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The mobile internet: access, use, opportunities and divides among European children

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Abstract

Based on data collected through the Net Children Go Mobile survey of approximately 3,500 respondents aged 9–16 in seven European countries (Belgium, Denmark, Ireland, Italy, Portugal, Romania and the UK), this article examines the diffusion of smartphones among children, and contributes to existing research on mobile digital divides by investigating what influences the adoption of smartphones among children, and whether going online from a smartphone is associated with specific usage patterns, thus bridging or widening usage gaps. The findings suggest the resilience of digital inequalities among children, showing how social inequalities intersect with divides in access and result in disparities in online activities, with children who benefit from a greater autonomy of use and a longer online experience also reaching the top of the ladder of opportunities.

Keywords

smartphones, internet, digital inclusion, digital divide, children

word count: 8408

Introduction

Mobile communication has become a taken for granted condition of young people's everyday lives (Ling, 2012), and early research on the adoption of smartphones suggests that mobile, ubiquitous internet access may soon become as constitutive of their social and media ecologies as mobile phones.

Therefore, empirical evidence on smartphone ownership and use among young people revives new hopes regarding the potential leapfrogging effect of mobile telephony (Castells et al., 2007), especially in less advantaged social groups: by providing a cheaper and more accessible route to the internet, it is argued, smartphones with data plans may reduce inequalities in access. However, prior research (Donner et al., 2011) has concluded that different devices do not lead to the same internet experience. Therefore, while mobile-based internet use reduces the access divide, it may actually produce new inequalities in terms of usage patterns and skills.

Drawing on the findings of the Net Children Go Mobile project, this article contributes to existing research on mobile digital divides by investigating what influences the adoption of smartphones among children, and whether going online from

a smartphone is associated with specific usage patterns, thus bridging or widening usage gaps.

Literature review

Divides in ownership and usage of mobile phones

Research examining mobile telephony in terms of digital divides has been sparse compared to the body of writing on digital and social inequalities associated with internet access and use. In the field of internet studies, research has moved past an initial understanding of the digital divide as a binary opposition between those who have access to online technologies and those who do not, towards a focus on inequalities that lie in differential online experiences – what has been defined as the 'second-level digital divide' (Hargittai, 2002). The refined approach to the digital divide conceptualises the issue of digital exclusion as a continuum of divides, whereby a variety of factors – divides in access, differential uses and motivations to use, unequal skills, inequalities in the ability to benefit from online opportunities – combine and concur to differential gradations of digital inclusion (Hargittai and Hinnant, 2008; Livingstone and Helsper, 2007; van Dijk, 2005; Warschauer, 2004). Moreover, digital inequalities have been recognised as strongly related to inequalities in the access to economic, cultural and social capital (Helsper, 2012a): opportunities and limitations of the use of ICTs are differentiated in intersection with social inclusion and exclusion,

whereby ‘those who are already in more privileged positions are more likely to use the medium for activities from which they may benefit’ (Hargittai and Hinnant, 2008: 615).

Research on mobile telephony from a digital divide perspective has followed a similar evolution – from access to inequalities. One of the first studies addressing the mobile digital divide investigated the impact of socio-demographic factors on the adoption of the internet and mobile telephony (Katz and Rice, 2003). The study showed that adoption patterns of the internet and mobile phone were quite similar, with income and education being the most influential factors shaping the use of both technologies. Moreover, though respondents who were internet users were also more likely to use mobile phones, the authors concluded that mobile phone and internet users were not necessarily the same sets of population, and that among both, differences persisted between early and late adopters. This pointed to a variety of patterns of adoption against mere opposition among users and non-users. With an ever-increasing penetration of mobile telephony on a global level (ITU, 2013), income and other measures of socio-economic status are now less important predictors of mobile phone ownership, though they are still associated with diverse patterns of usage that reproduce differences among *information-haves*, *information-have less* and *information-have nots* (Castells et al., 2007).

Another socio-demographic factor that has attracted a number of studies on variations in ownership and use of mobile phones is gender. Generally, research focused

on gender divides in mobile communication concluded that, while there are no significant gender differences regarding access to mobile phones and engagement in traditional communicative practices, specific patterns of use emerged in relation to gender, with recreational and non-communicative uses (such as gaming) being the domain of boys (Cotten et al., 2009), and with girls engaged in producing distinctive mobile phone cultures (Castells et al., 2007; Hjorth, 2009).

Finally, other research focused primarily on differences in specific communicative practices. For example, Ling and colleagues examined how texting is shaped by age and gender: based on the analysis of nearly 400 million texts, they found great variations by age in the volume of SMS exchanged, thus concluding that 'texting is a teen phenomenon' (Ling et al., 2012: 294).

Despite a not inconsiderable number of works, we can nonetheless conclude that issues of digital inequalities have not been the primary concern of mobile communication studies, which have generally privileged other topics and approaches, such as the study of the domestication of mobile phones into individuals and groups' everyday lives, the investigation of communication and social practices developed around mobile telephony and their social implications, the analysis of youth mobile cultures, or the reconfiguration of private and public spaces (Green and Haddon, 2009; Ling, 2004, 2012).

Divides in usage of smartphones and mobile internet

With the diffusion of smartphones, mobile phones have turned into an 'online, networked *media* device' (Hjorth et al., 2012), which supports an ever-growing repertoire of communication practices and online activities. Therefore, the once independent research agendas of mobile communication studies and internet studies have increasingly converged. As a consequence, the number of studies addressing mobile communication in terms of digital inequalities is likely to grow.

A few noteworthy studies have already been published. Among these, Hargittai and Kim (2010) examined how a user's background characteristics and internet experience informed different smartphone usage patterns among a group of young adults. They found considerable variation in both the availability of, and the effective use of advanced phone functionalities: while gender, parental education and ethnic group are important factors which partially explain this variation, regular engagement with advanced mobile phone functionalities was more strongly correlated with internet experience, measured by both 'autonomy of use' - that is free, unrestricted access to use the internet 'when and where one wants' (Hargittai and Hinnant, 2008: 606) - and digital skills. 'People who have more Internet access points are more likely to possess higher levels of online skill and have more opportunities to explore a wide range of mobile phone features', Hargittai and Kim conclude (2010: 25). This conclusion suggests caution regarding the potential leapfrogging effect of mobile internet devices: instead of

bridging digital inequalities, smartphone use is rather dependent on, and reproduces the so-called ‘second-level digital divide’ (Hargittai, 2002), that is, skills divides and usage gaps that relate to a user’s background characteristics.

That access to the internet through mobile devices may lead to a diverse and less capital-enhancing internet experience is also suggested in a study conducted in Armenia (Pearce and Rice, 2013): through a comparison of PC-based and mobile-based internet users, Pearce and Rice found pervasive differential divides for internet access and online activities. Mobile internet use is more common among lower socio-economic levels of the population: mobile phones, then, provide less advantaged social groups with a viable alternative to online resources. However, mobile-based users engage in less advantageous and beneficial uses of the internet: digital inequalities such as differential online activities may therefore result in strengthened offline social inequalities, leading to an entrenched digital exclusion of the most disadvantaged citizens (see also Helsper, 2012a).

When it comes to younger generations, digital exclusion, some argue, is no longer an issue since children are growing up in a convergent media ecology (Prensky, 2001). On the contrary, research indicates that inequalities in access, usage, skills and motivations to use the internet persist, even among the so-called ‘digital natives’. Studies show how age, gender and socio-economic background are correlated with where and how children gain access to the internet (Livingstone and Helsper, 2007;

Helsper, 2012b), and how socio-demographic factors combined with autonomy of use influence frequency of use and number of online activities taken up, thus shaping the progression onto the 'ladder of opportunities' from basic activities to more interactive, creative and capital-enhancing uses (Livingstone and Helsper, 2007).

Research on inequalities in smartphone ownership and use among young people has just started. A recent report by the Pew Research Center (Madden et al., 2013) shows that the mobile internet has become pervasive among young Americans aged 12–17: half of the respondents own a smartphone, and one in four report using the internet mostly from their smartphones. The Pew report also highlights divides in the use of the internet and smartphones based on socio-economic status: teens from disadvantaged families are less likely to use the internet overall; however, teenagers living in lower-income and lower-educated households are just as likely or, in some cases, more likely than peers from higher socio-economic households to use smartphones as their primary means of internet access. The implications of this finding in terms of children's digital inclusion needs to be further explored: while it is certain that smartphones provide children with greater autonomy of use (Hargittai and Hinnant, 2008; Park, 2014), when smartphones are the only connection point available, the issue of usage patterns associated with specific devices becomes crucial, as the risk that mobile internet use further reinforces social exclusions cannot be underestimated.

In this regard, a recently published article (Park, 2014) investigates the second-

level digital divide in mobile communication, and concludes that the benefits of mobile telephony are not uniformly accessible across different youth populations. More specifically, the study shows that variations in teens' social engagement are associated with different socialisation patterns, and that mobile internet use may represent a source of social inequalities: a combination of socio-demographics, parental background, and mobile skills and use results in lower or greater engagement in 'socially productive' activities.

Cross-national comparisons

The diffusion of mobile phones has been uneven across the world due to economic, regional, industrial (such as technological standards and pricing systems) factors, socio-cultural variations and different media regulation; moreover, there is evidence of differential rates of diffusion, not only across different regions, but also within wealthier economies (Castells et al., 2007).

While European countries have been at the forefront of the adoption of mobile communication, inequalities persist across countries, and also among children, especially regarding internet use. The EU Kids Online country classification (Helsper et al., 2013), for example, distinguishes European countries on the basis of daily internet use among children, online activities, incidence of online risks and parental mediation strategies. This suggests that the context in which young people domesticate

smartphones is far from uniform. We therefore assume cross-national variations as important factors influencing the adoption and use of smartphones.

In undertaking comparative research, researchers can rely on different models and aim at different theoretical goals. In this article we focus on countries as the 'context of study' (Kohn, 1989; Livingstone and Hasebrink, 2010); in other words, we aim to assess hypotheses concerning social inequalities in mobile internet access and use by testing their applicability in different national contexts.

Hypotheses

As we have seen, research on mobile internet use among adults and young adults points to differential gradations in digital inclusion and to the interplay between digital and social inequalities: socio-demographic factors, internet experience and range of available devices to access the internet are all influential factors explaining the second-level digital divide and the usage gap (Hargittai and Hinnant, 2008; Hargittai and Kim, 2010; van Deursen and van Dijk, 2014). While in Western societies it is especially internet users who benefit from greater autonomy of use (Hargittai and Hinnant, 2008), in less advantaged social contexts smartphones may represent the primary means of internet access (Pearce and Rice, 2013). On the other hand, studies of children and the internet have emphasised persisting inequalities based on gender, age and socio-economic background, at least on the quality of access (Livingstone and Helsper, 2007;

Helsper, 2012b). Furthermore, there are indications that teenagers' mobile internet use is related to social inequalities (Madden et al., 2013), and to the process of socialisation (Park, 2014).

Differential engagement in online opportunities is a better measure of digital inclusion compared to access to devices *per se*. However, as smartphones are currently being domesticated among the youngest, we are first of all interested in understanding what influences adoption. Moreover, since differences in children's online experiences persist across Europe (Helsper et al., 2013), we aim to explore country variations in the domestication of smartphones in this age group. Based on these reflections, we propose two hypotheses concerning children's access to smartphones:

H1: Ownership of smartphones will vary by age, gender, country, socio-economic background, parental ownership and use of mobile devices, and child's internet experience.

H2: Accordingly, the daily use of smartphones will also vary by age, gender, country, socio-economic status, parental ownership and use of mobile devices, and child's internet experience, and also by ownership of smartphones.

Beyond the question of access, we are also interested in differences in usage that may be related to mobile internet access. As outlined in the 'Literature review' section, empirical evidence so far has indicated large variations in online activities among adult PC-based and mobile internet users (Donner et al., 2011; Pearce and Rice, 2013), as

well as among mobile internet users (Hargittai and Kim, 2010; Park, 2014). Among children, autonomy of use seems to reduce inequalities in online activities; moreover, research has shown that the wider the range of online activities pursued, the more the child progresses along the 'ladder of opportunities' (Livingstone and Helsper, 2007). Despite potential constraints deriving from parental or school regulation (Mascheroni and Ólafsson, 2014), smartphones provide children with greater autonomy of internet use (Park, 2014). Based on this, the following hypothesis concerning online activities is formed:

H3: Access to smartphones broadens the number and type of online activities children engage in, thus shaping children's progression on the 'ladder of opportunities'. More specifically, we hypothesise that the number and type of online activities children engage in on a weekly basis varies by age, gender, smartphone ownership and daily use, child's experience with the internet and parents' ownership and use of mobile devices.

Methods

Data and sampling

This article draws on data collected in 2013–14 in a sample of internet-using children aged 9–16 in Belgium, Denmark, Ireland, Italy, Portugal, Romania and the UK as part of the Net Children Go Mobile project. In each country a stratified sample of approximately 500 children was drawn through a random methodology – random walk

route based on prior random selection of sampling points in all countries except Denmark, where households were randomly selected based on national residents lists – resulting in a total of 3,565 respondents. Using a very conservative approach, the response rate ranged from 21% in Denmark to 56% in Romania.

Similar to the 2010 EU Kids Online survey on the same age group (Görzig, 2012), questionnaires were administered face to face at home, and self-completed for sensitive questions on risky experiences, lasting 40 minutes on average. The selection of this particular age-group is based on methodological and theoretical considerations: 9-16 years old offer an insight on the early process of encountering and coping with online risks, while also being amenable to parental mediation. The questionnaire included many of the questions already asked in the EU Kids Online project – to facilitate comparison over time – and new questions on smartphones and tablets; it underwent cognitive testing in all countries in order to ensure the highest possible comprehension by children, and to evaluate the validity of translations in national languages. Validation of translations also relied on the process of translation and back-translation already completed during the EU Kids Online II project (Görzig, 2012).

Measures: independent variables

User background: parents were asked about socio-demographics. The parent who answered the questionnaire was to be 'the parent/carer in the household who is likely to

know most about selected child's use of the internet'. Interviewers also noted if the parent was in the role of mother (73%), father (23%) or another carer (4%). *Socio-economic status* was measured as a combination of the household income and the educational attainment of the main income earner in the household. With respect to children's demographic variables, interviewers were asked to indicate the *age* and *gender* of all children eligible to take part in the survey (respondents were then selected on the basis of the last birthday method).

Parents' experiences with the mobile internet: parents were also asked to indicate whether both (in the case of two parent households) were internet users, and whether they owned a smartphone or a tablet that they used to go online. Prior research suggests that use of the internet by parents shapes the social context of internet use: more specifically, a parent's domestication of the internet is associated with quality of access and frequency of internet use among children (Mascheroni et al., 2012). Since the use of the internet among sampled parents is almost universal in all countries (89–99%), except in Romania (57%), including it as a predictor is of limited value in the analysis. Thus, we focus on parents' ownership of mobile devices.

Child's internet experience: since research has shown that the quality and number of online opportunities varies by age and number of years the child has used the internet for (Livingstone et al., 2011; Livingstone and Helsper, 2007), we collected information on the age of first internet use. More specifically, children were asked how

old they were when they first used the internet. They were also asked how old they were when they had their first mobile phone and first smartphone. However, since mobile internet use seems more influenced by internet experience than traditional mobile communicative practices (Hargittai and Kim, 2010), we focus on the number of years a child has been online for.

Country: as anticipated, we use the country as the 'context of study' (Kohn, 1989; Livingstone and Hasebrink, 2010), to assess how patterns of access and use are differentiated across countries.

Measures: dependent variables

Smartphone ownership: children were asked the following question: 'Do you personally own or have for your private use any of these devices? By private use of a device we mean a device that only you use.' Overall, 46% of children say that they own a smartphone, though smartphone ownership varies consistently by age and country (Figure 1).

Daily use of smartphones: we asked children how often they used different devices at different places to access the internet. Forty-one per cent of the respondents reported using smartphones several times per day or at least daily to go online, with great variations by age and country (Figure 1).

Figure 1 here

Type and number of online activities: children were asked how often (several times each day, daily, at least every week, never or almost never) they engaged in a number of online activities from any of the devices they use to go online. We collected information regarding 25 activities (for a detailed list of online activities, see Mascheroni and Ólafsson, 2014). Here, we focus on watching videos as a measure of leisure online activities, on social network sites as an indicator of communication practices, and using the internet for schoolwork as a proxy for academic and information usage (Kalmus et al., 2011). Since we hypothesised that children who use smartphones are on average more likely than those who do not use smartphones to engage in more complex types of activities and to be higher up on the 'ladder of opportunities' (Hasebrink et al., 2011; Livingstone and Helsper, 2007), we also look at those children who engage in at least two activities associated with levels 4 and 5 as defined by Hasebrink et al. (2011: 27–28), namely: playing games with other people on the internet; publish photos, videos or music to share with others; use file sharing sites; download music or films; post a message on a website or a blog; create a pet or an avatar; using a webcam; visiting a chatroom; spending time in a virtual world.

Results

Access and use

H1: A logistic regression model was used to estimate the effect of age, gender, country,

years online, parental education and parent's ownership and use of mobile devices on children's likelihood of owning a smartphone (see Table 1). Model 1 includes only the main effects of these variables, and indicates that age, country and use of mobile devices by parents are strongly correlated with children's smartphone ownership. Together these variables account for around a third of the variability in smartphone ownership.

Table 1 about here

More specifically, the probability of children owning a smartphone increases by 58% for each year they grow older. Regarding country variations, children in Denmark are almost three times as likely to own a smartphone as children in the UK. Children in Italy and Ireland are slightly less likely to own a smartphone than children in the UK, while Belgian, Portuguese and Romanian children are much less likely to do so. We can also observe an effect of the child's internet experience, with children who started to use the internet later than average being less likely to own a smartphone. Socio-economic status does not seem to be related to smartphone ownership; however, children whose parents use mobile devices to go online are almost three times as likely to own a smartphone. Vice versa, when parents do not use mobile devices, their children are unlikely to own such a device.

Model 2 tests for interaction between age and country (adding variables which are the multiplication of age and the dummy variable for each country). The possibility of an interaction between age and gender was also explored but was not significant: boys and girls seem to acquire smartphones at a similar age. There is, however, an interaction effect between age and country and between age of first internet use and country. These interaction effects are explored in Figures 2 and 3. Adding the interaction terms to the model does not improve the overall model fit in terms of the explained variance, but offers a more accurate assessment of the effect of individual variables.

Figures 2 and 3

Figure 2 shows the predicted probabilities of a child owning a smartphone by age and country for girls (the boys are much the same) who began to use the internet when they were of an average age (seven years), in households with average socio-economic status (mode = 35%), and where their parents have a mobile device (mode = 64%). The results show that the reason why fewer children in Romania own smartphones is partly because older children in this country are less likely to own smartphones than older children elsewhere, while in Belgium and Portugal younger children are less likely to own a smartphone compared to their peers in other countries.

If we then look at the age of first internet use, the main effect is that as children start using the internet at an older age, they are less likely to own a smartphone. If we

add an interaction term by country, then this effect is statistically significant just for Italy, where the decrease in smartphone ownership has a stronger correlation with age of first internet use than in the other countries. If we calculate the predicted probabilities of owning a smartphone and look at this by country and as beginning age of internet use runs from 4 to 11 years for a 12-year-old girl (the boys are much the same), where the child lives in an average socio-economic status household, and where parents have a mobile device, we see clearly how the higher age of first internet use has a bigger effect in Italy.

H2: If we use the model for smartphone ownership (Table 1, Model 1) as a starting point in examining daily use of smartphones we can observe similar patterns (Table 2, Model 1) in terms of age, gender, country and socio-economic status differences. However, daily use would seem unlikely unless the child owns a smartphone, and indeed, around 60% of the variability in daily use of smartphones can be explained by smartphone ownership. On the other side, this finding also suggests that smartphone use is not simply a question of ownership.

If we compare the coefficients in Models 1 and 2, we can note that age still has an important effect. And differences in country effects between the two models suggest potential country interactions that are worth exploring. The third model in Table 2 adds interaction with age and ownership of smartphones, gender and ownership (adding

variables that are a multiplication of the original variables), as well as countries and ownership. The gender and ownership interaction is not relevant, while the importance of ownership seems to increase with age. In Ireland and Denmark, ownership seems to be less important in terms of explaining daily use than in the other countries, while it is more important in explaining daily use in Portugal.

Table 2 about here

The interaction effects again are best explored by looking at them graphically. Figures 4 and 5 show the predicted probability of a child using a smartphone daily at any location. Figure 4 shows this for children who own a smartphone, but Figure 4 for children who do not have a smartphone for private use. The analysis suggests again that the main reason why children do not access the internet on a smartphone is because they do not own one. But it also indicates a very important age effect. Thus, even if a 9-year-old child owns a smartphone, the probability that she will use it to access the internet is as low as 39% in Belgium; however, if 16-year-old teenagers own a smartphone, then there is about a 80–90% likelihood of them using it to go online. Figure 5 also shows that in Denmark and Ireland, older children are still quite likely to have accessed the internet from a smartphone on a daily basis, even if they don't own one.

Figures 4 and 5

Activities

H3: To address this hypothesis, we first look at the number of activities that children engage in on a daily basis. Most children engage in only a few of the 25 activities on a daily basis; in fact, half engage in four or fewer activities every day. As a result, the variable for the number of activities has a positive skew. To compensate for this we use a logarithmic transformation of the dependent variable, and then report the exponential of the slope coefficients to indicate the proportional effect of the independent variables. Table 3 shows two linear regression models for the log-number of online activities.

Table 3

Model 1 includes the same independent variables as previous models for ownership and daily use of smartphones. Here we can see that with each year a child grows older, the number of online activities they engage in increases by 19%, and that girls engage in slightly fewer activities than boys (around 6% fewer). Children in Romania, Italy, Denmark and Portugal pursue on average more online activities than their UK counterparts. Higher age of first internet use is related to a smaller number of online activities, with each year a child grows older before starting to use the internet

being related to a 7% reduction in the number of online activities. Socio-economic status and parents' use of mobile devices is not correlated with number of activities engaged in by children. Conversely, using a smartphone to access the internet at least daily is associated with a substantial increase (70%) in the number of online activities.

Model 2 adds interaction terms for age and daily smartphone use as well as gender and daily smartphone use. These indicate that using smartphones to access the internet on a daily basis has a slightly bigger effect on the number of online activities for younger children.

The question of types of activities can be approached both from the viewpoint of different kinds of activities (e.g., leisure, communication and information, as in Kalmus et al., 2011) and from the viewpoint of different complexities – the so-called 'ladder of opportunities', whereby children tend to progress from basic to participatory uses of the internet (Livingstone and Helsper, 2007). Table 4 shows four logistic regression models using the same independent variables used in Table 3. However, the focus here is rather on the extent to which smartphone use might be related to different types of activities. The first three models explore the probability of using the internet at least weekly for schoolwork, watching video clips and visiting profiles on social network sites. The fourth model shows the probability of engaging in at least three activities associated with levels 4 and 5 in the ladder of opportunities (Hasebrink et al., 2011; Livingstone and Helsper, 2007).

Table 4

Looking across the four models, age has a similar effect on all activities, with the likelihood of children engaging in these activities increasing by 30–85% for each year they grow older. The effect of gender is smaller, but highest when considering use of the internet for schoolwork and use of social network sites, with girls being 26% more likely than boys to do both at least weekly. Country effects are, however, more diverse, with children in Italy, Portugal and Romania being considerably more likely to use social network sites than their peers in the UK. While parents' use of mobile devices has a low effect on leisure and communication activities, socio-economic status has a diverse effect across the activities examined, with children from medium socio-economic status homes 36% more likely to use the internet for schoolwork than lower socio-economic status children, and children from higher socio-economic status households 69% less likely to use social network sites. Smartphone users are more likely to engage in entertainment and communication activities - but smartphone daily use is not correlated with use of the internet for schoolwork - and they are between three and four times more likely than those who do not use smartphones to reach at least level 4 in the ladder of opportunities. Pursuing activities in the creative sphere also increases among older children, children in Denmark, Ireland, Italy and, especially, Romania, and

children whose parents also use smartphones or tablets to go online. By contrast, the likelihood of reaching level 4 and 5 on the ladder of opportunities increases by age (49% for each year a child grows older) but decreases by 11% each year a child grows older before starting to use the internet; there is, however, no gender difference.

Figures 6 and 7

Figure 6 shows the interaction between age and smartphone use in the third model in Table 4 by looking at the predicted probability of girls in the UK visiting social networking sites by age and smartphone use: daily use of smartphones makes less of a difference for teenagers aged 16. Figure 7 shows the interaction between age and smartphone use in the fourth model (in Table 4) by looking at the predicted probability of girls in the UK reaching level 4 or 5 on the ladder of opportunities by age and smartphone use. In this case, the divide between children using a smartphone daily to go online and those who do not becomes narrower by age, but is still noteworthy.

Discussion and conclusions

In this article we have examined variations in the ownership and use of smartphones among children aged 9–16 in order to understand what socio-demographic factors influence the adoption and regular use of smartphones, and whether smartphone use is associated with specific patterns of online activities and with children's progression

from basic to more advantageous uses of the internet. These research questions have guided the analysis.

Concerning ownership, the most influential factor explaining variations in the adoption of smartphones is whether parents themselves use a smartphone or a tablet to go online. There are also large variations by country, age and children's experience with the internet, while gender and parents' socio-economic status show little or no effect on smartphone ownership. These findings have some implications for the access digital divide among children: first, we can conclude that socio-economic background does not seem to have a simple and direct effect on children's adoption of smartphones. Rather, it is mediated by the domestication of smart mobile devices, both at a family level and at a country level. In households and countries with a higher domestication of the mobile internet, smartphones are also more diffused among children. Second, since children who start to use the internet later are less likely to own a smartphone, we can conclude that smartphones do not provide alternative access to the internet for children who haven't had any opportunity to go online regularly before. If we consider the interaction between age in general and age of first internet use more specifically, these findings are, instead, consistent with prior studies on inequalities in internet use among children in showing that autonomy of use – here measured by access to the internet by means of a private mobile device – increases with age and online experience (Livingstone and Helsper, 2007). In other words, and in accordance with studies on young adults

(Hargittai and Hinnant, 2008; Hargittai and Kim, 2010; Park, 2014), children with more internet experience also benefit from greater autonomy of use. Therefore, this suggests caution regarding the leapfrogging effect of mobile devices: not only is the potential of smartphones to bridge the access digital divide weaker among children than it is among adults (Pearce and Rice, 2013), but as autonomy of use is associated with the take-up of more online activities, including more beneficial activities, then divides in access result in differential uses and activities.

Second, we investigated how daily use of smartphones varies by age, gender, country, parental education, parental ownership and use of mobile devices, child's internet experience and ownership of smartphones. If daily use is mainly predicted by ownership, we observed a significant interaction of age and country, whereby younger children in general, and younger children in Belgium, Ireland and Romania more specifically, are less likely to use a smartphone to go online on a daily basis. This finding suggests that the access divide cannot simply be reduced to material access to devices: the availability and cost of connectivity also matter, as well as parental mediation strategies (e.g., the choice not to provide younger children with an internet plan in order to limit their unsupervised internet use). Indeed, younger children are less likely to be provided with an internet plan on their smartphones: 36% of children aged 9–10 use only wifi networks to go online from their smartphones, 14% use either a wifi connection or a mobile internet plan, and just 9% access the internet using only an

internet plan (Mascheroni & Ólafsson, 2014). This suggests further caution against easy assumptions on the potential of smartphones to reduce digital inequalities in access.

We were also interested in understanding whether the use of smartphones is associated with variations in the number and type of online activities children undertake, and more specifically, whether smartphone use is associated with less or more capital-enhancing uses of the internet. Consistent with prior studies on children and the internet (Livingstone and Helsper, 2007; Livingstone et al., 2011), we found that the number of online activities varies by age, gender, and internet experience: older children, boys and those who have started to use the internet at a younger age are more likely to engage in a wider range of online activities. Country of residence also matters, while a household's socio-economic status or parents' ownership and use of mobile devices is not influential. However, the greatest variation in the number of online activities is explained by daily use of smartphones: as observed among adults (Hargittai and Hinnant, 2008), users who benefit from more autonomous access to the internet engage in a wider range of online activities. Regarding the type of activities children undertake, beyond persisting differences by age, gender and child's internet experience, we found that smartphone use is associated with a consistent increase in social networking and entertainment activities, but is not correlated with use of the internet for schoolwork. Moreover, we also observed a significant correlation between daily use of smartphones to go online and children's progression on the ladder of opportunities:

children who access the internet from their smartphones on a daily basis, and especially younger children, are more likely to pursue activities included in stages 4 and 5 of the ladder of online opportunities. Therefore, the findings of research on the adult population showing that smartphones are associated with less capital-enhancing activities, thus reducing the access divide while widening the usage gap (Pearce and Rice, 2013), are not supported by the empirical evidence presented here. However, the findings are at least partially supportive of the 'second-level digital divide' (Hargittai, 2002; Hargittai and Hinnant, 2008): indeed, gaining participatory activities is correlated with autonomy of use and with the number of years a child has been using the internet for, suggesting that both technological platforms and different family backgrounds still function as sources of online disparities that are mirrored in, and entrench, offline inequalities. Moreover, there are indications that children from medium or higher socio-economic status households engage in more productive uses of the internet compared to peers from lower socio-economic backgrounds, which is consistent with studies on adults (van Deursen and van Dijk, 2014).

We have observed a general pattern, whereby access to smartphones is influenced by parental domestication of the mobile internet, child's age and internet experience, and country; moreover, daily use of smartphones is strongly, but not exclusively, predicted by ownership; and, finally, more capital-enhancing uses of the internet are strongly associated with autonomy of use, which, in turn, is associated with

smartphone ownership, parents' use of mobile devices and age of first internet use. While this pattern is valid throughout Europe, some variations across countries are noteworthy. In terms of access to smartphones, children in Romania, Portugal and Belgium are generally less likely to own a smartphone, but Portuguese children who own a smartphone are the most likely to use it daily to go online, together with Italian children, who, at the same time, are the least likely to own a smartphone if they start using the internet late. These findings suggest that, despite being mediated by family's domestication of the internet, socio-economic and cultural inequalities across and within European countries can still influence autonomy of use. On the other hand, cross-national comparison also shows that beneficial uses of the internet vary largely across countries, despite being strongly predicted by autonomy of use (measured by daily use of smartphones), child's age, and parents' use of mobile devices: here, inequalities may also be the product of different parental mediation strategies, with restrictive approaches in the so-called 'protected by restrictions' countries (Helsper et al., 2013) restricting opportunities as well as reducing risks, the UK being a paradigmatic example (Mascheroni and Ólafsson, 2014).

To conclude, this study aimed at showing the resilience of digital inequalities among a segment of the population – children – who are usually assumed to be on the 'right' side of the digital divide. It has also shown how social inequalities intersect with divides in access and result in disparities in online activities, with children who benefit

from a greater autonomy of use and a longer online experience also engaging in more productive and capital-enhancing uses of the internet. However, this study has some limitations that may make findings about differential access and use of the internet among children less generalisable. First, the relatively low response rate registered in some countries limits the extent to which we can draw generalisable conclusions from the sample. Nonetheless, the study offers unique comparative data on children's ownership and use of smartphones.

Second, the research was conducted in Europe, in a context where digital inequalities persist, but where both the number of internet users and mobile telephony subscriptions is above the world average (ITU, 2013). As a consequence, we didn't have the opportunity to examine a significant number of internet users who access the internet exclusively from smartphones: smartphone use is almost always complementary to access from other platforms, with smartphone and laptop being the most common combination.

A third major limitation lies in the structure of the questionnaire: due to the specific requirements that research with children implies, in terms of comprehension of the questions as well as length of the questionnaire, we didn't ask children what activities they engage in on different devices. What we are showing is correlations between smartphone use and the number of online activities overall, or the frequency of specific sets of activities. Research on children who only use smartphones to go online,

compared to children who benefit from a variety of access devices and locations, may help better understand the relationship between smartphone use, digital inequalities and social inequalities.

Another divide that has not been addressed in this article, and that could instead help grasp the potential of mobile devices, is digital skills. Despite having measured a number of self-reported online skills, including instrumental, informational, safety skills and communicative abilities, at this stage we have limited our analysis to access and use. Future analysis on the dataset may, then, provide further confirmation for these conclusions.

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Figure 1: Children's ownership and daily use of smartphones, by country

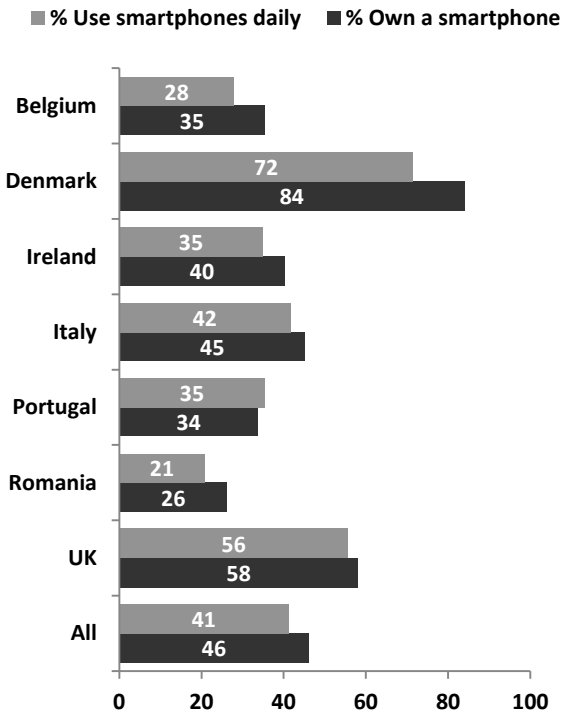

Table 1: Logistic regression models for the probability of children owning or having for their own use a smartphone.

	Model 1			Model 2			Model 3		
	b	SE(b)	OR	b	SE(b)	OR	b	SE(b)	OR
Constant	**-0.57**	**0.15**	**0.57**	**-0.57**	**0.15**	**0.57**	**-0.60**	**0.16**	**0.55**
Age	**0.48**	**0.02**	**1.13**	**0.48**	**0.06**	**1.61**	**0.46**	**0.06**	**1.58**
Girls	0.12	0.09	0.36	0.13	0.09	1.14	0.13	0.09	1.13
Belgium (BE)	**-1.04**	**0.16**	**2.72**	**-1.10**	**0.17**	**0.33**	**-1.11**	**0.19**	**0.33**
Denmark (DK)	**1.00**	**0.18**	**0.67**	**0.94**	**0.18**	**2.56**	**1.02**	**0.19**	**2.77**
Ireland (IE)	**-0.40**	**0.16**	**0.69**	**-0.44**	**0.16**	**0.65**	**-0.54**	**0.18**	**0.58**
Italy (IT)	**-0.38**	**0.16**	**0.36**	**-0.45**	**0.17**	**0.64**	0.12	0.23	1.12
Portugal (PT)	**-1.02**	**0.17**	**0.26**	**-1.01**	**0.17**	**0.37**	**-1.04**	**0.19**	**0.35**
Romania (RO)	**-1.34**	**0.18**	**0.89**	**-1.09**	**0.18**	**0.34**	**-0.99**	**0.20**	**0.37**
Age of first internet use	**-0.12**	**0.02**	**1.19**	**-0.12**	**0.02**	**0.88**	**-0.09**	**0.06**	**0.91**
Medium SES (vs low SES)	0.18	0.11	1.18	0.18	0.11	1.19	0.18	0.11	1.20
High SES (vs low SES)	0.17	0.12	2.71	0.15	0.12	1.16	0.15	0.12	1.16
Parent(s) use(s) mobile devices	**1.00**	**0.11**	**2.71**	**1.01**	**0.11**	**2.74**	**1.02**	**0.11**	**2.78**
Age x BE				0.12	0.08	1.12	0.12	0.09	1.13
Age x DK				-0.12	0.08	0.89	-0.13	0.09	0.88
Age x IE				0.10	0.08	1.11	0.07	0.09	1.07
Age x IT				0.11	0.08	1.12	**0.29**	**0.10**	**1.34**
Age x PT				-0.01	0.08	0.99	**-0.01**	**0.09**	**0.99**
Age x RO				**-0.22**	**0.08**	**0.80**	**-0.16**	**0.09**	**0.85**
Age of first internet use x BE							-0.01	0.08	0.99
Age of first internet use x DK							0.05	0.09	1.05
Age of first internet use x IE							0.06	0.08	1.07
Age of first internet use x IT							**-0.29**	**0.09**	**0.75**
Age of first internet use x PT							0.02	0.09	1.02
Age of first internet use x RO							-0.10	0.08	0.90
Chi-square		1104			1133			1153	
df		12			18			24	
-2 Log likelihood		3233			3203			3184	
Cox & Snell R Square		0.30			0.30			0.31	
Nagelkerke R Square		0.40			0.41			0.41	

Numbers in bold are significant at the 0.05 level. OR is the odds ratio.

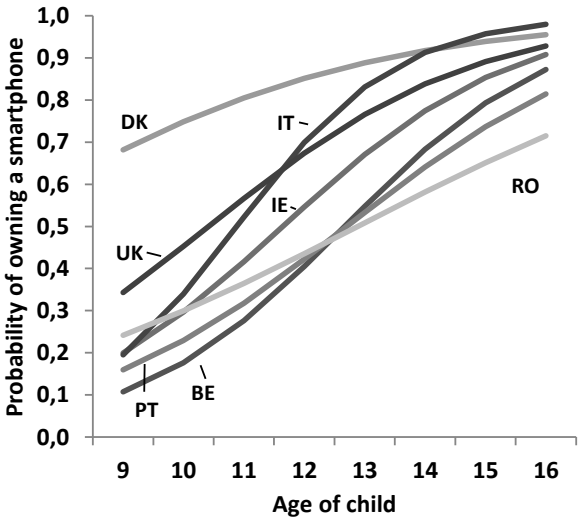

Figure 2: Predicted probability of owning a smartphone by age and country.

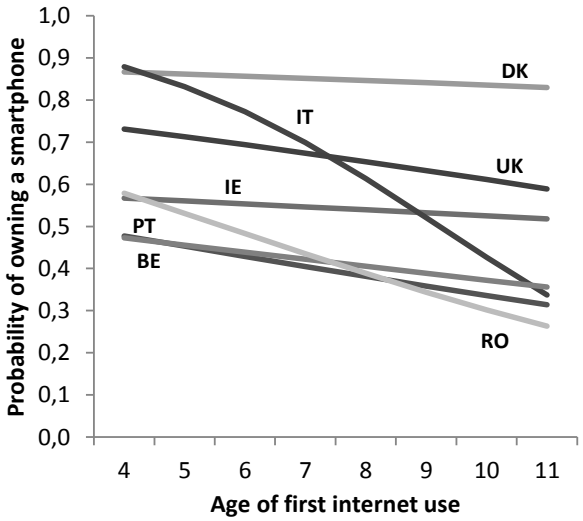

Figure 3: Predicted probability of owning a smartphone by age of first internet use and country.

Table 2: Logistic regression models for the probability of using a smartphone to go online at least daily at any location.

	Model 1			Model 2			Model 3		
	b	SE(b)	OR	b	SE(b)	OR	b	SE(b)	OR
Constant	**-0.77**	**0.16**	**0.46**	**-2.79**	**0.24**	**0.06**	**-2.55**	**0.35**	**0.08**
Age	**0.50**	**0.03**	**1.64**	**0.33**	**0.03**	**1.39**	**0.25**	**0.06**	**1.28**
Girls	0.15	0.09	1.16	0.09	0.12	1.09	0.05	0.25	1.05
Belgium (BE)	**-1.20**	**0.17**	**0.30**	**-0.91**	**0.23**	**0.40**	**-1.24**	**0.52**	**0.29**
Denmark (DK)	**0.44**	**0.16**	**1.55**	-0.16	0.22	0.85	0.77	0.45	2.15
Ireland (IE)	**-0.35**	**0.16**	**0.71**	-0.21	0.22	0.81	0.54	0.38	1.72
Italy (IT)	**-0.19**	**0.16**	**0.82**	0.08	0.24	1.08	-0.55	0.46	0.58
Portugal (PT)	**-0.79**	**0.17**	**0.46**	-0.11	0.24	0.89	**-1.58**	**0.55**	**0.21**
Romania (RO)	**-1.35**	**0.19**	**0.26**	**-0.68**	**0.26**	**0.51**	**-1.52**	**0.55**	**0.22**
Age of first internet use	**-0.12**	**0.02**	**0.88**	**-0.08**	**0.03**	**0.92**	**-0.08**	**0.03**	**0.93**
Medium SES (vs low SES)	-0.04	0.11	0.96	**-0.36**	**0.16**	**0.70**	**-0.39**	**0.17**	**0.68**
High SES (vs low SES)	-0.14	0.12	0.87	**-0.54**	**0.17**	**0.58**	**-0.57**	**0.17**	**0.57**
Parent(s) use(s) mobile devices	**1.01**	**0.11**	**2.74**	**0.56**	**0.15**	**1.75**	**0.54**	**0.16**	**1.72**
Child owns a smartphone				**4.06**	**0.15**	**58.21**	**3.77**	**0.38**	**43.25**
Owning a smartphone x age							**0.11**	**0.07**	**1.12**
Owning a smartphone x gender							0.07	0.28	1.07
Owning a smartphone x BE							0.39	0.57	1.47
Owning a smartphone x DK							**-0.96**	**0.50**	**0.38**
Owning a smartphone x IE							**-1.10**	**0.45**	**0.33**
Owning a smartphone x IT							0.87	0.54	2.38
Owning a smartphone x PT							**2.46**	**0.67**	**11.65**
Owning a smartphone x RO							**1.15**	**0.62**	**3.14**
Chi-square		965			2236			2302	
df		12			13			21	
-2 Log likelihood		3176			1905			1839	
Cox & Snell R Square		0.27			0.52			0.53	
Nagelkerke R Square		0.36			0.70			0.71	

Numbers in bold are significant at the 0.05 level. OR is the odds ratio.

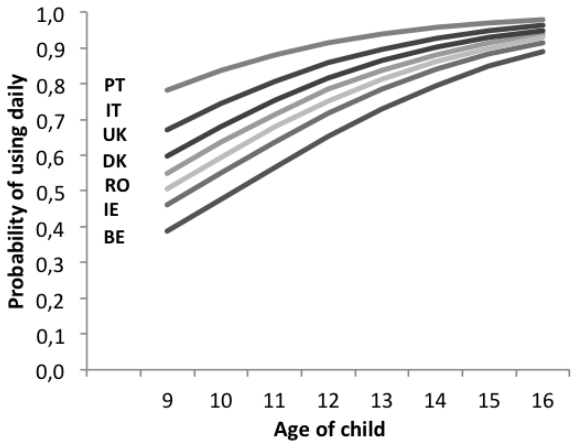

Figure 4: Predicted probability of using a smartphone by age and country for children who own a smartphone.

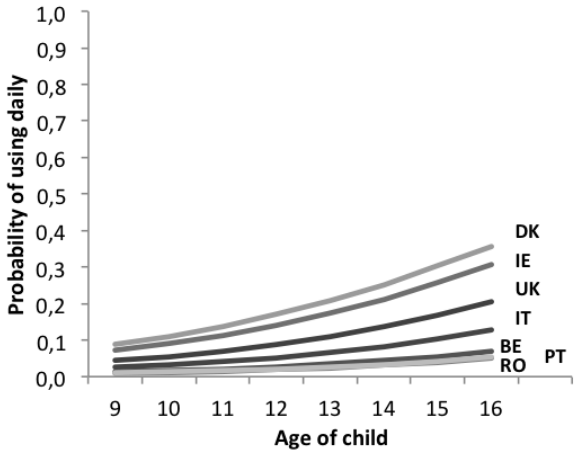

Figure 5: Predicted probability of using a smartphone by age and country for children who do not own a smartphone.

Table 3: Linear regression models for the log-number of online activities.

	Model 1			Model 2		
	b	SE(b)	OR	b	SE(b)	OR
Constant	**1.08**	**0.05**	**2.95**	**1.06**	**0.05**	**2.90**
Age	**0.17**	**0.01**	**1.19**	**0.19**	**0.01**	**1.21**
Girls	**-0.06**	**0.03**	**0.94**	-0.02	0.03	0.98
Belgium (BE)	-0.04	0.05	0.97	-0.04	0.05	0.97
Denmark (DK)	**0.19**	**0.05**	**1.21**	**0.19**	**0.05**	**1.21**
Ireland (IE)	0.04	0.05	1.04	0.03	0.05	1.03
Italy (IT)	**0.24**	**0.05**	**1.27**	**0.24**	**0.05**	**1.27**
Portugal (PT)	**0.18**	**0.05**	**1.20**	**0.18**	**0.05**	**1.20**
Romania (RO)	**0.46**	**0.06**	**1.58**	**0.44**	**0.06**	**1.56**
Age of first internet use	**-0.08**	**0.01**	**0.93**	**-0.08**	**0.01**	**0.92**
Medium SES (vs low SES)	0.01	0.03	1.01	0.01	0.03	1.01
High SES (vs low SES)	-0.03	0.04	0.97	-0.03	0.04	0.98
Parent(s) use(s) mobile devices	0.05	0.03	1.05	0.05	0.03	1.05
Daily use of a smartphone by child	**0.53**	**0.03**	**1.70**	**0.62**	**0.04**	**1.86**
Age x daily use of smartphones				**-0.05**	**0.01**	**0.95**
Gender x daily use of smartphones				**-0.10**	**0.05**	**0.91**
F		129.13			113.67	
P		< 0.001			< 0.001	
R Square		0.38			0.38	

Numbers in bold are significant at the 0.05 level. OR is the odds ratio.

Table 4: Logistic regression models for the probability of engaging in three different online activities at least weekly and for engaging in at least three activities to levels 4 and 5 in the ladder of opportunities.

	Used the internet for school work			**Watched video clips**			**Visited a social networking profile**			**Reach level 4 or 5 in ladder of opportunities**		
	b	SE(b)	OR	b	SE(b)	OR	b	SE(b)	OR	b	SE(b)	OR
Constant	**1.70**	**0.20**	**5.48**	**1.17**	**0.19**	**3.22**	**-0.35**	**0.18**	**0.70**	**-1.66**	**0.18**	**0.19**
Age	**0.26**	**0.03**	**1.30**	**0.34**	**0.04**	**1.40**	**0.62**	**0.04**	**1.85**	**0.40**	**0.03**	**1.49**
Girls	0.23	0.11	1.26	-0.05	0.12	0.95	**0.23**	**0.11**	**1.26**	-0.08	0.13	0.92
Belgium (BE)	**-1.75**	**0.19**	**0.17**	0.09	0.19	1.09	**0.49**	**0.18**	**1.64**	-0.19	0.18	0.83
Denmark (DK)	**-0.95**	**0.21**	**0.39**	0.25	0.22	1.29	**0.58**	**0.19**	**1.79**	**-0.81**	**0.17**	**0.45**
Ireland (IE)	**-1.35**	**0.19**	**0.26**	**0.60**	**0.20**	**1.81**	**0.01**	**0.18**	**1.01**	**-0.61**	**0.18**	**0.55**
Italy (IT)	**-0.77**	**0.20**	**0.47**	**0.42**	**0.20**	**1.52**	**0.94**	**0.19**	**2.56**	**0.50**	**0.17**	**1.64**
Portugal (PT)	**-0.46**	**0.21**	**0.63**	**0.46**	**0.20**	**1.59**	**1.46**	**0.19**	**4.31**	-0.11	0.18	0.90
Romania (RO)	**-0.52**	**0.22**	**0.60**	**1.11**	**0.23**	**3.03**	**1.79**	**0.20**	**6.00**	**1.10**	**0.18**	**2.99**
Age of first internet use	**-0.08**	**0.03**	**0.92**	**-0.17**	**0.03**	**0.84**	**-0.12**	**0.03**	**0.89**	**-0.12**	**0.02**	**0.89**
Medium SES (vs low SES)	**0.31**	**0.12**	**1.36**	**0.18**	**0.14**	**1.20**	-0.01	0.12	0.99	0.11	0.12	1.11
High SES (vs low SES)	0.18	0.12	1.20	-0.05	0.15	0.95	**-0.37**	**0.13**	**0.69**	-0.08	0.13	0.93
Parent(s) use(s) mobile devices	0.14	0.11	1.16	**0.25**	**0.13**	**1.29**	**0.22**	**0.12**	**1.25**	**0.32**	**0.12**	**1.37**
Daily use of a smartphone by child	0.12	0.14	1.13	**1.26**	**0.22**	**3.51**	**1.24**	**0.16**	**3.46**	**1.26**	**0.14**	**3.54**
Age x daily use of smartphones	0.04	0.05	1.04	**-0.13**	**0.06**	**0.88**	0.09	0.06	1.10	**-0.18**	**0.05**	**0.84**
Gender x daily use of smartphones	0.04	0.19	1.04	**-0.74**	**0.27**	**0.48**	-0.11	0.22	0.89	-0.26	0.18	0.77
Chi-square		325			269			1174			507	
df		12			15			15			15	
-2 Log likelihood		3057			2361			2708			2932	
Cox & Snell R Square		0.10			0.08			0.32			0.16	
Nagelkerke R Square		0.15			0.15			0.44			0.23	

Numbers in bold are significant at the 0.05 level. OR is the odds ratio.

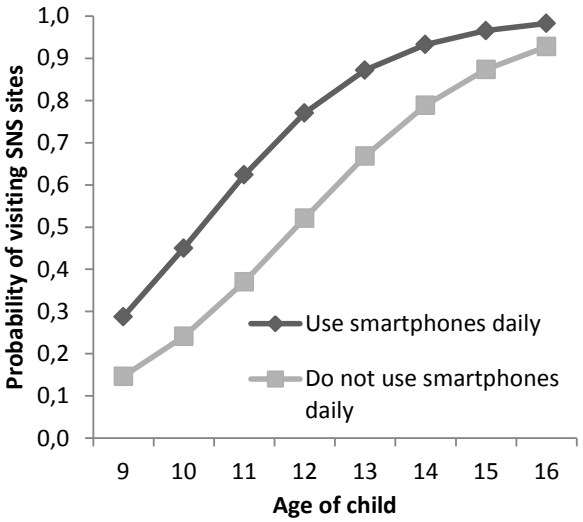

Figure 6: Predicted probability visiting social networking sites at least weekly by age and use of smartphones

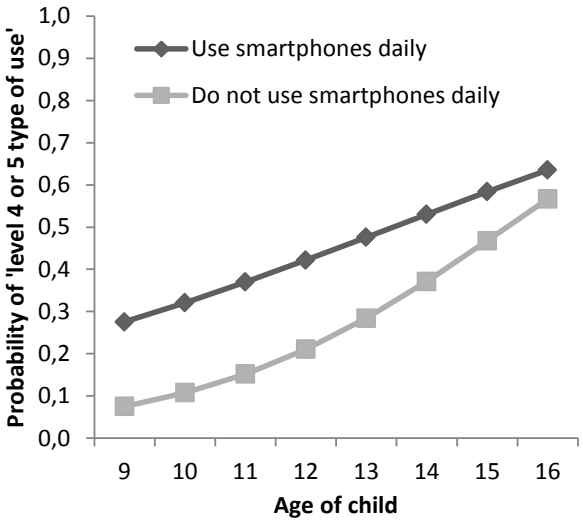

Figure 7: Predicted probability of reaching level 4 or five on the "ladder of opportunities" by age and use of smartphones