

# The Impact of Security and Privacy Concerns on Home Internet Use of Parents and Children

*Research-in-Progress*

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## **ABSTRACT**

Internet users' choices about their extent and types of usage and the types of precautions they take for their online security and privacy is an increasingly important research topic. As business and personal Internet usage grows so do concerns about misuse and abuse leading to financial loss or breaches of privacy. For the younger user, the risk of sexual exploitation from misuse is a particular concern. Effective mitigation of these risks is critical to the full achievement of the benefits the Internet can offer in e-commerce, e-learning, business and social communication. The interrelations between comfort with sensitive Internet use, security measures taken, and the types of Internet usage among home Internet users has not been extensively examined. We plan to empirically examine these interactions and to then extend our analysis to examine the impact of parental attitudes, usage, and controls on the level and types of Internet usage.

## **KEYWORDS**

Internet usage, Internet security, Internet privacy, parental controls

## **INTRODUCTION**

Internet use has raised security and privacy concerns from the early days of the World Wide Web (Furber, 1997). As e-commerce uses of the Internet have expanded it has become increasingly important that adequate security and privacy mechanisms be developed and utilized to allow consumers to feel comfortable in utilizing e-commerce sites. Where children and teens are involved there are additional concerns about the potential for misuse and exploitation and the role of parents in controlling their children's Internet use. In this study, we extend previous models to examine the interrelationships between privacy fears and the extent and types of Internet use by adults. We then plan to extend this analysis to examine the determinants of the use of parental controls and to examine the impact that use of these parental controls, as well as, parental Internet use characteristics, have on the extent and types of Internet usage by their children.

## **BACKGROUND AND LITERATURE REVIEW**

Studies have shown that privacy concerns affect both consumers' use of privacy protection measures and their willingness to provide information online. Milne, Rohm, and Bahl (2004) found that the level of privacy concern had a significant positive relationship to the number of privacy measures taken by Internet users, based on a nationwide survey of over 1200 users. In this study increased frequency and extent of web use and demographic characteristics - being male, higher education level, and lower age - were also significantly positively related to the number of privacy measures taken. Malhotra, Kim and Agarwal (2004) developed a consolidated measure of Internet user information privacy concerns (IUIPC) which was designed to combine user concerns about collection, control and awareness of privacy measures taken by web sites collecting information from consumers. They, found that high level of privacy concern (IUIPC) significantly reduced trusting beliefs and increased risk beliefs and that the trusting beliefs increased intention to provide information online while risk beliefs reduced this intention - based upon a set of scenarios of information requests from marketers. They also found that the effects of demographic characteristics of users were attenuated when the (IUIPC) construct was added to the analysis.

A number of studies have focused specifically on privacy and security issues related to e-commerce. Turow, Hennessy, and Bleakley (2008) found that consumers have limited knowledge of privacy regulations and suggested that this lack of

understanding makes it difficult for consumers to demand that merchants apply standards of online privacy before doing business with them. Christiansen (2011) notes that Internet marketing provides both benefits: free online content and potentially beneficial targeted marketing offerings, and costs: loss of privacy and potential misuse of personal information, to consumers. Miyazaki (2008) found that covert cookie use caused strong negative reactions from consumers, but found that these reactions were substantially attenuated when the cookie use was disclosed by the web site. This study also found that strong desire for privacy in a consumer led to a greater distaste for cookies. Another study (Tsai, Egelman, Cranor, and Acquisti, 2011), introduced a shopping search engine interface that displayed privacy policies of companies in a clear and concise fashion. They found that, when this information was available, consumers tended to purchase more frequently from those companies providing stronger privacy protection and that customers were willing to pay a premium to purchase from such sites. A study focusing on location based services (Xu, Teo, Can and Agarwal, 2010) found that financial compensation for the sacrifice of privacy was more important (and needed) for pull versus push based services. A study by Son and Kim (2008) identified types of information privacy-protective responses – refusal, misrepresentation, removal, negative word-of-mouth, complaining to the company or to 3<sup>rd</sup> parties – and found that higher levels of privacy concerns among users led to most of these responses. This study further found that perceived justice or fairness on the part of an online company led to lower refusal and misrepresentation, and that perceived societal benefits – helping others avoid a bad experience – was positively related to the use of complaining responses.

Privacy and security concerns surrounding Internet use by children and teens add additional dimensions of appropriate parental control, as well as added misuse and exploitation issues. Parental control over media exposure of children has been always been a concern (Austin, 1993), and with the emergence of the Internet the degree of risks and complexity of controls has expanded (Furger, 1997). While the risks of child and adolescent use of the Internet has led many parents to employ parental controls, there are risks associated with these measures. (Mayer, 2003) suggests that the use of privacy limiting technologies within families – including Internet tracking software – raises the likelihood of loss of trust issues if the measures are taken secretly and may create a “moral hazard” to teens – the temptation to engage in hiding behaviors - if teens are informed of the monitoring action.

This concern appears to be borne out by recent surveys. McAfee (2012) found that over 70% of teens report having used techniques to avoid parental monitoring including: 53% who clear their browser histories and 46% who close/minimize browsers when parents come in. This study also found that 45% of teens visit web sites their parents don't approve of, 43% have accessed simulated violence online, 36% have accessed sexual topics online and 32% have accessed nude content or pornography. A survey by the Family Online Safety Institute (2012) suggests that there is a disconnect between the perceptions of teens and their parents with regard to usage and monitoring of Internet use. While 84% of parents report that they monitor their teens' online/mobile usage at least fairly closely, only 39% of teens say they are fairly closely monitored by their parents. Similarly 90% of parents feel well informed about what their teens do online but only 62% of teens feel that their parents are well informed about their online activities. Effective monitoring of Internet use may be limited by difficulty in using Internet privacy tools effectively. A recent study (Spice, 2011) based upon interviews of non-technically trained, but frequent Internet users found that for most users the Internet privacy tools were confusing and ineffective and that the users often chose settings that did not protect their privacy as much as they expected.

A few studies have looked specifically at privacy concerns expressed by children and youth. Yan (2005) found that an adult level of awareness of negative consequences of Internet use was generally present in students by the 7<sup>th</sup> grade while students in grades 4 through 6 were less mature in these understandings. Youn (2009) studied the privacy concerns and behaviors of middle school students and developed a model for analysis. This study hypothesized that the level of privacy concern in Internet use is negatively influenced by perceived benefits and positively influenced by perceived risks, and that increased perceived self-efficacy of Internet use would also mitigate privacy concerns. Empirical results of the study confirmed the first 2 hypotheses, but self-efficacy had no significant effect. This study also hypothesized that the level of privacy concern would impact (positively) the use of privacy protective behaviors (fabricating- providing false or incomplete information to web sites, seeking advice from adults, and refraining from use). Results of the study found that this was true particularly for those seeking adult advice and refraining from responses, and found that, when the privacy concern measure was included in the model, the other factors (perceived risk, perceived benefit, and privacy self efficacy – as well as other demographic measures were no longer significant.

Based upon some of the prior research outlined above, Dinev and Hart (2006) developed a model of the antecedents of online activities that involve sensitive information being transmitted over the Internet. Their model specified that the willingness to provide personal information over the Internet is determined by Internet privacy concerns, Internet trust, perceived Internet privacy risk, and personal Internet interest, with the first 2 in turn being impacted by perceived Internet privacy risk. We have

combined the features of this model with those involving parental concerns about privacy and security in their children's online activities as presented in Yan (2005) and Youn (2009) in developing the empirical model presented here.

## EMPIRICAL MODEL AND HYPOTHESES

The analyses presented here use a set of data collected as a supplement to the Current Population Survey for the month of July, 2011 (U.S. Department of Census, 2011). This data set provides a rich collection of data relating to extent of and types of Internet and mobile device use, the level of concern about the privacy of Internet use. The survey also gathers data about the amount and types of parental controls employed on home Internet use in households that have children under 18. The survey is designed to be a representative national sample of U. S. households. It includes about 15,000 households having children under the age of 18.

Figure 1 on the next page and the descriptions of variables used and hypotheses tested as shown below present the proposed model. Following Dinev and Hart, the willingness to engage in Sensitive Online Activities (SOA), Equation 1 below, is expected to be influenced by the level of Internet Trust (IT) and the degree of personal internet interest, as measured by hours of Internet Use (IU). Also included in this equation are a standard set of demographic control variables. Dummy variables for Internet Use at Work (WIU) and working in a Computer Occupation (CO) are also included since these characteristics are expected to enhance perceived computer efficacy, which in turn may increase the individual's level comfort in engaging in sensitive internet activities. In Equation 2, hours of internet use per week (IU) are expected to be influenced by a set of demographic characteristics similar to those in Equation 1; In addition, the level of Internet Trust may impact the level of internet use both directly and indirectly through its impact on SOA. Further, the degree of parental controls (PC) used may influence IU if parents using them directly or indirectly limit their internet activities as a result. Note that simultaneous equations models are needed here: IU as a proxy for personal internet interest is expected to influence SOA, while these sensitive activities, SOA, represent a significant component of internet usage and must be expected to impact IU.

We are in the process of cleansing and transforming the variables needed for the Parental Controls (PC) equation, which will become the third equation of the model. A preliminary representation of the hypothesized relationships for this equation is presented (with Parental Controls being the endogenous factor) inside the ellipse in Figure 1. In results below, we present preliminary estimates only for a two equation system involving the SOA and Internet Use (IU) endogenous variables.

The 2 equation model specification is shown below:

$$1. \text{ SOA} = \alpha_1 + \beta_{11}\text{CO} + \beta_{12}\text{G} + \beta_{13}\text{R} + \beta_{14}\text{WIU} + \beta_{15}\text{IT} + \beta_{16}\text{EL} + \beta_{17}\text{IU} + \epsilon_1$$

$$2. \text{ IU} = \alpha_2 + \beta_{21}\text{CO} + \beta_{22}\text{G} + \beta_{23}\text{R} + \beta_{24}\text{WIU} + \beta_{25}\text{IT} + \beta_{26}\text{A} + \beta_{27}\text{FI} + \beta_{28}\text{PC} + \beta_{29}\text{SOA} + \epsilon_2$$

### Demographic (Control) Variables

Gender (G)-> Male or Female

Age (A) -> In years

Family Income (FI) -> \$1'000 per year, in categories – recorded as midpoint of specified range

Residence (R) ->Urban area (2) or Other (1)

Education Level (EL) -> Number of years of education, recoded from categories, using midpoint of range

### Exogenous Internet Use Related Variables

Computer Occupation (CO) -> Not employed, Employed in a non-computer field (1), Employed in a computer field (2)

Work Internet Use (WIU) -> Do not use Internet at work (1), Use Internet at work (2)

Internet Trust (IT) -> Belief in the use of the Internet for online transactions - less risky than traditional means e.g., telephone (3), about the same (2) or more risky (1)

### Endogenous Variables:

Sensitive Online Activities (SOA) -> Count of # of types of online actions involving sensitive information transfer

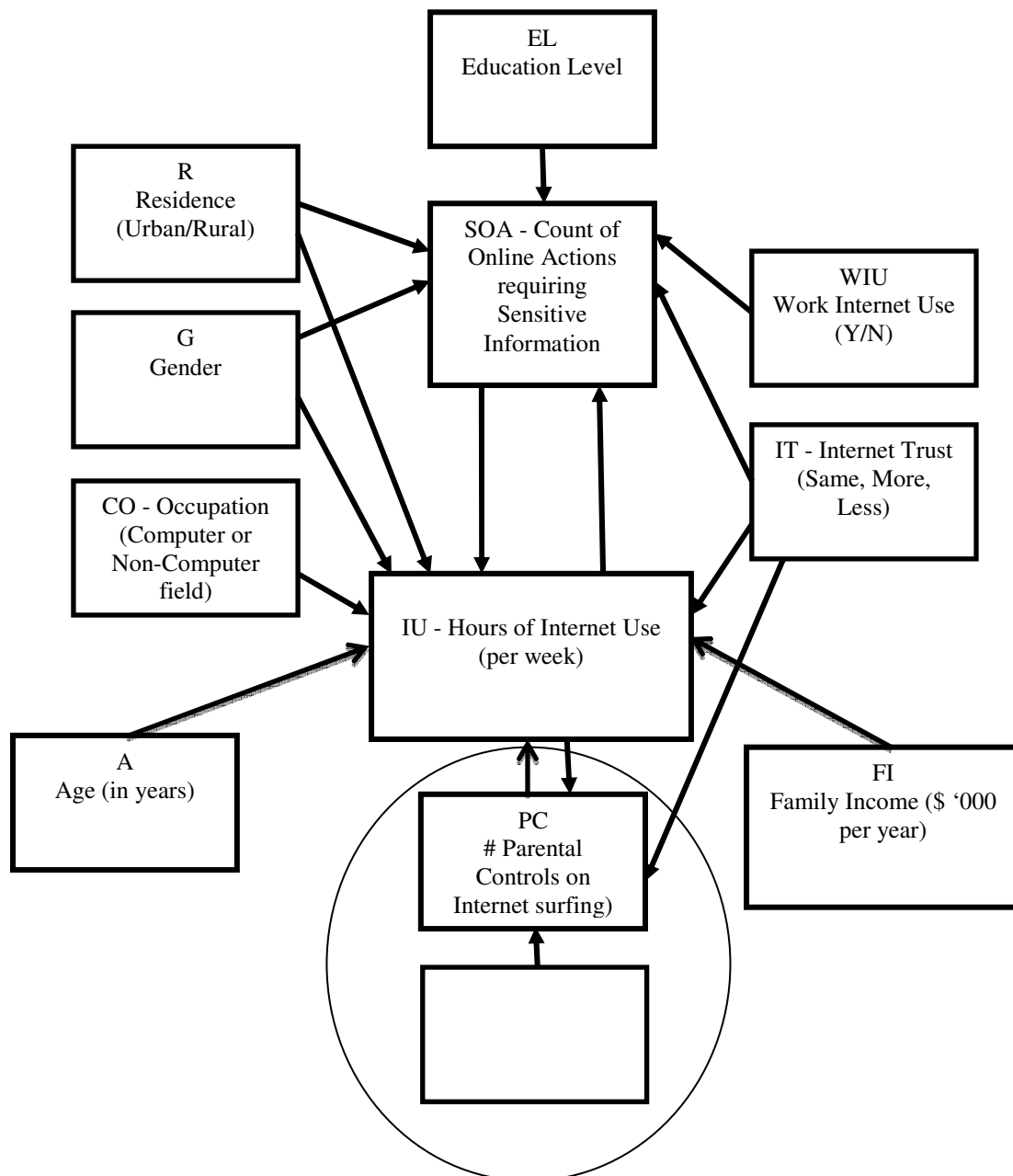
Internet Use (IU) -> count of the number of hours per week spent on the Internet

Parental Controls (PC) -> Count of # of types of parental controls used on Internet surfing

Hypotheses:

- H1: Internet Trust (IT) positively affects Internet Use (IU) and Sensitive Online Activities (SOA)
- H2: There is a simultaneous positive impact between Sensitive Online Activities (SOA) and Internet Use (IA)
- H3: Family Income (FI) has a positive effect on Internet use (IU)
- H4: Education Level (EL) has a positive effect on Sensitive Online Activities (SOA)
- H5: Age (A) has a negative effect on Internet Use (IU)
- H6: Parental Controls (PC) negatively affect Internet Use (IU)

**Figure 1: Empirical Model**



## RESEARCH METHOD

The data needed for the model was extracted from the source specified previously and transformed as needed to provide the variables described above.

The respondents who reported their work situation as unemployed were eliminated from the dataset in order to avoid confounding the results of the analysis, leaving a total of 9056 observations. The data was split almost evenly between male and female respondents. Gender, Residence, Occupation and Internet Trust were converted to dummy variables in the empirical model. To reiterate, the estimated empirical model shown in Figure 1 posits that there is a simultaneous effect of OA and IU on each other. Additionally, FI is expected to positively impact IU while EL is expected to have a positive effect on OA. We also expect a negative impact of A on IU, i.e., younger Internet users will spend more time on the Internet. Lastly, in households that have more parental controls on the use of Internet browsers there should be fewer hours spent online on the Internet or World Wide Web.

Gender, Occupation, Internet use at work and Residence are added as control variables. The level of trust in the Internet (IT) is expected to have a significant effect on both endogenous variables – those who are less trusting of the Internet will (1) use the Internet for fewer hours and (2) carry out less online activities that require transmission of sensitive data.

Table 1 below shows descriptive statistics for the variables. As can be observed there is sufficient variance in the data. We also tested the correlations between the continuous exogenous variables to justify their use in our empirical model.

**Table 1: Descriptive Statistics**

Item	Mean	Std. Devn.	Min	Max
Age	40.14	9.09	15	80
Income	83.12	60.47	2.5	225
Residence (Urban or Other)	1.80	0.40	1	2
Education (Years)	14.28	2.52	0	20
Occupation (Computer/Other)	1.04	0.19	1	2
Internet Use at Work	1.34	0.47	1	2
Online Sensitive Activities (Count)	3.47	1.70	0	6
Parental Internet Controls (Count)	5.15	1.27	0	6
Internet Use (Hours)	20.72	22.24	0	105
Internet Trust (Less, Same, More)	2.09	0.95	1	3

The Pearson correlation coefficients, among the exogenous variables, as shown below, indicate that they are in order. We note that Education (Years) and Family Income show high correlation but do not appear in the same regression equation.

**Table 2: Correlation Coefficients**

	Age	Fam. Inc.	Ed. Yrs.	Par. Controls
Age	1.00000	0.23296	0.21995	-0.06203
Fam. Inc.	0.23296	1.00000	0.45246	-0.07222
Ed. Yrs.	0.21995	0.45246	1.00000	-0.10311
Par. Controls	-0.06203	-0.07222	-0.10311	1.00000

## RESULTS OF THE ANALYSIS AND DISCUSSION

Because of the joint endogeneity in the model, the estimation employed a 3 stage least squares regression method. Each of the two equations had at least 1 independent variable not occurring in the other equation, thus satisfying the identification criterion needed for the estimation. The results are shown in Table 3 that follows.

Some of the expected effects are validated while others are not, in fact a few of the findings run counter to intuition. Firstly, living in a non-urban area does not significantly decrease (or increase) the hours spent online, as is the case with the number of online activities needing sensitive information. This can be explained by observing that non-urban areas have adequate Internet access which makes it possible to look for information as well as make payments and place orders online just as easily as for those in urban areas. In addition, rural residents may have less attractive options for brick and mortar shopping for some types of products. Next, both genders spend equal time online but males seem to do marginally more of the online transactional activities. Those in a computer related occupation do appear to spend more hours and carry out more transactions online, perhaps because of higher levels of familiarity and ease with technology. Somewhat surprising is the result that Internet use at work significantly reduces the hours of Internet use in households. This could be the result of “Internet fatigue” combined with finding most of what one needs during periods of such use at work. However, it has no effect on the count of online transactions. Perhaps online transactions are precluded when one is at work and therefore, these are done at home out of necessity.

One counter intuitive finding is that Education levels marginally reduce the number of online actions that demand the transfer of sensitive data. We expected that education would raise the awareness of Internet users on how to protect their online data transmission and thereby result in more such activity. The reverse result could be due to media coverage of hacking attempts and identity theft cases, combined with the warnings on use of mobile devices which are not fully protected and this may be having a deterrent effect.

Those that believe the Internet is less risky or about the same as traditional means of business transactions do not use the Internet to a greater extent than those viewing it as more risky, another finding that is contrary to expectation. We may speculate that even the pessimistic users (those who mistrust the Internet more) are aware that online business web sites are secure sites which use encryption protocols and hence no less safe than handing over a credit card at a restaurant. As expected, the pessimistic users do spend fewer overall hours online, compared to the ones who believe the Internet is less risky or about the same, which is in line with their beliefs.

**Table 3: Three stage least squares results**

Variable	Model		(Hours of) Internet Use			
	DF	Parameter	Standard Error	t Value	Pr >  t	
Intercept	1	32.34956	2.581143	12.53	<.0001	
Online Activities	1	-1.47810	0.848201	-1.74	0.0814	
Residence	1	0.629874	0.567710	1.11	0.2672	
Gender	1	0.679541	0.451105	1.51	0.1320	
Age	1	-0.01043	0.020023	-0.52	0.6025	
Family Income	1	0.022127	0.003739	5.92	<.0001	
Occupation	1	9.634005	1.307681	7.37	<.0001	
Internet Use at Work	1	-9.25673	1.060836	-8.73	<.0001	
Internet Trust (Same)	1	2.835647	0.827725	3.43	0.0006	
Internet Trust (More)	1	1.157968	0.470104	2.46	0.0138	
Parental Controls	1	-1.33860	0.194883	-6.87	<.0001	

Variable	Model		(Count of) Online Activities	
	DF	Parameter	Standard Error	t Value

Variable	DF	Estimate	Error	t Value	Pr >  t
Intercept	1	7.083484	0.307137	23.06	<.0001
Residence	1	-0.03151	0.065581	-0.48	0.6309
Gender	1	0.085637	0.052199	1.64	0.1009
Education (Yrs)	1	-0.09656	0.012218	-7.90	<.0001
Occupation	1	0.618253	0.218160	2.83	0.0046
Internet Use at Work	1	-0.20838	0.187889	-1.11	0.2674
Internet Trust (Same)	1	0.107301	0.101425	1.06	0.2901
Internet Trust (More)	1	0.051097	0.055217	0.93	0.3548
Internet Use(Hours)	1	-0.10831	0.015491	-6.99	<.0001

Lastly, the number of hours spent online is not significantly impacted by age of a user – the expectation was that younger users would spend more time online. In line with intuition, those with higher family incomes spend more hours on the Internet for the reason that they have subscription plans that allow unlimited Internet usage. Also as expected, the number of parental controls (which may depend upon the number of children in a household in specific age groups) may reduce the number of hours spent online in that household.

The most interesting finding seems to be that Online Activity count and Hours of Internet use do not reinforce each other as originally hypothesized but act as substitutes. A possible explanation for this is that any user (or household) has a fairly fixed number of hours that is spent online and more of 1 activity reduces time spent on the others. Thus, a user who uses the Internet more for different types of online transactions (buying, selling, bank transactions, filling out Government returns etc.) spends fewer hours on other online activities, and vice versa.

#### PLANNED EXTENSIONS

While the results above provide a number of interesting insights, this study is a work in progress. The authors plan to extend the analysis to examine the determinants of parental controls and the simultaneous impact of parental controls on time spent online and vice versa. We are in the midst of collecting more data on the number of children in each responding household and dividing it up into specific age groups – this will shed light on the interesting and rarely studied issues of, what drives parental concerns and their use of nanny software and manual controls on their children’s use of the Internet/Web as well as the types software based screening they use.

#### CONCLUSION

Since this study is research in progress, its conclusions thus far are necessarily limited. However, we can say that the results thus far look quite promising and examination of the data resource being used suggests that it provides a rich opportunity for further analysis.

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