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Using the technology acceptance model to explain how attitudes determine Internet usage: The role of perceived access barriers and demographics

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Abstract

Despite the fact that most Americans use the Internet, those who are older, less educated, minority and lower income have lower usage rates than younger, highly educated, white and wealthier individuals. We develop and test an extended version of the technology acceptance model (TAM) to explain these differences. We found that age, education, income and race are associated differentially with beliefs about the Internet, and that these beliefs influence a consumer's attitude toward and use of the Internet. Further, we found that although access barriers have a significant effect in the model, perceptions regarding ease of use and usefulness have a stronger effect. Our results suggest that by extending the TAM, to include perceived access barriers helps to explain demographic-based differences in Internet use. We also provide key insights for both managers and policymakers.

Keywords: Technology acceptance model; TAM; Internet use; Internet adoption

Approximately 68% of American adults use the Internet (Internet World Stats, 2005; Pew Internet and American Life Project, 2005), and marketers are poised to reap the benefits associated with technology-based marketing strategies. Indeed, some of the fastest rates of growth in Internet use have been among individuals who are older, less educated, of minority status or with lower incomes. However, Internet usage rates associated with these demographic groups are lower than that of the general population (The Digital Future Report, 2004; Fox, 2004; Lenhart et al., 2003; NTIA, 2002).

Why are there differential rates of Internet use, based on age, education, income and race? The answer to this question is important, given the significant impact of the Internet on business practice and the general importance of these demographic consumer groups. Perhaps the cost to access the Internet explains why demographic-based differences persist (see Hoffman et al., 2000). However, recent data suggest that cost might not be the only causal factor (Lenhart et al., 2003; NTIA, 2002; The Digital Future Report, 2004).

In conducting this study, we sought to understand which consumer beliefs explain attitude toward and use of the Internet. Indeed, we felt that variables other than cost could be equally or more important. We also sought to understand how age, education, income and race are related to beliefs about the Internet, since these variables are most often associated with demographic-based differences in Internet use (Madden, 2003; Pew Internet and American Life Project, 2005).

The technology acceptance model (TAM) suggests that perceived usefulness and perceived ease of use are beliefs about a new technology that influence an individual's attitude toward and use of that technology (Davis et al., 1989). The TAM has been applied in the context of online consumer behavior (e.g., Bruner and Kumar, 2005). Further, it has received empirical support via numerous studies (Venkatesh and Davis, 2000).

Despite vast support for the TAM, researchers call for others to explore whether the TAM's belief variables are mediators of the effect of external variables and, if so, which external variables are important (Venkatesh, 2000; Venkatesh and

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Brown, 2001). To our knowledge, no previous research has included collectively age, education, income and race in a single TAM-based model, even though these variables are relevant in the context of explaining Internet use. Also, while previous research shows that access barriers, such as cost, could influence the use of personal technology (Hoffman et al., 2000; Venkatesh and Brown), perceived access barriers has not been included as an additional belief variable in previous applications of the TAM.

Thus, we extended the TAM in two ways. First, we included perceived access barriers among the key beliefs about a technology that influence its use. Also, we added four key demographic constructs as external variables to the TAM (i.e., age, education, income and race). Our model suggests that the TAM's belief variables are differentially relevant to consumers with different demographic profiles and serve to mediate the relationships between demographic variables and attitude toward the Internet.

1. Benefits of increasing internet usage

Encouraging more consumers to use the Internet could be valuable for firms. For example, firms operating in the health services industry could benefit from having older consumers online, since online seniors tend to search for information related to medical products and services (Fox, 2004). Furthermore, older consumers tend to have greater wealth, spending power and store-loyalty than younger consumers (Moschis et al., 2004).

African-Americans and Hispanics also have significant purchasing power (Humphreys, 2004), and trends in their online behavior represent great opportunity for marketers. As firms increasingly design websites with both utilitarian and hedonic features (Bruner and Kumar, 2005), marketers are poised to capture an increasing share of online-minority consumers.

Firms also have untapped opportunities with consumers with lower incomes and less education. For example, low-income individuals tend to pursue hobbies and entertainment online (Madden, 2003) and, given trends such as advergaming (Daugherty, 2004), marketers could leverage the power of the Internet as a promotion tool with these consumers. Furthermore, expanding Internet use among less-educated consumers could help them increase their purchasing power by helping them find better jobs, facilitating their participation in online shopping. Before any of these benefits can be achieved, however, we must first understand why members of certain demographic groups are not using the Internet.

2. Theoretical perspectives on technology adoption and acceptance

Two research paradigms have emerged to explain technology adoption and acceptance. Using the first paradigm, researchers focus on trait variables to explain an individual's propensity to use new technology. For example, Parasuraman's (2000) technology readiness index delineates two drivers (optimism and innovativeness) and two inhibitors (discomfort and security) of an individual's propensity to use new technologies. The second paradigm focuses on how a technology's attributes affect an individual's perceptions and, ultimately, use of that technology. Indeed, the TAM is the most widely applied of these theories (Venkatesh, 2000). According to the TAM, perceived usefulness and perceived ease of use are beliefs that are presumed to (1) influence attitudes toward new technology and (2) mediate the relationship between external variables and attitude (Davis et al., 1989).

The TAM is a preferred choice of models when parsimony, research costs and outcomes are considered (Mathieson, 1991). For example, the TAM explains more variance in attitude toward a technology, and a comparable percentage of variance in usage, as the Theory of Planned Behavior (Mathieson, 1991; Taylor and Todd, 1995). Also, the TAM constructs are more amenable to operationalization and empirical testing than are the broad concepts of Rogers' (1995) diffusion of innovations framework. Finally, while numerous extensions to the TAM have enhanced our understanding of technology acceptance (Wixom and Todd, 2005), prior studies exclude variables that are relevant to explaining demographic differences in Internet use and reflect perceptions of access barriers relating specifically to cost.

3. Model and hypotheses

Our model is presented in Fig. 1. Attitude toward an innovation is a critical intervening variable in the innovation adoption decision (Rogers, 1995). Thus, attitude toward a specific information technology is conceptualized as a potential user's assessment of the desirability of using that technology (Davis et al., 1989) and, according to the TAM, predicts an individual's use of technology.

H1. An individual's attitude toward Internet usage is positively associated with their use of the Internet.

Accessibility or cost could be an important factor in explaining technology use (Mathieson, 1991; Venkatesh and Brown, 2001), and research suggests that it is a central reason why differences in Internet usage exist (Hoffman et al., 2000; NTIA, 2002). We conceptualize perceived access barriers as a belief that the Internet is expensive to use and difficult to access. According to the TAM, beliefs affect technology use as mediated by attitude (Davis et al., 1989).

H2. The higher an individual's perception of access barriers associated with using the Internet, the less favorable their attitude toward Internet usage.

Attributes about a new technology such as relative advantage and complexity are critical to the attitude an individual forms about a new technology (Rogers, 1995). These attributes conceptually embrace the main constructs of the TAM. For example, relative advantage is consistent with the perceived usefulness construct in the TAM, while complexity is consistent with perceived ease of use. According to the TAM, both perceived usefulness and perceived ease of use are beliefs about a new technology that influence an individual's attitude toward using that technology (Davis et al., 1989).

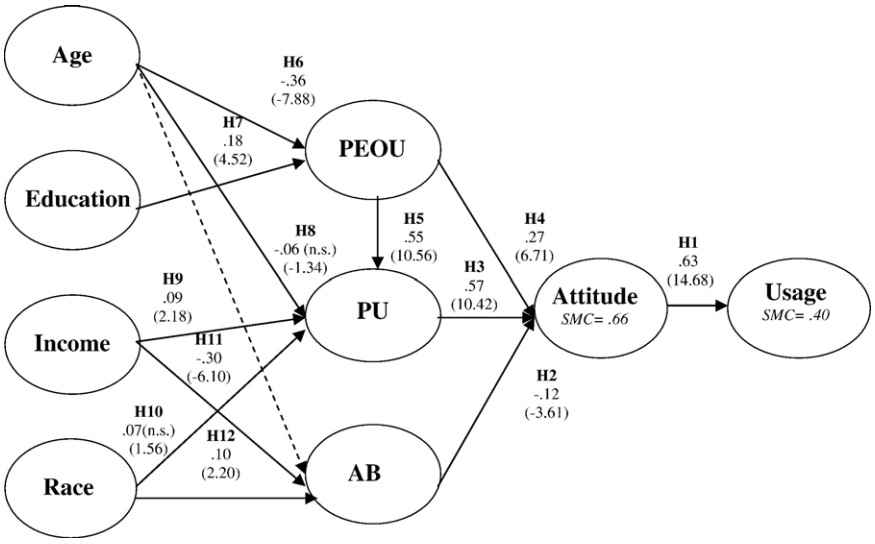

Fig. 1. Model of Internet use based on the technology acceptance model. The model, as depicted, shows a modified path from Age to AB. Standardized parameter estimates are shown with associated *t*-values in parentheses. The modified path, Age → AB, had a standardized parameter estimate of .22 (*t*-value=4.50, $p<.001$). The exogenous variables were allowed to correlate, although not shown in the model. All paths depicted were statistically significant, unless noted as insignificant by "n.s." appearing after the parameter estimate.

H3. The more that an individual perceives the Internet as useful, the more favorable that individual's attitude toward use of the Internet.

H4. The more that an individual perceives the Internet as easy to use, the more favorable that individual's attitude toward use of the Internet.

In prior TAM-based studies, perceived usefulness typically has a stronger direct effect on attitudes than does perceived ease of use and a direct effect on perceived usefulness. According to Davis (1989), an individual adopts a new technology primarily because of the functionality offered, rather than because it is easy to use. Thus, users tend to overcome difficulties in using new technology if the benefits of usage are substantive.

H5. The more that an individual perceives the Internet as easy to use, the more that individual will perceive the Internet as useful.

Older individuals tend to perceive a reduction in their own cognitive capabilities to learn (Hertzog and Hultsch, 2000) and have lower perceptions of self-efficacy with regard to cognitive functioning (Bandura, 1997). Thus, since many older individuals have limited experience using computers and the Internet, it is likely that they have self-efficacy concerns related to learning how to use the Internet. Similarly, older individuals tend to have self-referent beliefs about perceived changes related their performance capabilities due to aging. According to Hertzog and Hultsch (2000, p. 440), these metacognitive beliefs can affect an older individual's decision to "engage in or avoid cognitively demanding situations." Thus, since many older individuals have limited experience using computers and the Internet, it is likely that learning to use the Internet creates an anxiety-provoking situation that many would choose to avoid because of perceived difficulty associated with the task.

H6. Age is negatively associated with perceived ease of use of the Internet.

The decision to adopt a new technology is related to the amount of knowledge one has regarding how to use that technology appropriately, and complex technologies, such as the Internet, require more knowledge (Rogers, 1995). Indeed, early adopters of new technologies tend to have higher educational levels, perhaps reflecting their ability to understand "how-to" knowledge more quickly than those with less education (Rogers). Empirically, less educated individuals report insufficient knowledge as one of the main reasons that they choose not to use the Internet (NTIA, 2002). They feel more computer anxiety and have less sophisticated cognitive structures that impede their ability to learn in new environments (Hilgard and Bower, 1975). Furthermore, empirical studies also show a significant positive relationship between education level and perceived ease of use (see Agarwal and Prasad, 1999).

H7. Perceived ease of use associated with the Internet is lower for individuals who are less educated.

The Internet allows individuals to find information using a wide variety of sources. Indeed, one of the primary reasons why users go online is to obtain information quickly (The UCLA Internet Report, 2003). However, because older individuals are motivated to satisfy emotional goals in relationships (Carstensen, 1995), they are less likely to perceive the Internet as useful because the benefits associated with using the Internet are information-based rather than emotional.

Furthermore, the Internet allows individuals to stay connected with a large, network of individuals. However, as an individual grows older, their social network decreases and their desire to meet information goals though new social contacts decreases (Charles and Carstensen, 1999). At later stages of life,

only a few, select emotional relationships with close friends and loved ones remain important in fulfilling emotional goals. Thus, not many seniors are expected to perceive the Internet as useful, due to the fact that the Internet facilitates communication within a large network of individuals.

H8. Perceived usefulness associated with the Internet is lower for individuals who are older.

Innovations tend to enter society through homophilous groups that have higher socio-economic status (Rogers, 1995). For this reason, Internet users of higher socio-economic status are less likely to persuade or influence individuals of lower socio-economic status of the usefulness of the Internet, because of infrequent cross-group communication flows. Indeed, the influence of homophilous groups on individual consumer behavior embraces the concept of the comparison function of reference groups that facilitates consumer attitudes based on an individual's perceived similarity with group members (Kelley, 1952).

H9. Perceived usefulness associated with the Internet is lower for individuals who have lower incomes.

Individualistic cultures stress freedom, information seeking and nonconformity, all of which motivates innovation (Herbig and Dunphy, 1998). However, African-Americans and Hispanic-Americans tend toward collectivist behavior. Thus, members of these groups are expected to have less favorable perceptions of the Internet and, ultimately, lower usage rates. Also, late adopters of innovations tend to be of lower social status (Rogers, 1995), and members of these groups tend use each other as sources of information about the usefulness of an innovation (Stanley, 2003). Since African-Americans and Hispanic-Americans have a smaller base of existing Internet users (NTIA, 2002), these few individuals are likely to have a smaller span of influence over their peers' perceptions about the usefulness of the Internet.

H10. Perceived usefulness associated with the Internet is lower for individuals who are Hispanic-American and African-American.

Perceptions about access barriers to the Internet include perceptions regarding the financial investment required to purchase an Internet access device (e.g., a personal computer) and to pay ongoing access fees. Lower income consumers resist services with continuing costs (Taglang, 2000) and, although public facilities often provide free access, the quality of access (e.g., connection rates) is often low and serves as a disincentive to using the Internet.

H11. Perceived access barriers associated with the Internet is higher for individuals with lower incomes.

Stanley (2003) suggests that low exposure to technology influences an individual's self-concept regarding the desirability of using that technology, and that African-Americans and Hispanics are particularly vulnerable to developing such a self-concept due to lack of daily exposure to various technologies. Further, she suggests that some minorities cite cost as a perceived access barrier in an attempt to "save face" when they are too embarrassed to admit other reasons for not choosing to use technology. Thus, Stanley suggests that African-Americans and Hispanics will *report* higher perceived access barriers associated with the Internet, regardless of whether they actually perceive the Internet to be cost-prohibitive. The fact that members of these minority segments often are associated with lower than average incomes (Humphreys, 2004) also gives some perceived credence to their citation of cost as an access barrier.

H12. Perceived access barriers associated with the Internet is higher for individuals who are Hispanic-American and African-American.

4. Data and methodology

A survey instrument was administered to a convenience sample of real consumers (i.e., no full-time students), in a major Southeastern US metropolitan area. The over 100 surveyors were undergraduate students, at a large public university, who administered the paper survey as part of an extra-credit assignment. We encouraged the surveyors to select respondents comprised of a balanced number of frequent users and infrequent users/non-users, as well as respondents who represented diverse backgrounds in terms of the key demographic variables. A total 614 surveys were completed, and the final analysis included 539 cases.

We used existing multi-item scales, adapted to suit the context of the study, to measure perceived ease of use, perceived usefulness, attitude toward Internet usage and Internet usage. Internet usage was operationalized as an individual's extent of Internet usage (e.g., frequency of use), based on a Likert-type scale response. Age, education, income and race were single item measures, based on categorical survey responses. Race was coded dichotomously, as suggested by Hypotheses 10 and 12. The perceived access barriers scale was developed for this study. The survey was pretested, and we made minor revisions before the final survey was administered.

A confirmatory factor analysis (CFA) by means of LISREL 8.5 (Joreskog and Sörbom, 1996) was conducted and measurement items were deleted on both substantive and statistical grounds (Anderson and Gerbing, 1988). As a result, 8 items were eliminated, leaving a total of 19 items (see Table 1 for the 15 items associated with the non-demographic variables). The final measurement model had good fit ($\chi^2 = 233.68$, degrees of freedom [df] = 120, $p < .001$; comparative fit index [CFI] = .98; root mean square error of approximation [RMSEA] = .042; standardized root mean square residual [SRMR] = .026) (see Hu and Bentler, 1999). The stability of the measurement model was supported by applying the model to two randomly generated sub-samples of the data.

Several criteria were used to analyze measurement reliability and validity (see Table 1 for final measurement properties). Cronbach's alpha values, composite reliabilities and the average variance extracted measures (AVE) provided strong evidence of measurement reliability (Fornell and Larcker, 1981; Nunnally and Bernstein, 1994; Gerbing and Anderson, 1992 for criteria). Convergent validity is supported by the composite reliabilities (Fornell and Larcker) and the

Table 1
Measurement properties for multi-item constructs[a]

Construct	Standard loading	Mean	Standard deviation
Perceived ease of use [PEOU] (.92, .90, .75)[b]			
Learning to use the Internet is easy	.85*	3.54	1.14
Using the Internet is clear and understandable	.79*	3.28	1.04
It is easy to become skillful at using the Internet	.84*	3.48	1.07
Overall, the Internet is easy to use	.96*	3.56	1.09
Perceived usefulness [PU] (.83, .83, .64)[b]			
Using the Internet can make one productive	.66*	3.60	1.12
The Internet can make things easier	.84*	4.06	.99
Overall, the Internet is useful	.89*	4.29	.95
Perceived access barriers [AB] (.93, .92, .88)[b]			
I do not have the money to get Internet access for personal use	1.00*	1.59	1.11
I cannot afford the Internet for personal use	.88*	1.58	1.12
Attitude toward Internet usage [Attitude] (.90, .89, .76)[b]			
I am positive toward the Internet	.87*	3.85	1.06
It makes sense to use the Internet	.94*	4.00	1.01
People should adopt the Internet	.81*	3.68	1.06
Internet usage [Usage] (.93, .87, .83)[b]			
I use the Internet quite often for personal use	.94*	3.37	1.48
I spend a lot of time on the Internet for personal use	.93*	3.01	1.43
I have been using the Internet for personal use for a very long time now	.87*	3.07	1.46

[a] Scale items were based on five-point Likert-type scales (1="strongly disagree", 5="strongly agree").
[b] Entries in parentheses for constructs are Cronbach' alpha, composite reliability estimate and average variance extracted, respectively.
* $p<.001$.

high and significant standardized loadings for the measures (Anderson and Gerbing, 1988).

Discriminant validity for the measures was supported by a clean exploratory factor analysis and AVE values that, for each construct, were larger than the shared variance with other latent constructs (Fornell and Larcker, 1981) (see Tables 1 and 2a). Finally, we constrained the correlations of every pair of constructs to 1.0 and then conducted a chi-square difference test between the constrained and the unconstrained measurement models, and the results of these tests provide strong evidence for discriminant validity (Anderson and Gerbing, 1988).

5. Analysis and results

The model in Fig. 1 was estimated using LISREL 8.5 (Joreskog and Sörbom, 1996). Reliability for the single item measures was fixed at 85% for age, education and race and at 80% for income. There was a reasonable fit between the model and the observed data ($\chi^2=413.91$, $df=138$, $p\leq.001$; CFI=.96; RMSEA=.06). However, other fit statistics (e.g., SRMR=.11), modification indices and standardized residuals indicated that the fit could be improved substantially. First, we freed a path from age to perceived access barriers. This modification is supported based on existing research showing that (1) age has a direct effect on perceived behavioral control—a construct related to perceived access barriers (Morris and Venkatesh, 2000), and (2) older consumers spend less and save more as they mature (Moschis, 1992). Second, we allowed two sets of residual error terms to correlate and allowed the measurement error terms of education and income to correlate. The model shown in Fig. 1 was estimated using LISREL 8.5 (Joreskog and Sörbom, 1996). The results indicated a good fit between the model and the observed data ($\chi^2=315.99$, $df=134$, $p\leq.001$; CFI=.97; RMSEA=.05; SRMR=.049).

5.1. Explanatory power and hypotheses tests

The model provides good explanation of attitude toward Internet usage and Internet usage (see SMCs indicated in Fig. 1). Also, based on parameter estimates and associated *t*-values, all hypotheses were supported except for Hypotheses 8 and 10, which is discussed below. Thus, we draw two conclusions. First, attitude toward Internet usage is significantly and positively correlated with Internet usage. Second, both perceived ease of use and perceived usefulness are related more strongly to attitude toward Internet usage than is perceived access barriers, based on a comparison of parameter estimates and *t*-values. In sum, the relationships hypothesized by the basic TAM were supported, as were all but two of the hypotheses related to the relationship between the demographic variables and belief variables.

Our hypothesis that perceived usefulness associated with the Internet is lower for individuals who are older (Hypothesis 8) was not supported. Indeed, the implication of Carstensen's (1995) socioemotional selectivity theory on a senior's attitude

Table 2a
Construct intercorrelations and measurement properties for multi-item constructs

	1	2	3	4	5	6	7	8	9
1. Age	1.00								
2. Education	.01	1.00							
3. Income	.20*	.22*	1.00						
4. Race	−.06	−.07	−.20*	1.00					
5. PEOU	−.32*	.16*	.03	.05	1.00				
6. PU	−.20*	.16*	.06	.09**	.52*	1.00			
7. AB	.11*	−.19*	−.24*	.13*	−.26*	−.32*	1.00		
8. Attitude	−.22*	−.23*	.13*	−.06	.57*	.67*	−.36*	1.00	
9. Usage	−.32*	.26*	.15*	−.06	.47*	.47*	−.29*	.59*	1.00

* $p<.01$.
** $p<.05$.

Table 2b
Subgroup composition

Demographic group	Subgroup 1	Subgroup 2
Age[a]		
Definition	Younger	Older
Cutoff	Less than 35 years	50+
Sample size	$n=310$	$n=90$
Education		
Definition	Less educated	More educated
Cutoff	Some college or below	College or above
Sample size	$n=293$	$n=246$
Income		
Definition	Lower income	Higher income
Cutoff	Below $40 k	$60 k or above
Sample size	$n=227$	$n=210$
Race[b]		
Definition	Black/Hispanic	White/Asian
Cutoff	Black or Hispanic	White or Asian
Sample size	$n=155$	$n=384$

[a] Respondents aged 36–50 were omitted from the analysis.
[b] Respondents with income level of $41–60 thousand/year were omitted from the analysis.

toward using the Internet is ambiguous. Our initial interpretation of the theory suggested that seniors who only want to keep in close contact with a few loved ones would perceive the Internet as less useful because they viewed it primarily as a tool that facilitates communication with a large network of individuals. Yet, another interpretation of the theory could suggest that seniors with fewer social connections see the Internet as a useful way of maintaining close relationships with a few loved ones via email, particularly if their loved ones are geographically dispersed and active Internet users.

Our hypothesis that perceived usefulness associated with the Internet is lower for Hispanic-Americans and African-Americans (Hypothesis 10) was not supported. Indeed, 87% of our minority respondents agreed with the statement, "Overall, the Internet is useful." This finding counters Stanley's (2003) suggestion that an individual's perceived utility or relevance of a technology is lower merely because members of their social network do not tend to use the technology.

6. Post hoc analysis

We conducted a post hoc analysis in order to (1) better understand the relationship between demographic variables and the basic TAM, (2) better understand how well our extended TAM explains Internet usage across key demographic groups and (3) understand the effects of the hypothesized belief variables in the model. We created eight subgroup sample data sets (two within each demographic category) to facilitate these tests (see Table 2b). Because our main study findings for both age and income were most significant for these variables, we omitted from the analysis respondents aged 36–50 and respondents with income levels between $41 and $60 thousand/year, in order to provide for a stronger test.

A central premise of this study is that consumer perceptions about the Internet vary based on demographic variables. Indeed, mean difference tests showed that (1) older and less educated individuals have lower perceived ease of use, (2) lower income individuals and Blacks/Hispanics perceive the Internet as more costly and (3) older individuals perceive more access barriers associated with the Internet. Furthermore, these tests showed that both attitude toward Internet usage and Internet usage vary significantly based on age, education and income, but not for race.

6.1. Multi-sample tests of structural parameters

Multi-sample analyses were conducted to understand whether the demographic variables are external to the TAM (i.e., have only direct effects on the belief variables) or whether they moderate the relationships in the TAM. We conducted two-group multi-sample analyses, one for each of the four demographic variables. Thus, the same eight subgroups that were used to conduct the mean difference tests were used to conduct the multi-group analyses.

The multi-sample model (which excluded only the demographic variables shown in Fig. 1) achieved good to excellent fit in each of the eight subgroups (e.g., CFI ranges from .97 to .98 across the subgroups). Furthermore, the model explains a substantive percentage of the variance in both attitude toward Internet usage (ranging from .59 to .70) and usage (ranging from .31 to .48), across the eight subgroups. This preliminary result provides further support that the TAM (including perceived access barriers) fits the data, not only in the overall sample, but in the demographic-based subsamples.

Multi-sample tests of structural model invariance showed no significant differences (at $p<.05$ level) in parameter estimates, based on chi-squared difference tests. Since we also found full metric invariance in the subgroups based on age and race, and partial metric invariance in the subgroups based on education and income, we concluded that interpretation of multi-sample tests of structural invariance would be valid. Indeed, the results of the multi-sample analysis, along with results from the main analysis, suggest that demographic variables are not moderators, supporting our hypotheses that demographic variables affect attitudes as mediated by the belief variables.

Furthermore, examining the relative parameter size and significance across specific subgroups revealed that in the older, less educated and lower income subgroups, perceived ease of use and perceived usefulness have a more significant effect on attitude toward Internet usage than perceived access barriers. This finding is consistent with findings from the main analysis and provides additional support for our contention that perceived access barriers is not a sufficient explanatory variable in our extended TAM, when perceived ease of use and perceived usefulness are considered.

6.2. Additional tests of mediation

We tested the direct, indirect and mediating effects of perceived ease of use, perceived usefulness and perceived access

barriers in the model. Our findings showed that perceived ease of use, perceived usefulness and perceived access barriers are substantive mediators. In order to conduct the test, we added direct paths from age, education, income and race, respectively, to attitude toward Internet usage (to the model depicted in Fig. 1) and tested using LISREL 8.5 (Joreskog and Sörbom, 1996). In the presence of the indirect paths through the TAM belief constructs, each of the direct paths from age, education and income, respectively, to attitude toward Internet usage were insignificant (based on parameter estimates and associated *t*-values). Furthermore, because age, education and income are directly and significantly associated with attitude when tested in a multiple regression model, we conclude that perceived ease of use, perceived usefulness and perceived access barriers have the full mediating effects proposed in the model, for each of these demographic variables.

With both direct and indirect paths in the model, the parameter estimate and associated *t*-value for the direct path involving race and attitude toward Internet usage was −.10 (*t*-value=−2.93). Since the relationship between race and perceived access barriers (Hypothesis 12) and between perceived access barriers and attitude toward Internet usage (Hypothesis 2) remained significant in the less constrained model, we conclude that perceived access barriers is, at least, a significant partial mediator (not a full mediator) of the relationship between race and attitude toward Internet usage.

7. Summary and contributions

So, why do older, less educated, minority and lower income individuals have lower Internet usage rates than those of younger, highly educated, white and wealthier individuals? We found that age, education, income and race are associated differentially with certain beliefs about the Internet, and that these beliefs mediate consumer attitudes toward and, ultimately, use of the Internet. Indeed, while perceived access barriers had a significantly negative effect on attitude, the effect of perceived ease of use and perceived usefulness on attitude was greater.

Our findings make several theoretical contributions. First, we extended the basic TAM by adding (a) perceived access barriers as third belief about a technology that explains a consumer's attitude toward technology and (b) demographic variables as external variables, due to their importance in the context of Internet use. We found that the three belief variables of our extended TAM (1) are differentially relevant to various demographic types and (2) mediate the relationships between demographic variables and attitude toward the Internet. Furthermore, we found that demographic variables are external to, rather than moderators of, our extended TAM.

In sum, our study not only confirms the theoretical importance of perceived ease of use and perceived usefulness in the basic TAM, but also demonstrates that, in the context of Internet use (1) other beliefs (i.e., perceived access barriers) can significantly influence consumer attitudes and (2) particular beliefs about a technology differently affect consumers representing diverse segments of the population. Indeed, it is important to understand the effect of context on theories of technology use (Olikowski and Iacono, 2001).

Our findings also make practical contributions for managers. As stated earlier, encouraging older, minority, less educated and lower income consumers to use the Internet makes good business sense. Internet use is a necessary precursor to ecommerce, and many firms focus their marketing resources on a particular demographic segment in order to build profitable, long-term relationships with consumers. However, while previous data showed clear usage differences across demographic groups, our findings explain *which perception*s matter to *which demographic groups*. From this perspective, our extended TAM can be used to develop segment-specific strategies that also align with a firm's internal capabilities.

For example, our data suggest that firms should not allocate resources on promotional efforts to educate older consumers about the usefulness of the Internet. Our findings indicate that older consumers understand the relevance of the Internet to their lives but, unfortunately, perceive the Internet as difficult to use and costly. Thus, our findings encourage marketers to focus on changing these perceptions by considering the following strategies:

- Developing access tools based on familiar devices (e.g., web-enabled televisions) because continuous innovations face less resistance by consumers
- Developing training programs that help older consumers overcome psychological barriers associated with Internet use (e.g., "learn at your own pace" training programs delivered by older individuals with whom older trainees can identify)
- Reducing the price of Internet access, particularly for broadband access
  - Seventy-two percent of online seniors use dial-up connections (Fox, 2004), but older consumers likely need broadband access to view family photos or streaming video.

Indeed, given that older consumers might already appreciate the potential usefulness of the Internet, if marketers are successful in getting older consumers to overcome perceptions about difficulty and cost, older consumers might migrate toward more traditional Internet access tools (e.g., personal computers) and more costly forms of access (e.g., broadband) because positive experiences would have reinforced the relative value of using the Internet.

Also, while cost appears to concern older and minority consumers, our data indicate that lower income consumers are the consumers who are most concerned about cost. Thus, our findings suggest that firms continue to support efforts to change perceptions about the affordability of the Internet. These efforts could be based on conceptualizations of cost that extend beyond absolute price. Indeed, cost could be related to a lower income consumer's fear of investing in technology that quickly becomes obsolete (Venkatesh and Brown, 2001), or their perception that cost is high relative to perceived usefulness. Furthermore, our data show that lower income users do not perceive the Internet as useful. Thus, our findings encourage firms to allocate resources

toward changing these perceptions of lower income consumers by

- Using promotions to educate lower income consumers about how the Internet is relevant to their goals (e.g., job searching, finding lower-priced goods)
  - Engaging lower income individuals in viral marketing programs
- Developing trade-in/up-grade plans to reduce fears of loss due to obsolescence
- Enhancing Internet capabilities for devices already owned by lower income consumers eliminating the need to buy new tools (e.g., wireless phone)
- Devising pricing plans that encourage trial access and time to understand/appreciate usefulness

Finally, our findings have meaningful implications for policymakers who are motivated to encourage consumers to use the Internet to enhance their opportunities for personal (e.g., dignity associated with self-efficacy and improved self-concept), economic (e.g., consumer choice) and social (e.g., political participation) benefit. To a large extent, government institutions have focused on subsidizing the cost of Internet access mainly for minorities and lower income groups. Our findings about race are consistent with recent reports that suggest that Internet usage differences are not defined by race (Rainie and Packel, 2001). Indeed, our findings encourage policymakers to broaden the scope of their efforts to include systemic investments such as continuing efforts to fight poverty, eradicate illiteracy and improve the quality and accessibility of higher education, particularly since our data reveal that systemic issues such as low income and education levels could have negative affects on consumer attitudes toward Internet use.

Finally, managers and policymakers are not restricted to using our extended TAM to pursue segment-specific strategies. Indeed, the elegance of the TAM is that the mediating effect of belief variables suggests that there is nothing so critical about the external variables, such as demographics, that directly effect attitude or usage (Agarwal and Prasad, 1999). This finding gives commercial and public institutions the freedom to pursue strategies to increase Internet usage that are independent of a consumer's particular demographic profile. Such a mass-market approach to influencing Internet use might be an attractive alternative for firms that specialize in particular capabilities that could favorably affect particular beliefs, but that are not focused on serving specific demographic segments of the population. For example, a technology firm that develops cheaper and faster broadband technology effectively could impact each of the three belief variables in the extended TAM, for all demographic segments.

8. Limitations and directions for future research

In this study we measured chronological age. However, age could be measured cognitively or biologically given the physical decrements that occur with aging such as arthritis, deteriorating eyesight etc (Barak and Schiffman, 1981). Also, the scale measuring perceived access barriers has only two items because several items were eliminated through purification and later refinements to the measurement model.

Also, regarding the race variable, Hispanic-Americans and African-Americans were grouped in the analysis as were Asian-Americans and Whites/Caucasians, consistent with data regarding the Internet usage by ethnic/racial category. However, we replicated the analysis using a subset of cases ($n=468$) that represented only White/Caucasians and African-Americans and the results showed that the model had identical fit statistics, and substantively similar parameter estimates (and associated t-values) as the model including the total 539 cases. Thus, we feel that the dichotomization of our race variable had minimal impact on the validity of our findings.

Regarding future extension to the TAM, researchers should conduct studies that explore the role of other belief or trait variables that could differentially impact members of various demographic segments (e.g., online security risk). Furthermore, with regard to Internet usage, although we operationalized Internet usage as "personal use", the Internet serves a variety of purposes for consumers including, communication, entertainment, information and socializing. In the future, researchers should investigate the impact of an individual's personal goals on their use of the Internet.

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