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Google Chrome and the Paradigm Shifts in the Browser Market Among Users

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Abstract

In November 2011, Google's Chrome browser became the second most popular browser worldwide, surpassing Mozilla Firefox for the first time. This study investigates the perspective of users using two methodologies. First, a focus group was interviewed regarding factors influencing their decision to use specific Internet browsers. Second, a survey was constructed and administered based on the information gathered from the focus group, recent studies noting influence of the 'affect' construct in decision-making, and Ajzen's recommendations for the Theory of Planned Behavior. The results of data analysis suggest Attitude, Perceived Behavioral Control, and Affect positively and significantly influence a user's intention to use the Chrome browser. Implications are discussed.

Keywords: Google Chrome, Theory of Planned Behavior, Behavioral Intention, Affect

1. INTRODUCTION

The widespread adoption and use of mobile computing devices (e.g., smart phones, tablet computers, etc.) and increased expectations among users (e.g., ubiquitous, processor intensive computing) are driving paradigm shifts among users. The solution is pushing processor intensive operations to servers and utilizing web applications through browsers to display the results. Traditional browsers were not originally developed to support web applications. Consequently, as this paradigm shift began, running web applications on traditional browsers proved to be problematic. Given these issues, developers at Google began developing a new browser designed specifically for seamless operation with web applications.

In September 2008, approximately 2 years after development began, Google introduced their Chrome browser to the public. Since its initial release, the popularity of the Chrome browser has increased exponentially. In November 2011, Chrome became the second most popular web browser worldwide (StatCounter.com). So why has the Google Chrome browser captured such a large share of the browser market in just over three years after its initial release? This research study attempts to answer this question.

To date, no known study has examined the factors influencing individual users to choose Chrome over other popular web browsers. The purpose of this research study is to use both qualitative and quantitative methods to

investigate the factors influencing individuals to use Google Chrome.

This paper is organized into several sections, beginning with the Literature Review section, which provides background information about Google Chrome and competing browsers. This section also includes the theory behind our paper, followed by the Hypotheses. The next section is Methodology, which describes our approach in collecting both interview and survey data for this study. In the findings section, we provide the results from our correlation and hierarchical regression analyses. We provide the implications of our findings in the Discussion section, which is followed by the Conclusion section.

2. LITERATURE REVIEW

Google Releases the Chrome Browser

Google introduced an Internet browsing platform named Chrome on September 9, 2008 (Perry, 2008). The initial launch, included 43 languages and 122 countries (Green, 2008), which is quite an extensive launch for a completely new browser. Many experts reported the Chrome browser to be the most significant change since Microsoft launched Internet Explorer (IE) to compete with Netscape (Rapoza, 2008).

Google's Overall Goal in Launching the Google Chrome Browser

In contrast to traditional browsers designed for simply viewing web pages, the Chrome browser was developed as part of Google's web application platform. This is what made the Chrome browser unique. Google's engineers were often crashing traditional browsers while working on web applications such as Gmail and YouTube. To overcome these problems, the development of a browser application for internal use began approximately two years before it was released to the public (Green, 2008).

Google's goal in the development and release of the Chrome browser was "to change the nature of Internet browsing and the way we use computers" (Green, 2008). This follows Google's overall "Cloud Computing" initiatives with the ultimate goal of moving computing from the desktop toward data centers ("Chrome Wars," 2009). Google offers their Chrome browser to the public free of charge on an open-source

development platform utilizing Apple's Web Kit and some of the best parts of Mozilla's Firefox and other browsers (Perry, 2008).

Features of Chrome

One of the best features of the Google Chrome browser is security. Chrome includes the use of sandboxing to limit the amount of damage caused by malicious software, automation of browser updates, and a variety of technical strategies for protecting against malware (Reis, Barth, & Pizano, 2009). Chrome received much praise and publicity from experts for incorporating security into the core underlying development (Ashford, 2008a, 2008b; "Google Chrome -- an essential guide," 2008; Reis, et al., 2009). However, recent reports have pointed out security vulnerabilities in Google Chrome (Brinkmann, 2011) and its operating system extensions (Finkle, 2011).

Other advantages of the Chrome browser include speed and improved user interaction. Chrome was developed with a focus on running web applications and supporting cloud computing. This resulted in a faster and more stable browsing experience (Ashford, 2008b; Reid, 2008; Schenker, 2008). Chrome also offers a streamlined user interface with less tool bars, menus, and includes multipurpose areas for entering both web addresses and search terms. This increases the amount of real estate on the screen dedicated to viewing web sites on the Internet (Gibbs, 2008; "Google Chrome -- an essential guide," 2008; Gray, 2009; Reid, 2008). Google Chrome is also the first browser capable of language translation without requiring plug-ins or extensions ("Google Chrome Features", 2011).

Publicity, Marketing, and Advertising

The launch of the Chrome Browser included another initiation for Google – television advertisements. A series of promotional videos for the Chrome browser were created in-house by Google in Japan. These promotional videos became extremely popular after they were made available on YouTube, and given the popularity of the videos, Google decided to promote the Chrome browser with 30-second television ads (Morrissey, 2009). Google's television promotion continued in 2011 with a campaign created with the ad agency Bartle Bogle Hegarty (Cain Miller, 2011). However, this campaign focused on the

overall mission of Google with more subtle references to the Chrome Browser.

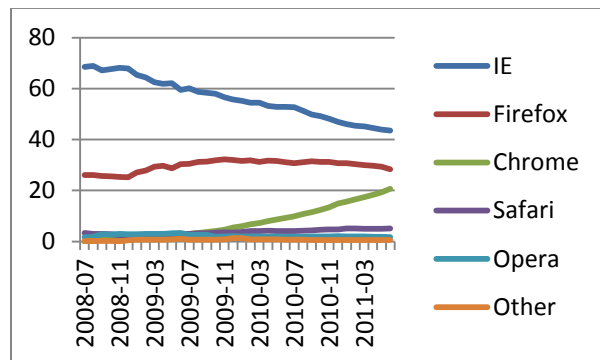
Browser Market Share

Google’s overall goal is to push the market leaders to adopt and support web based applications and cloud computing initiatives ("Chrome Wars," 2009; Claburn, 2010; "Google Chrome OS to Boot PC Within 7 Seconds," 2009; Green, 2008). The popularity and general acceptance of each application Google releases help promote future web applications and tools released by Google.

Both in the United States (see Figure 1) and worldwide (see Figure 2), the Chrome Browser has steadily increased its market share since it was first released on September 9, 2008 (StatCounter.com). Worldwide, Google Chrome surpassed Safari and Opera becoming the third most popular web browser in August of 2009 with 3.38% of the market following Mozilla Firefox (31.28%) and Microsoft IE (58.69%). In the United States, Google Chrome surpassed Safari and Opera becoming the third most popular web browser in November of 2010 with 10.89% of the market following Mozilla Firefox (26.75%) and Microsoft IE (50.24%).

According to StatCounter.com, the most recent data available from November 2011 indicates Google’s Chrome browser has become the second most popular browser worldwide (25.49%) and remains the third most popular browser in the United States (17.3%).

Figure 1: Percent Usage of Top 5 Browsers Worldwide



Theory of Planned Behavior

The Theory of Planned Behavior (Ajzen, 1991) can be used to examine the factors that

influence an individual’s decision to use Google Chrome. This theory uses three constructs to predict Behavioral Intention: Attitude towards the Behavior, Subjective Norms, and Perceived Behavioral Control. Behavioral Intention has been shown to be a strong predictor of actual behavior, which is difficult to measure in some domains. Attitude towards the behavior is defined as the degree to which a person has a favorable or unfavorable evaluation of the behavior in question (Ajzen, 1991). Attitude examines a person’s beliefs concerning a behavior of interest. Subjective Norm refers to the person’s perception of the social pressures to perform or not perform the behavior (Ajzen, 1991). Perceived Behavioral Control deals with the perceived ease or difficulty of performing the behavior (Ajzen, 1991). The Theory of Planned Behavior (TPB) expands a previous theory, the Theory of Reasoned Action (Fishbein and Ajzen, 1975), by including Perceived Behavioral Control as a third predictor of Behavioral Intention. The TPB is illustrated in Figure 3.

Figure 2: Percent Usage of Top 5 Browsers in the United States

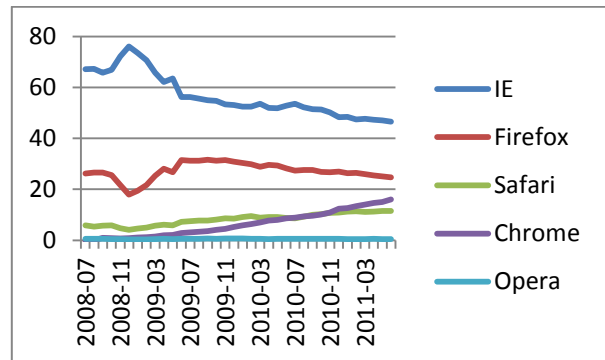
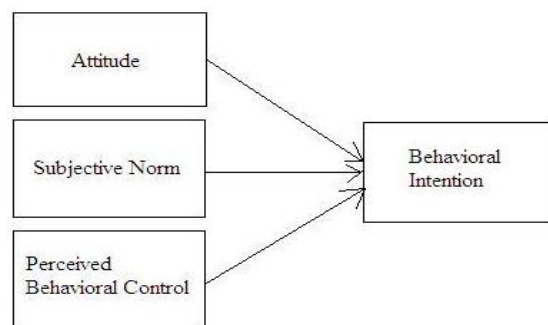


Figure 3: Theory of Planned Behavior (after Ajzen, 1991)



Ajzen (2001) has acknowledged that the TPB does not directly measure a person’s feelings or

emotions about a behavior of interest. Therefore, we have included an additional construct, Affect, as a fourth predictor of Behavioral Intention in order to determine whether feelings significantly influence the usage of Google Chrome.

3. HYPOTHESES

Hypothesis 1: Attitude toward the Behavior is significantly and positively correlated with the intent to use Google Chrome.

Hypothesis 2: Subjective Norm is significantly and positively correlated with the intent to use Google Chrome.

Hypothesis 3: Perceived Behavioral Control is significantly and positively correlated with the intent to use Google Chrome.

Hypothesis 4: Affect is significantly and positively correlated with the intent to use Google Chrome.

4. METHODOLOGY

We integrated both qualitative and quantitative approaches to capture data for this study. First, we asked for twelve volunteers from our classes to participate in short interviews. The purpose of the interviews was to elicit background information from students concerning their usage of Internet browsers such as Google Chrome. These interviews were open-ended in order to allow students to elaborate on reasons why they may or may not use specific Internet browsers.

We then used the interview responses to guide the construction of the survey instrument. Our survey followed Ajzen's suggestions (Ajzen, 2001) for using the Theory of Planned Behavior. We also included questions to measure the Affect construct. 149 students taking a required course for all College of Business majors at our university were asked to participate in our survey. 133 students began the survey; 131 completed it. Near the beginning of the survey, we asked students whether they had heard of Google Chrome before today. After removing the incomplete responses and the data for those students who had not previously heard of Google Chrome, we ended up with a sample size of 115.

Measures

Attitude

A direct measure of Attitude toward using Google Chrome was measured with three statements. (ATT1) Using Google Chrome is a good idea, (ATT2) Using Google Chrome is a positive idea, and (ATT3) Using Google Chrome is a helpful idea.

Subjective Norm

We used three statements to measure the construct of Subjective Norm: (SN1) My professors influence me in my decision whether to use Google Chrome, (SN2) My friends influence me in my decision whether to use Google Chrome, and (SN3) Other people important to me influence me in my decision whether to use Google Chrome.

Perceived Behavioral Control

Four statements were used to measure Perceived Behavioral Control: (PBC1) I have the ability to use Google Chrome, (PBC2) I possess enough knowledge to use Google Chrome, (PBC3) I have the resources to use Google Chrome, and (PBC4) I have the time to use Google Chrome.

Affect

We measured Affect using four statements: (AFF1) I would love/hate to use Google Chrome, (AFF2) I would be excited about/be bored using Google Chrome, (AFF3) I would be happy/unhappy using Google Chrome, and (AFF4) I would be relaxed/stressed using Google Chrome.

Behavioral Intention

To measure Behavioral Intention, we used three statements: (BI1) I intend to use Google Chrome in the next three months, (BI2) I plan to use Google Chrome in the next three months, and (BI3) I anticipate I will use Google Chrome in the next three months. Respondents replied using a seven-point scale ranging from Strongly Agree to Strongly Disagree.

Listed below in Table 1 are the results for Cronbach Alpha for each construct. Each construct is acceptable as the Cronbach Alpha is greater than .70 for each as recommended by Santos (1999).

Table 1: Cronbach Alpha for each Construct

Construct	Value
Attitude	.975*
Subjective Norm	.822*
Perceived Behavioral Control	.877*
Affect	.851*
Behavioral Intention	.986*

Demographics

Undergraduates at a large southeastern university were recruited as participants for this study. A total of 115 participants (62.6% males and 37.4% females) completed the research survey and indicated they had heard of Google Chrome prior to participating in the research study. At least 80% of the participants were business majors (23.5% Computer Information Systems, 22.6% Undecided, 11.3% Accounting, 9.6% Management, 8.7% Marketing, 7.0% Healthcare Management, and each of the remaining majors represented less than 5.0% of the sample).

Table 2: Count of Gender Versus Major

Major	Male	Female	All
Accounting	8	5	13
CIS	23	4	27
Economics	2	1	3
Entrepreneurship	3	0	3
Finance & Banking	3	2	5
Healthcare Mgmt.	3	5	8
H & T Mgmt.	1	3	4
Int'l Business	3	1	4
Management	9	2	11
Marketing	4	6	10
Undecided	13	13	26
Other	0	1	1
Grand Total	72	43	115

Table 3: Percentage of Gender Versus Major

Major	% M	% F	% All
Accounting	7.0	4.3	11.3
CIS	20.0	3.5	23.5
Economics	1.7	0.9	2.6
Entrepreneurship	2.6	0.0	2.6
Finance & Banking	2.6	1.7	4.3
Healthcare Mgmt.	2.6	4.3	7.0
H & T Mgmt.	0.9	2.6	3.5
Int'l Business	2.6	0.9	3.5
Management	7.8	1.7	9.6
Marketing	3.5	5.2	8.7
Undecided	11.3	11.3	22.6
Other	0.0	0.9	0.9
Grand Total	62.6	37.4	100.0

Table 4: Class Distribution by Gender

	Male	Female	All
Freshman	0	0	0
Sophomore	1	2	3
Junior	40	26	66
Senior	31	15	46
Grand Total	72	43	115

Table 5: Class Distribution by Gender

	% M	% F	% All
Freshman	0.0	0.0	0.0
Sophomore	0.9	1.7	2.6
Junior	34.8	22.6	57.4
Senior	27.0	13.0	40.0
Total %	62.6	37.4	100.0

5. FINDINGS

We used hierarchical regression in this study since it allows for specification of the order of entry of the variables based upon theory and previous studies. This approach also let us observe the change in R^2 as we entered each independent variable into the model. This allowed us to see whether additional variables are significant as they are entered into the equation.

We imported the survey data from SurveyMonkey, analyzing it in Excel 2010 and SPSS 17.0. The following tables provide the

results from the correlation analysis and hierarchical regression analysis.

Table 6: Correlation Matrix

	ATT	SN	PBC	AFF
BI	.730*	.142	.357*	.798*
ATT		.306*	.260*	.784*
SN			.107	.251*
PBC				.241*

ATT - Attitude; SN - Subjective Norm; PBC - Perceived Behavioral Control; AFF - Affect

* Correlation is significant at the 0.01 level

Table 7: Hierarchical Regression Analysis

Predictors (Constants)	R	Adjusted R ²	Sig. F Change
ATT	.730	.529	.000
ATT, SN	.730	.525	.765
ATT, SN, PBC	.751	.552	.007
ATT, SN, PBC, AFF	.817	.655	.000

(Dependent Variable = Behavioral Intention)

ATT - Attitude; SN - Subjective Norm; PBC - Perceived Behavioral Control; AFF - Affect

We tested for autocorrelation using the Durbin-Watson test. The results ($d = 1.814$) fell within the expected range of 1.5 - 2.5 (Tabachnick and Fidell, 2000).

Hypothesis 1 is supported. The correlation between Attitude and Behavioral Intention = +.730. Attitude was entered first into the hierarchical regression equation and explained 52.9% of the variance in Behavioral Intention. It is therefore concluded that Attitude is significantly and positively correlated with the intent of students to use Google Chrome.

Hypothesis 2 is NOT supported. The correlation between Subjective Norm and Behavioral Intention = +.142, which is not significant. Subjective Norm was entered second into the hierarchical regression equation and the total variance in intentions explained did not increase. Therefore, we conclude that Subjective

Norm is NOT significantly and positively correlated with the intent of students to use Google Chrome.

Hypothesis 3 is supported. The correlation between Perceived Behavioral Control and Behavioral Intention = +.357. Perceived Behavioral Control was entered third into the hierarchical regression equation and the total variance in intentions explained increased to 55.2%. Therefore, we conclude that Perceived Behavioral Control is significantly and positively correlated with the intent of students to use Google Chrome.

Hypothesis 4 is supported. The correlation between Affect and Behavioral Intention is +.798. Affect was entered in last into the hierarchical regression equation and the total variance in Behavioral Intention explained increased to 65.5%. Therefore, we conclude that Affect is significantly and positively correlated with the intent of students to use Google Chrome.

6. DISCUSSION

The findings initially seem surprising considering the strong support in the literature indicating a significant relationship between subjective norm and behavioral intentions. However, in this study the results may be an indication of a unique relationship between Google's Chrome browser and its users. In this study "affect" relates to an individual's emotional response towards an information technology artifact namely the Chrome Browser. So, influential others (subjective norm) could be of lesser importance than a user's emotional response toward the Chrome Browser.

"Affect" as it relates to emotions attached to an IT artifact measures sentiment. Sentiments are properties or attributes assigned to an object or class of objects, which are generalizations formed through direct experience or through social learning (Frijda 1994). Sentiments are judged by bringing an object to mind and observing the affective reaction (Clore 1994).

Sentiments can persist indefinitely, while emotions and moods are fleeting (i.e., lasting minutes, hours, or days), (Frijda 1994). Therefore, an individual's sentiment towards interacting with an object will motivate them to either seek or avoid opportunities to interact with that object (Brave and Nass 2003). For example, if a computer user says using browser

XYZ is frustrating because it often crashes while accessing web applications, they are essentially stating that through past experience or social learning they have come to expect that interactions with browser XYZ will result in a negative emotional state. As a result of this sentiment, the computer user will likely choose to avoid opportunities to interact with browser XYZ. This is actually the exact scenario which led Google to begin development of a web browser oriented toward the use of web applications (Green, 2008).

Also, events associated with negative emotion tend to be highly arousing, and tend to be remembered better than events associated with positive emotions (Newhagen and Reeves 1991; Reeves, Newhagen et al. 1991; Newhagen and Reeves 1992; Reeves and Nass 1998). Therefore, users may have a strong positive sentiment toward using Google's Chrome browser and/or a strong negative sentiment toward other browsers that often crash while interacting with a web based application.

Web based applications include Google Chrome, Gmail, Google Docs, Facebook, Twitter, and many more popular applications often accessed and utilized on a daily basis. Social sites such as Facebook can also elicit strong emotional responses or sentiments through social interaction. Given Chrome's reported superiority (Green, 2008) in running web applications this could also increase positive sentiments toward the Chrome browser.

Given the highly advertised security features designed into the core of the Chrome browser users may also have a positive sentiment towards using Chrome because it makes them feel safer than other browsers.

7. LIMITATIONS

It is important to note several limitations which could have biased the results of this research study. First, the data collected from the survey instrument is self-reported data. This data relies on the accuracy of the participants' perceptions of their own behavior and behavioral intentions rather.

Second, there is strong evidence within the research literature indicating that behavioral intention is a reliable predictor of actual behavior (Ajzen, 1991; Ajzen 2001; Fishbein and Ajzen, 1975). However, actual behavior could

potentially vary from self-reported behavioral intentions.

Lastly, the use of students as surrogates in social science research is a controversial issue and has often been debated within the IS research literature. Burnette and Dunne (1986) suggest that students should only be used as subjects when they represent the subject of interest. Bass and Firestone (1980) note that research findings which are not widely generalizable beyond a specific population, can provide evidence of causal relationships and testable hypotheses that can be extended to other subject populations. Despite the controversy, previous social science research seems to indicate that it is suitable to use students as surrogates when the participants' skills and experiences are considered appropriate for an experimental task (Chi and Glaser 1985; Hughes and Gibson 1991). Undergraduates are required to use web browsers extensively for various tasks related to coursework. Therefore, the participants seem suitable as research subject for this research study.

The participants in this study are undergraduate students from a medium sized southeastern university, and consequently they represent a relatively homogenous demographic group. Therefore, it should be noted that the homogeneous nature of the research subjects may limit the generalizability of the results.

8. CONCLUSION

Google Chrome has quickly become one of the most popular Internet browsers since its release in September 2008. The results of this study provides evidence suggesting two of the three independent factors shown to influence behavioral intention within the Theory of Planned Behavior (Attitude and Perceived Behavioral Control) are significantly and positively correlated with a person's intentions to use the Google Chrome Browser. We found that Subjective Norm is not significantly correlated with Behavioral Intention in this domain. However, our findings indicate that Affect, a construct not measured in the Theory of Planned Behavior, significantly influences intention. Future research in this area should further examine the role of Affect since it was a significant predictor in this study.

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