the case. One possible explanation is that women may underestimate their competence in abstract thinking and problem solving because of the

socially common belief that women have lower abilities in those fields than men. These stereotypes are then perceived and learned through interaction with others (Krämer et al., 2016). As such, it is possible that this socially learned behavior may also be articulated in lower engagement in independent ICT problem solving. Future research might investigate whether gender differences in independent, proxy, and supported internet use and problem solving are also apparent in other countries or cultures, and whether these gender effects stay stable when technological characteristics are included as explaining variables of internet use and problem solving.

Finally, it is interesting that when including the technological variables, the internet skills variables are the main significant determinants of engagement patterns while internet attitudes and access are not, except when explaining membership of the self-reliant user class. This suggest that more important than the evaluation of one's internet attitudes and access, it is the evaluation of one's (lack of) competences in internet searching or ICT problem solving that determines whether people turn to others for internet use and problem solving. This finding is in line with previous studies that identified perceived computer competence as a significant predictor of internet use while computer attitudes was not (Durndell & Haag, 2002; Rohatgi et al., 2016). A practical implication of this finding is that if people prefer to become more independent or self-reliant for internet use and/or problem solving they should aim to improve their internet searching and ICT problem solving skills. An effective way to improve skills is through experiences. This could be done either by enactive experience which means learning by doing it oneself, or by vicarious experience which means learning by observing others (Bandura, 1977, 1989; Courtois & Verdegem, 2016). Future research could investigate how enactive and vicarious learning experiences for internet skills take place and when these experiences actually result in higher internet skills.

An important limitation to keep in mind when interpreting the results of this study is that we relied on a convenience sample. Although we were able to gather a heterogeneous sample including vulnerable people in terms of income, education, health condition, migration background and digital literacy, caution is needed when generalizing our results. Therefore, the results of our study should not be generalized for these vulnerable populations neither for other people. Researchers and governments should aim for large-scale representative survey studies, in order to fully understand engagement in independent, proxy and supported use, and the consequences of engagements in these varying uses. A second limitation is that we used our own operationalization of independent, proxy and supported internet use and problem solving, which limits comparability with other studies. However, this is a shortage of research on proxy and supported use in general as currently no validated operationalizations of proxy and supported use exist. Therefore, we encourage future research to analyze existing conceptualizations of independent, proxy and supported ICT use and develop and validate operationalizations based on conceptual agreement.

Our results identified two groups of respondents who regularly engage in proxy or supported internet use and problem solving, accounting for 60.9% of our sample. Furthermore, these two engagement patterns were largely explained by internet skills, and therefore can be seen as a person's adaptive behavior based on the evaluation of his/her competences. These two findings imply an important recommendation for governments and policy makers to structurally invest in opportunities for citizens to rely on proxy or supported use and problem solving when using governmental websites or apps, so everyone has equal chances to benefit from these websites and apps. This could be realized, for example, by providing a physical counter or telephone line where people can go for proxy or supported use of governmental websites or apps. Another solution could be that governments give financial support to social organizations or libraries to provide assistance with internet use for citizens.

These formal support sources (e.g., governmental counters, libraries, social organizations) are especially of importance, for those who lack experts (i.e., people who are proficient in using the internet) in their own informal social networks of friends and family, which is more likely for people who are less proficient in internet use themselves (Asmar et al., 2020).

To conclude, this study investigated engagement in independent, proxy and supported internet use and problem solving and identified three distinct engagement patterns, i.e., the self-reliant user, the convenience user, and the assisted (moderate) user. While the former is both independent regarding internet use and problem solving, the latter two rely on others for internet use and/or problem solving. These three engagement patterns were explained to different extents by socio-demographic and technological variables, providing support for digital divide theory and social-cognitive theory.

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Figures and Tables

Figure 1

Bayesian Information Criterion (BIC) Values for Different Tested Latent Class Models

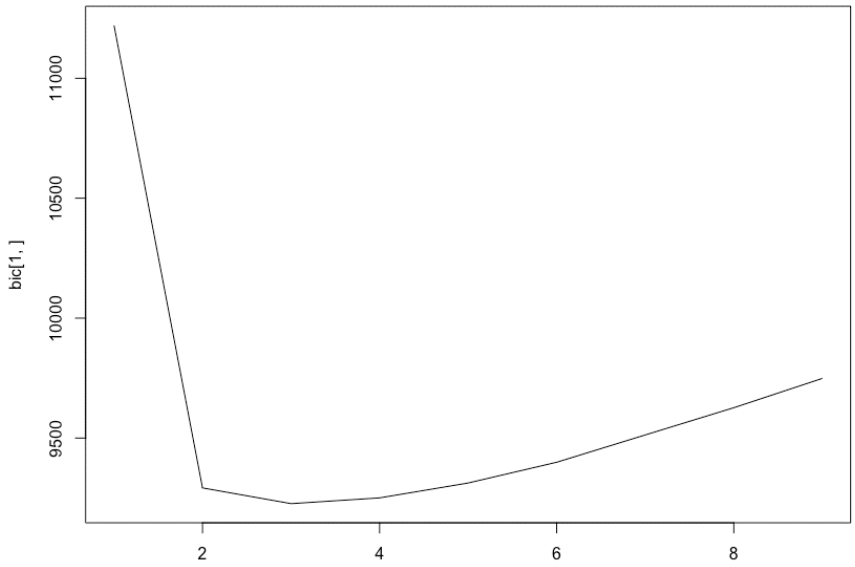

Figure 2

Probability Scores of Each Answer Category of Independent, Proxy, and Supported Internet Use and Problem Solving per Class

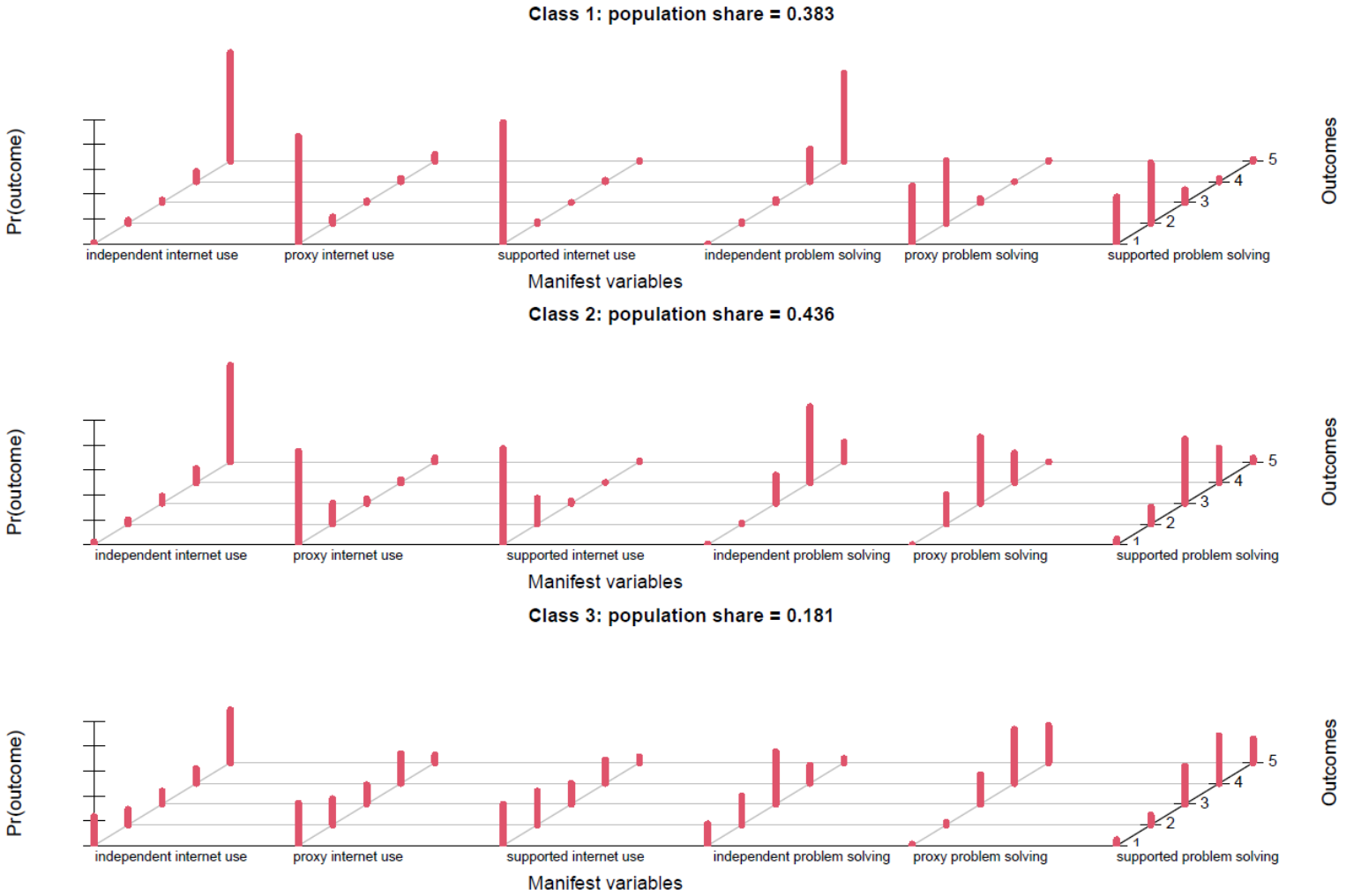

Table 1

Socio-Demographics of the Sample

Variable	n (%)
Gender	
Male	291 (41.3%)
Female	413 (58.7%)
Age (M; SD; Range)	50.53; 14.07; 22-90
Educational degree	
No degree, degree in primary education, or a degree in lower secondary education	92 (13.1%)
Degree in secondary education	176 (25.0%)
Degree in higher education (short or long type)	336 (61.9%)
Employment status	
Employed	468 (66.5%)
Unemployed	236 (33.5%)
Adolescent or adult children	
Not having children or having children younger than 14 years	333 (47.3%)
Having children of 14 years or older	371 (52.7%)
Migration background	
Mother had Belgian nationality at her birth	605 (85.9%)
Mother did not have Belgian nationality at her birth	99 (14.1%)
Health status	
Not having a health problem	497 (70.6%)
Having a health problem	207 (29.4%)
Financial hardship (M; SD; Range)	2.12; 1.09; 1-5

Table 2

Descriptive Statistics and Reliability Scores of Internet Attitudes, Access, and Skills Constructs

Variable	Mean	Standard Deviation	Range	Cronbach's Alpha
Technology optimism	3.77	0.98	1-5	.85
Technology discomfort	2.54	1.23	1-5	.88
Number of devices	4.29	2.26	0-12	na
Quality of internet connection	3.36	0.96	0-4	na
Internet searching skills	4.31	1.10	1-5	.94
ICT problem solving skills	3.87	1.24	1-5	.90

Table 3

Frequencies of Independent, Proxy and Supported Internet Use and Problem Solving

Internet use	n (%)	Problem solving	n (%)
Independent		*Independent*	
Never	39 (5.5%)	Never	24 (3.4%)
A few times, but less than monthly	33 (4.7%)	Seldom	33 (4.7%)
Monthly	35 (5.0%)	Sometimes	129 (18.3%)
Weekly	71 (10.1%)	Often	276 (39.2%)
Daily	526 (74.7%)	Always	242 (34.4%)
Proxy		*Proxy*	
Never	505 (71.7%)	Never	127 (18.0%)
A few times, but less than monthly	91 (12.9%)	Seldom	209 (29.7%)
Monthly	33 (4.7%)	Sometimes	201 (28.6%)
Weekly	44 (6.3%)	Often	128 (18.2%)
Daily	31 (4.4%)	Always	39 (5.5%)
Supported		*Supported*	
Never	541 (76.8%)	Never	121 (17.2%)
A few times, but less than monthly	101 (14.3%)	Seldom	182 (25.9%)
Monthly	26 (3.7%)	Sometimes	224 (31.8%)
Weekly	27 (3.8%)	Often	141 (20.0%)
Daily	9 (1.3%)	Always	36 (5.1%)

Table 4

Latent Class Analysis Results of Model Comparisons

N Clusters	BIC	AIC	LL
1	11220,3	11106	-5529,2
2	9292,1	9068,8	-4485,4
3	9226,5	8889,3	-4370,6
4	9250,5	8799,4	-4300,7
5	9312,2	8747,1	-4249,6
6	9398,3	8719,4	-4210,7
7	9507,7	8714,8	-4183,4
8	9629,8	8723	-4162,5
9	9736,4	8715,6	-4133,8

Note. BIC: Bayesian information criterion; AIC: Akaike information criterion; LL: Log-likelihood.

Table 5

Multiple Linear Regression Models with Continuous Class Membership Probability as Dependent Variables and Socio-Demographics, Internet Attitudes, Access, and Skills as Explaining Variables

	Self-reliant user			Convenience user			Assisted (moderate) user		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Gender (male = ref [a])	-.315***		-.176***	.220***		.177***	.136***		.009
Age	-.053		.073	.054		.001	.002		-.095
Educational degree (higher education = ref)									
Primary or no education	-.074		.076	-.104		-.109	.224***		.036
Secondary education	-.013		.002	-.024		-.022	.047		.025
Employment status (employed = ref)	-.009		.046	-.086		-.090	.118**		.052
Adolescent or adult children (no = ref)	-.044		-.090	.012		.047	.042		.059
Migration background (no = ref)	-.062		.013	-.055		-.061	.148***		.059
Health status (no health problem = ref)	-.111***		-.078	.065		.058	.063		.030
Financial hardship	-.082		.102**	-.073		-.100	.196***		-.008
Technology optimism		.094**	.100**		-.084	-.084		-.018	.026
Technology discomfort		-.087	-.083		.094	.077		-.004	.012
Number of internet devices at home		.052	.106**		.002	-.060		-.071	-.063
Quality of internet connection at home		-.010	.012		.026	.002		-.019	-.018
Internet searching skills		-.017	.053		.261***	.164**		-.300***	-271***

	Self-reliant user			Convenience user			Assisted (moderate) user		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
ICT problem solving skills		.433***	.411***		-.112	-.109		-.422***	-.399***
R^2	.140***	.292***	.359***	.092***	.044***	.121***	.253***	.506***	519***
Adjusted R^2	.129	.286	.345	.080	.035	.102	.243	.502	.508

Note. [a] ref = reference category in case of binary and dummy categorical variables. **$p < .01$ and ***$p < .001$.