1. INTRODUCTION

Programming is an inherently complex task; the ability to design and implement computer applications relies on an understanding of software engineering concepts and skills, as well as their application within specific programming languages. This continues to be true as we move towards the World Wide Web as a platform for new forms of computer software. Throughout this book you will find examples of end-user programming on the web. Recently there has been an upsurge of research interest in mashups – a web application that combines multiple data sources and presentations into one interface. From an end user programming (EUP) perspective, mashups provide users with the opportunity to integrate and assimilate many different web resources into a personalized view, and allows users to help themselves.

However, because of the relatively complex programming methods needed to create a mashup, more nonprogrammers and novice users are left out. Numerous tools have been created and studied that attempt to help these naïve end users to create these advanced web applications (see Chapter X and Y), however there is still much to learn about the users. There is the idea of "if we build it, they will come" that is prevalent when developing end user tools, but we should more carefully examine the question "if we build it, why will they come?" For mashups, what would users want out of a tool? How do they think about mashups in general? Moreover, what motivates or would motivate end users to create mashups?

2. WHO ARE MASHUP DEVELOPERS?

To better understand current activities surround mashups we must first understand the status quo. Who are the developers that currently creating mashups? Why do they create the mashups?

We surveyed developers from various online communities were we expected those who were interested in mashups to be active. In total, we were able to post a link to our survey on 15 forums including popular ones such as Google Maps API and Flickr API, as well as more general forums like DaniWeb.

We included questions regarding general web development as well with questions specifically dealing with mashup development. We were also concerned with how mashups developers discovered mashups and proceeded to learn how to create them. Finally, from our own general experience as developers, we speculated that developers would rely primarily on online information resources for help when developing, so we also probed their experiences with API documentation.

At the end of the survey period we had gathered a total of 63 responses. As with any survey, the number of responses (N) for individual questions varied because not every participant responded to every question. Roughly half the questions were presented only to developers who had responded earlier that they had created at least one mashup. To simplify the discussion of data presented here, we report results in terms of percentages, where the value of N varies from 24 to 63.

Characteristic	Distribution	
Gender (N=54)	Male: 88.9% Female: 11.1%	
Age (N=53)	18-23: 18.9% 24-29: 22.6% 30-35: 22.7%	36-41: 22.6% >41: 13.2%
Education (N=53)	High School: 30.2% College: 41.5%	Masters: 13.2% Doctorate: 5.7%
Occupation (N=53)	Software Dev.: 34% Contractor: 18.9%	Student: 13.2% Consultant: 7.5%

Table 1: Expert developer demographics, including those who did and did not report having created at least one web mashup.

Of the 63 respondents, 31 reported that they had created mashups before. The average overall age is 33 years; 88.9% were male, and 53% had at least a university degree (see Table 1 for summary of respondents' demographics). Out of the 31 participants who had created mashups, all were male, the average age was 34 years, and 76% had university degrees or higher. The developers varied considerably in their experiences with different web technologies, but as one would expect mashup developers reported more exposure to advanced programming activities (e.g. "Programming desktop applications", "programmed using web-based API"). This suggests that the individuals who have learned about mashup development are those who are actively involved in web programming.

To help us quantify participants' technical skills, we asked them how often they use a range of web technologies and tools. Over half of the respondents reported that they use web scripting and programming languages frequently or daily, but the majority of them rarely or never develop desktop applications or use web-based APIs. We found this to be interesting because most mashups require the use of APIs. It is possible that while the developers answering our questions are regular participants in general web development activities, that mashup development is not a common task.

When examining mashup developers separately, we observed a clear difference in programming activities. Specifically, mashup developers have more exposure to developing desktop applications, they are more likely to have used web-based APIs, but they are slightly less likely to have programmed using web-based languages like PHP and ASP. Table 3 represents the respondents who reported they participate in each of the activities frequently or daily.

	All Developers (N=61)	Mashup Developers (N=30)
Use a web page editor	54.4%	58.6%
Use HTML/XHTML only	56.9%	57.1%
Use CSS	71.5%	78.6%
Use web programming language (PHP, ASP, etc)	75.0%	73.4%
Program Desktop Applications	32.8%	44.8%
Programmed using web-based API	28.1%	50.0%

Table 2. Frequent programming activities for expert developers

The developers reported that they create mapping mashups most often and they identify the Google Maps API as the most frequently used API. These results are consistent with reports from ProgrammableWeb (http://programableweb.com), a website that tracks mashups, confirming that our survey results closely match widespread trends. A breakdown of the types of mashups created and the APIs used to create them is displayed in Figure 1.

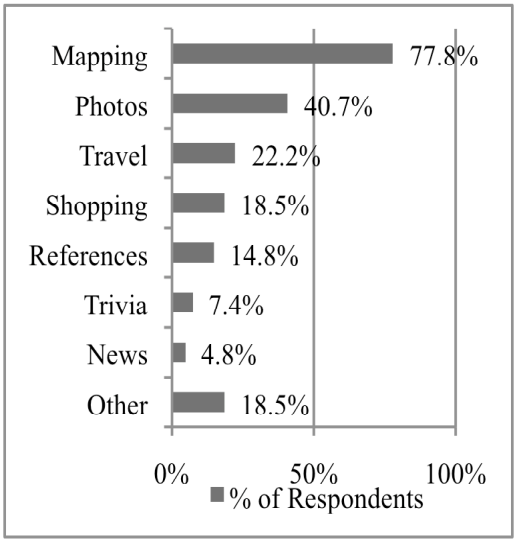

Figure 1a. Types of mashups created

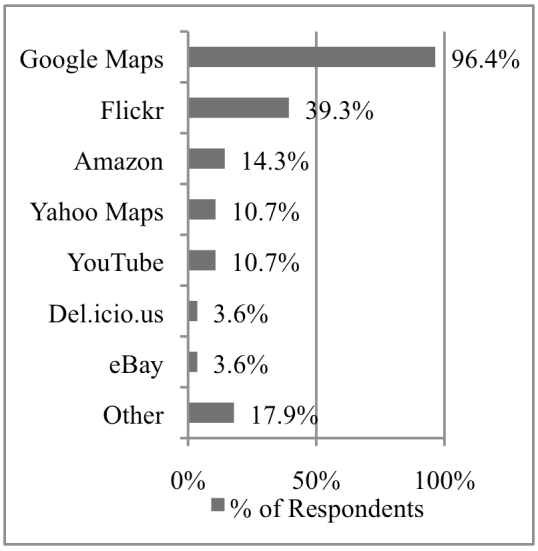

Figure 1b. APIs used in development

We also examined the tools that experts use to develop mashups. Are there any specialized software tools used specifically for mashup development? It is logical to assume that that popular web development tools like Dreamweaver would be used, but with the complex nature of mashups we hypothesized that these tasks may require specialized domain-specific tools. We directly asked the participants to "list the tools you use when developing web applications." The results, summarized in Figure 2, show that indeed most developers use Dreamweaver and text editors with code completion features, but that many also used more advanced and customizable programming environments like Microsoft Visual Studio and Eclipse.

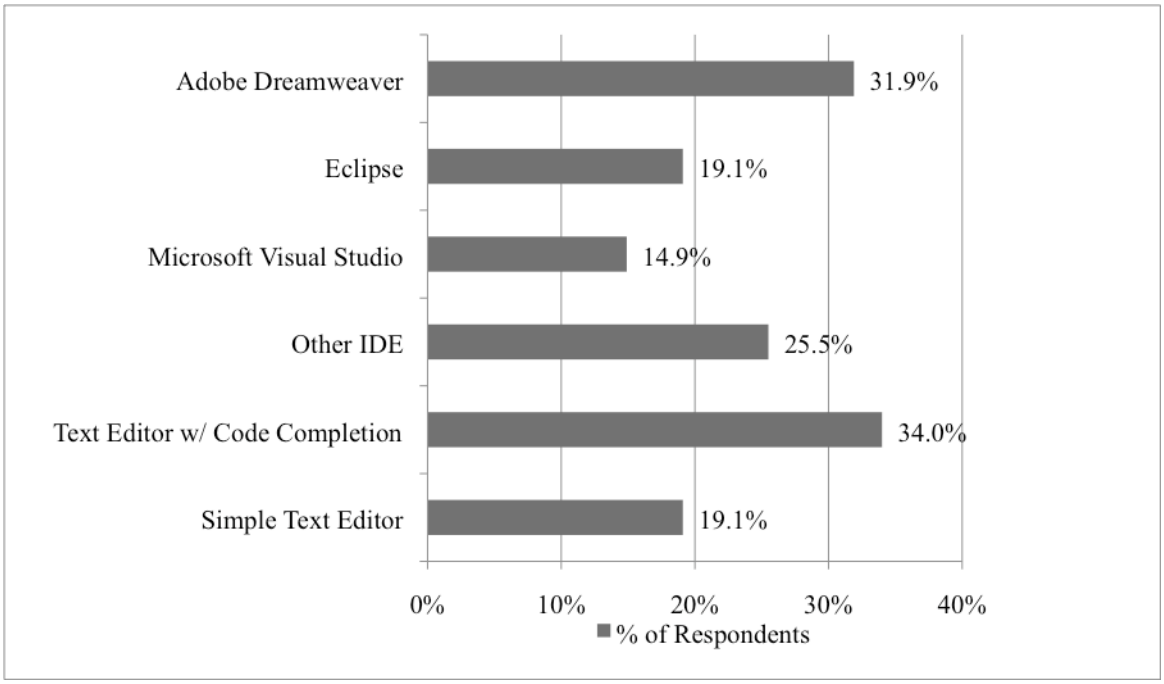

Figure 2. Development tools used to create web applications

When thinking about the problems encountered in mashup development the developers described three problem areas: API reliability, coding issues and documentation. Reliability refers to the issues and frustrations involved when dealing with third-party APIs, both in the sense of system availability time and the trustworthiness of the data. Because mashups rely almost completely on public services, the bulk of a mashup system is not in the hands of the developer, and thus API reliability is very important. Another issue relates to coding skills; the programming expertise needed to bring together multiple APIs using languages like JavaScript or PHP create barriers for even relatively experienced programmers.

When asked how they learned to create mashups, all of those who responded reported that they were self-taught. From these responses we also learned that documentation is a primary resource for that developers to learn how an API works. The participants valued the accuracy of the documentation and the availability of examples as most important. Developers cited lack of proper tutorials and examples as a major problem area when developing mashups. Some suggestions to improve documentation included proper "examples of working code" and "graduated information for beginners to experts by level".

This exploratory survey provided two areas of insight. The first is the high importance of documentation in the initial step of learning how to create a mashup and later sustaining API usage. There are supporting technologies, such as web service definition language (WSDL), which can cue developers into the functionality of an API. However, in most cases they are far too complex for novices and nonprogrammers. Furthermore, many APIs, including the Google Maps API, do not provide access to these types of programming assistance, and so developers only have documentation to turn to.

The second insight from this study is that mashup development is quite limited in variety. There are a very small number of APIs that are used in the majority of mashups, with the majority focused on the use of maps. While it is unclear why this is, we believe that the visual nature of maps combined with the Google Maps API being one of the first major public APIs makes this type of mashup more attractive to developers. There is plenty of data on the Internet, but it may be that useful visualizations are a prerequisite for attracting the average web user. From a tool designer's prospective, this suggests that instead of focusing supporting mashups development in the most general terms, we might begin by designing tools that support this more limited list of visualizations.

3. WHO ARE THE PROSPECTIVE MASHUP DEVELOPERS?

After exploring the experiences and problems of expert mashup developers, we turned to the population we hoped to target – end users without programming experience. In doing so, one goal was to identify some of the skill differences between the experts and the end users. Furthermore, the previous study pointed to a need for better understanding the actual data manipulation step of creating a mashup. In what ways do nonprogrammers consider that integral development step? While past research has been aimed at requirements for end user tools, these tools may not be an opportunity that the user would want to use.

Another important goal of this inquiry was to develop a benchmark for the user population that we have termed *web-active end users*. Guided by studies from the Pew Internet and American Life Project (Horrigan, 2007; Madden, 2006), we argued that users are becoming more and more active online, and that many spend great amounts of time exploring advanced technologies that may contribute to enhancing their lives online. We speculated that college students are at the forefront of this trend, because they have relatively more time to explore new services and are of a generation that has been using and growing with the Internet since they were born. [Would like a citation here about trends of why there is this sudden "Web 2.0" besides just availability of the technology; Wisdom of the Crowds, The Wealth of Networks]

This survey contained questions about technology experience and general web activities; specifically we asked them to describe some of their sharing activities online. We postulated that creating and sharing content online could be a notable factor in promoting mashup development for this user population. Also, to take advantage of any respondents who had experiences with APIs and/or mashups we created a subsection with similar mashup related questions from our prior study.

One of the questions we asked ourselves when developing this study is: How do we ask an end user who has never been exposed to mashups to describe their future mashup use? While providing some context for the participants is required, supplying them with too much information would bias their responses. In the end, we furnished them with a single sentence description of mashups, followed by an illustration of the concept using two simple examples. We then followed this with questions about their presumptions about the difficulty of creating a mashup, and also the benefits this skill could offer. Further, to probe their technical understanding of mashup development, we asked

respondents to speculate on the steps needed to create a mashup. After considering these aspects of mashups, we asked the participants to brainstorm mashups that they would be interested in creating.

We received 259 responses to the survey. Table 3 summarizes these demographics.

Characteristic	**Distribution**	
Gender (N=225)	Male: 60.9% Female: 39.1%	
Age (N=225)	18-21: 74.2% 21-25: 20.0%	>25: 5.7%
Education (N=202)	Some College: 84.2% Associates Deg: 3.0%	College: 10.4% Masters: 2.5%
Discipline (N=176)	IST: 50.6% Communications: 29.5% Business: 7.4%	Humanities: 7.4% Science & Eng: 5.1%

Table 3. Web-active end user survey participant demographics

Regarding general technology experiences, most respondents (72%) reported that they have used computers for more than 10 years. They spend a large amount of time on the computer, with 76% reporting over 15 hours per week and 32.3% spending more than 30 hours per week. With other digital technologies, only one respondent did not own a cell phone, 80% own a digital camera, and 93% own an MP3 player; Webcams and PDAs were much less common. Another distinct feature is that 87% own a laptop computer, but only 64.2% own a desktop computer. This could be due to an increase in mobile computing. Of course, many respondents owned both.

Technology	**Mean (Std. Dev.)**
HTML (N=135)	3.66 (1.23)
Java (N=135)	2.76 (1.35)
Database (N=134)	2.63 (1.22)
C++ (N=135)	2.59 (1.33)
Streaming Media (N=134)	2.54 (1.32)
CSS (N=131)	2.33 (1.50)
Adobe Flash (N=134)	2.25 (1.19)
Javascript (N=134)	2.21 (1.11)
XML (N=135)	2.10 (1.15)
PHP (N=132)	1.99 (1.18)
ASP (N=133)	1.49 (0.92)
C# (N=132)	1.42 (0.95)
RSS (N=133)	1.42 (0.87)
Perl (N=134)	1.29 (0.80)
Adobe Flex (N=134)	1.28 (0.80)
ColdFusion (N=134)	1.27 (0.81)
Python (N=134)	1.16 (0.65)

Ruby on Rails (N=134)	1.11 (0.57)
Django (N=132)	1.08 (0.45)

Table 4. Technology experience

With respect to computer expertise, we asked them to rate themselves on a 5-point Likert scale, with 1=no experience and 5=a great deal of experience. The majority of the respondents (62.2%) self-rated a 4 or higher; the average rating was 3.83. Most had taken classes on programming (63.4%) but the larger percentage (79.6%) did not consider themselves programmers. As a way to gauge their skills with web technologies, we asked the participants to rate their own experiences with a number of programming languages and online media. They used the same style of 5-point scale used to rate computer expertise. As we expected, the only example of advanced experiences was with HTML and very little experiences with web-based languages like PHP and ASP. These details are summarized in Table 4.

As mentioned before, we expected that certain participants would have experience with web based APIs; a small group (N=17) reported that they did. Comparing this group to the rest of the respondents, it was not surprising that they reported themselves as higher in computer expertise (4.56). Moreover, all but one person in the API-experienced group had received formal programming training. However, only seven of these web developers consider themselves to be programmers. It may be that web development – even when APIs are used – may not qualify as "real programming" by these end users.

Statement	**Mean (Std. Dev.)**
Out of my friends I am one of the first to adopt a new technology or gadget.	3.16 (1.29)
I actively search for new and interesting websites to visit.	3.11 (1.25)
My friends and co-workers come to me for help with computer- and technology-related questions.	3.36 (1.36)

Table 5. Variables contributing to technology initiative

To accompany the self-reports on computer expertise and technology experiences, we probed respondents' personal initiative and motivations when dealing with technology. The reason for this is that we wanted to examine the more psychological property of curiosity. Past research suggests that a person's motivation to explore and learn new ideas could be closely tied to the success of novel EUP systems (Rosson & Kase, 2006; Wiedenbeck, Sun, & Chintakovid, 2007). The three statements in Table 5 were used to evaluate a respondent's technology initiative. While the average response was concentrated towards the midpoint, the data had good variability, so the three items were averaged for each respondent into a single Technology Initiative variable, which we will talk about later.

As a way to better understand the online activities that our participants engage in, we asked them how often they used specific web services on a scale from 1 to 4, where 1=never and 4=daily. As one might expect, social networking was most frequently used, along with online videos. Other socially oriented services like bookmarking or photos were less frequently used. These results are summarized in Table 6.

Online Activity	**Mean (Std. Dev.)**
Social Networking (N=258)	3.63 (0.74)
Video (N=257)	3.05 (0.71)
Online Maps (N=257)	2.53 (0.63)
Shopping (N=258)	2.39 (0.66)
Photography (N=258)	2.15 (0.87)
Travel (N=254)	1.78 (0.55)
Social Bookmarking (N=256)	1.32 (0.67)

Table 6. Frequency of Online Activities

We also asked respondents to estimate how often they participated in creating and sharing content online. Many of the respondents (30.6%) reported that they share their creations on a weekly basis. Also, 69% report having created a personal website, and 45.6% have their own weblog or online journal. When asked why they participate in these types of sharing activities, most say "Just for fun" or, predictably, "To socialize". As students, they also create items online for class. What is fascinating is that 48.8% create content online as a way to share their hobbies. This data is consistent with a growing trend of hobbyists pursuing their interests online (Griffith & Fox, 2006).

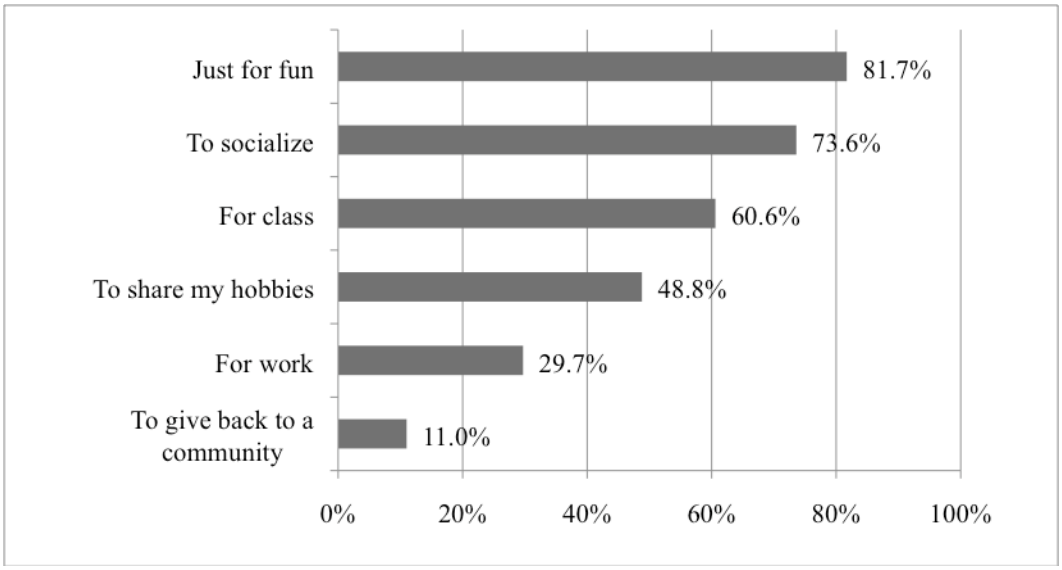

Figure 3. Reasons to create online content

As a way to introduce the concept of mashups to the participants we provided the simple explanation and examples in Figure 4.

"Mashups are web applications that combine information or data from two or more sources into one interface. For example, plotting the top 25 best companies to work for onto a map is considered a mashup (Figure 1). Another example could be cross-referencing CNN news feeds with Wikipedia (Figure 2)."

Figure 4. Description and examples of mashups

Using this introduction as a point of reference, we asked participants to consider "How difficult do you think it would be to create the mashup (in Figure 2)?" and "How useful do you believe mashups are?" indicating their response on 5-point Likert scales. We expected that the responses gathered here would be prototypical of "novice" web-active end users. While the average difficulty (3.34) ratings were lower than usefulness ratings (3.14), it is inadvisable to make side-by-side comparisons; we do not know how these end users judged usefulness and difficulty. However, their ratings were quite modest, with 41% rating difficulty at 3 points or lower.

When examining difficulty ratings as a function of gender, we found that women judged mashup creation as more difficult than men (3.38 versus 3.04), but that usefulness did not vary as a function of gender (3.39 versus 3.30).

This gender effect is consistent with other studies in EUP; studies have shown that women report lower self-efficacy and less confidence in a number of EUP situations (Beckwith, et al., 2006; Rosson, Sinha, Bhattacharya, & Zhao, 2007).

To supplement the ratings of Difficulty and Usefulness we followed up with open-ended questions. After the Difficulty ratings, we asked the participants to speculate on the steps needed to create the second example (the left mashup in Figure 4). We received 171 open-ended responses, which we coded for accuracy on a scale from 0 to 3. We based this scale on the three steps needed to create a mashup: data gathering, data manipulation, and data presentation. Each answer received a point for any step that was correctly conveyed; for example "Locate RSS feed […] and format page to accept feed" was coded with a 2 because locating an RSS feed corresponds to data gathering and formatting a page equates to data presentation. Response that mentioned none of the three steps received a score of 0.

Initially we expected that people's ability to describe the mashup process could be related to ratings of difficulty, but we found no such pattern. It is possible that competing tendencies could be in play – people who know more about the mashup process might recognize that it can be difficult, while those who are totally naïve may have no way of assessing difficulty.

In conjunction with the Usefulness rating, we asked participants to describe how they could benefit from creating mashups. We coded the 82 responses into categories; we found some that deny any benefit, but that many others allude to effects on search, web browsing, data integration, creativity, visualization, efficiency, as well as just gaining a new skill. Not surprisingly, we found that the number of imagined benefits had a positive correlation with ratings of mashup Usefulness.

As one of the final questions, we asked participants to describe some mashups they could envision creating. Given that they have little knowledge of mashups beyond the descriptions we gave them, we hoped that by thinking about mashups in the context of benefits and costs, that the mashups they described would be representative of what notice mashup developers would desire. The 116 respondents to this question generated 134 ideas. Using the existing mashup categories (Musser, 2008) we coded each of the ideas. The frequency they appeared in the data is summarized in Figure 5.

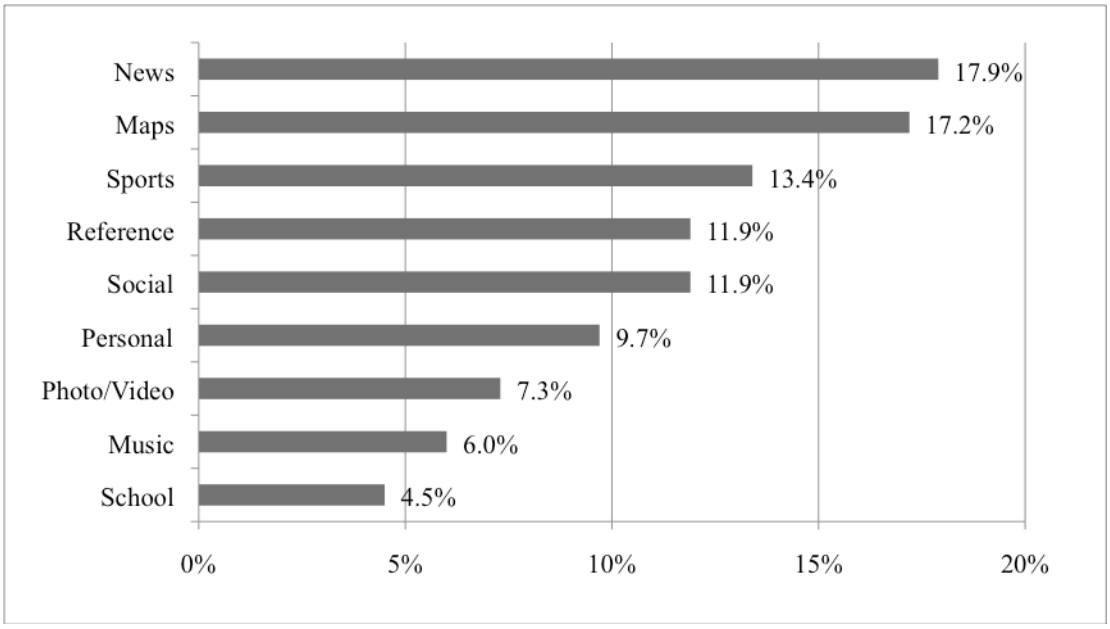

Figure 5. Categories of mashup ideas

3.1 Motivation for Mashing Up

One of the main concerns in EUP generally, and in end-user development of mashups in particular, is the motivation for end users to learn programming techniques. If end users do not have the skills to create mashups, what would be

needed to encourage them to learn? There are many internal factors that come into play when a user decides to devote efforts into learning a new system.

In the case of many novel programming technologies, a reasonable way to describe the factors contributing to users' decisions to learn new skills is the attention investment model (Blackwell & Green, 1999). Drawing from the Cognitive Dimensions (CD) of Notations framework (Blackwell & Green, 2003), this model can be used to frame the initials steps a user takes before deciding to invest effort into a task. In particular, it uses aspects of CD to examine the cognitive requirements on the user. Furthermore, it applies cost-benefit analysis (Blackwell, 2001) as a predictor of possible effort investment. This technique has been applied to EUP problem-solving tasks (Blackwell & Burnett, 2002).

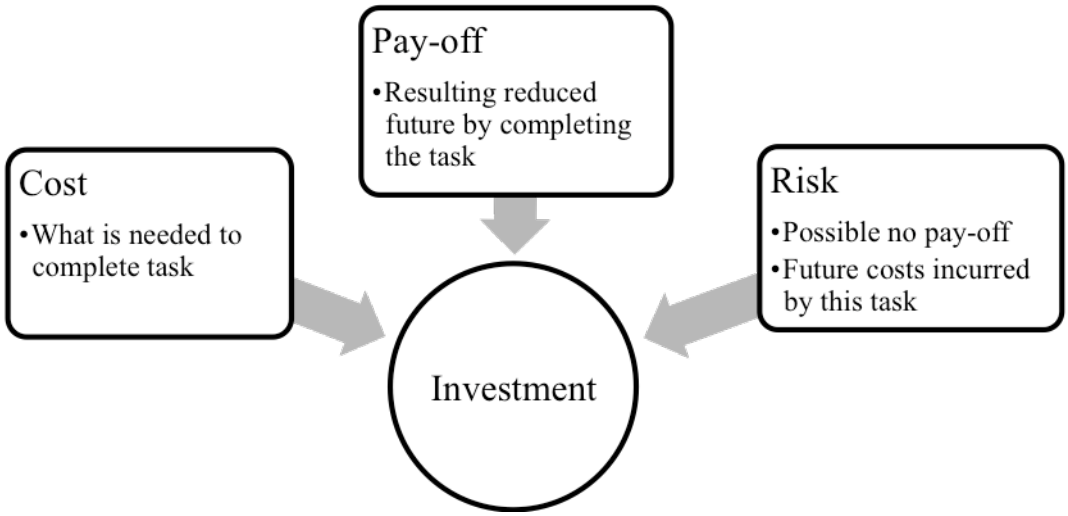

Figure 6. Attention Investment Model applied to creating mashups

Attention Investment considers four cognitive cost-benefit variables: cost, risk, investment and pay-off. As summarized in Figure 6, we applied these variables to users' estimates concerning their future use of mashups. Here we map the user's perception of the attention costs needed to complete a mashup. Risk is a combination of the possibility of failure and there is no pay-off, and the possible future costs from attention investment choice. Pay-off is the estimated future cost saved by investing the attention towards creating a mashup. Investment is then represented by the choice that the end user makes.

If we consider a hypothetical situation where an end user has the opportunity to create a mashup using a tool, the decisions he/she would make may be strongly influenced by their notions of benefits versus the costs associated with learning this new tool. To investigate this, we asked the survey participants to estimate how often they would create mashups, if they had the skills and expertise, on a 4-point scale; the ratings corresponded to 1=never, 2=rarely, 3=weekly, and 4=daily. We anticipated that this metric would give us a way to predict future actions.

	Never (N=38)	**Rarely (N=148)**	**Weekly (N=30)**
Difficulty	3.29	3.10	3.17
Usefulness	2.74	3.37	3.97

Table 7. Difficulty and Usefulness by possible Mashup Frequency

As shown in Table 7, the majority of the respondents suggested that they would rarely use mashups. But when compared to ratings of Usefulness and Difficulty, we found a correlation between the ratings of Usefulness and mashup frequency, but no significant relation to Difficulty. This suggests that users' expectations about possible future mashup activities are influenced by their current judgment of how useful the technology is, but not of how difficult they expect the task to be. In other words, benefits or pay-off affect the user's willingness to invest attention more than the perception of risks.

3.2. Predicting future Mashup Activity

Another goal of this exploratory research is to identify user characteristics that might help to predict which end users might be most likely to engage in future mashup activity. We assume that this information would be useful for EUP tool designers as a guideline to create mashup tools that attract the right people, so as to maximize early adoption.

Variable	Definition	Summary
Gender	Female or Male	Male, N=137 Females, N=88
Computer Experience	Sum of four normalized scales (α=0.76)	Mean: -0.018 SD: 3.05
Technology Initiative	Average of three 5-point scales (α=0.77)	Mean: 3.21 SD: 1.07
Advanced Media	Use of video camera, web cam, or smart phone	Mean: 1.41 SD: 1.18
Web 2.0	Use of online maps, photo, and video services	Mean: 2.26 SD: 0.51
Hobbies Online	Post online content for hobbies (Y/N)	Yes, N=120 No, N=126
Difficulty	Difficulty creating a mashup 5-point rating	Mean: 3.34 SD: 1.01
Usefulness	Usefulness of mashups 5-point rating	Mean: 3.17 SD: 0.94

Table 8. Characteristics of web-active end users that may predict future mashup activity

Using the variables collected in our survey, outlined in Table 8, we performed a step-wise regression to find predictors for the future Mashup Frequency variable. This technique for statistical model building progressively adds variables into a regression equation. At each step, the overall model equation is tested against all the other variables being considered. If a variable is added to the equation and the predictive power of the regression is increased, the variable is incorporated into the model.

Once the regression model was complete, we learned that Usefulness, Hobbies Online, and Technology Initiative were statistically significant predictors. Interestingly, gender and computer experience did not play a significant role in predicting future Mashup Frequency. This is especially surprising because we found that men rated themselves more highly than women in both Computer Experience and Technology Initiative. Of course, keep in mind Difficulty was strongly related to Gender.

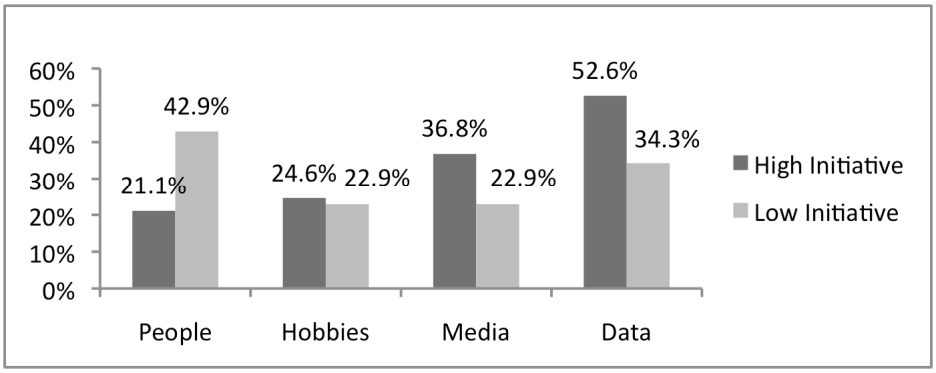

Figure 7. Categories of mashup ideas

As a final piece of exploratory analysis, we wondered whether the types of mashups that users envisioned might be related to variations in Technology Initiative. To examine this, we separated users into those with high Technology Initiative and those with low Technology Initiative. We then compared this to the mashup ideas they came up with. To simplify our analysis, we collapsed the nine categories from Figure 5 into four: Hobbies (Sports and Music), People (Social and Personal), Media (Photo/Video and News), and Data (Maps, School, and Reference). This comparison (see Figure 7) suggested a slight trend for Data-related mashups to be suggested more often by high initiative participants, while those with low initiative suggested People-related mashups more.

In order to attract future mashup builders, it is important to consider the properties that web-active users are attracted to. What are the features of a novel technology that will entice them? What motivates them to pursue something new? Essentially, it is their recognition of the benefit weighed against their perception of cost and risk. We found that a combination of technology initiative, perceptions of mashup usefulness and the sharing of hobbies online to be key factors in how often a user will consider creating mashups.

In order to enhance the perception of usefulness, designers should consider the types of mashups uses would want to create based on the users they wish to target. The users with more initiative will pursue data-intensive, sophisticated mashups, while those with less initiative will tend towards people-driven, social mashups. Tailoring tools towards either of these activities will make building mashup more attractive for these users.

4. A CLOSER LOOK AT THE ONLINE DATA EXPOSURE

To closer examine some of the characteristics we uncovered in our surveys, we conducted more detailed interviews of individuals who fell into the category of web-active users. We recruited 12 students from a major northeastern university as participants after a pre-screened survey.

All but one participant was quite vocal when talking about their activities online. To seed their responses we provided a list of categories of information (see Figure 5). When speaking about each of these categories, the participants listed numerous sites that they commonly visit. It is unsurprising that the most popular sites for each category were also mentioned most often. For instance, Amazon is the most mentioned single site for shopping, and CNN was mentioned most for news sources. While these popular sites were mentioned most frequently, less common web sites were also brought up. For example, when talking about shopping, retailers like Forever 21 or Kohl's were also cited. In all categories but sports, the total number of unique sites mentioned outnumbered the references to the more popular sites. This pattern is consistent with the general trends of the Long Tail (Anderson, 2008) – when probed, the participants describe interests and goals related to a wide range of online information, even though there are clearly a number of "obvious" sources.

Another theme is the integration of the physical world with the online experience, with retail stores (e.g., Kohl's, Dick's Sporting Goods) being a prime example. While each participant is very active on the web, many of his or her activities are grounded in the physical world. When talking about shopping, about half of the participants mentioned that they often use online shopping sites to identify or price items, but then go to a physical store to examine and purchase the actual product. For news and sports scores, many end users also interleaved their discussion of physical newspapers and their online equivalent. For example, students from the Pittsburgh area cited the Post Gazette, a local newspaper, as a place to get both sports scores and news. Now that they live in another town and cannot get a physical copy of the paper, they depend on the website for the same content.

When participants were asked about other categories of sites they use, all but two mentioned social networking; specifically they immediately raised the example of Facebook. In this context, a common theme was how Facebook includes the different types of information mentioned before; "You can find pictures of your friends, news about events and I'm pretty sure there's an App that lets you see sports teams." Beyond social networks, the only other recurring category was coursework. This is not surprising given that all of the participants were students.

4. DISCUSSION

Throughout this work, we have referred to a class of end users as "web-active". But what does it really mean to be active on the web, or to use the web in an active way? Generally, this concept cannot be exactly quantified, but there are numerous features that can identify this user group, specifically their activities online, the initiative towards technology, and their technology expertise.

4.1 Online Activities

A primary indicator for a web-active end user is the activities he or she pursues. Throughout all of these studies, we consistently found that social networking was a primary engagement factor for this university population's web-based activities. However, this was not the only indicator. While they spend copious amounts of time on social networking sites, many times these activities serve as a gateway to other activities. In interviews that followed our survey studies, many of our participants cite Facebook as the site they visit most, but further probes often extracted descriptions of other activities that were initiated in Facebook. Other studies have shown that using community-building features of these social networking sites can be leveraged to encourage users to extend their presence into other systems (Rosson, Sinha, Zhao, Carroll, & Ganoe, 2008). At the same time, the Web 2.0 trend that is promoting the sharing of personal creations is another feature of these web-active users. In particular, our studies have shown that creating content to share common interests in hobbies is an important factor that may contribute to their adoption of new technologies. Through the course of schoolwork and social interactions, these users have explored developing web sites and sharing their personal interests through blogging and online journals.

Another feature is that many of their online activities have close ties to behavior in their everyday offline lives. Interests in sports-related information lead these web-active users to search for sports information online. Shopping activities, particularly in brick and mortar stores, have a strong attraction for these users. Many use a store's websites to first do research on products and then purchase them in the real world stores. Similarly, students who have left home for college still connect to elements from their hometown, including local news and sports teams. They use these past connections as a starting point and guide when looking for information online.

Web-active end users are at the top of the online food chain. While they may not know how to program and develop applications, they are more often then not, the target of designers and developers. Because of this, they will continue to be active participants in shaping the online landscape. Not only do they consume content, they increasingly are active contributors to online activities. The things they create and share add to the overall richness of the online experience. This is a defining feature of the web-active end user.

4.2 Technology Initiative

Beyond their activities, Technology Initiative helps to quantify the *active* in web-active end user. The idea of initiative in this work is composed of three features: active technology adoption, active technology assimilation, and active technology dissemination. These three items are directly related to each of the three variables that combine to form the Technology Initiative index. These users sit at an intersection where they absorb information and technology for their own purposes, but also pass it on to their friends. This is very similar to what Gladwell (2000) described as Mavens. Mavens are people who specialize in gathering information and are the ones who the average user relies upon to learn about new activities, gadgets, and other novel technologies.

In our survey of web-active users, we found a close relationship between these three aspects of initiative, so we combined them to create a single index. In the larger population we found that this value was varied widely (from 1 to 5). While we find high initiative for many web-active users, a large number of users are active on the web but do not high technology initiative. Indeed we found that this index has predictive significance for their web activities, so we must see it as just one index of "active" status in this population. Many users who have low technology initiative are nonetheless active in their web behavior – however they may be more interested in spending time on social or "people-oriented" activities.

4.3. Technology Expertise

Web-active users vary widely in computer expertise. From the data gathered here, we found that most do rate themselves highly, but these types of ratings are unreliable because we do not have a full understanding of how each participant made these decisions. However, it appears that these users are very confident in their general skill levels. This is a promising feature of web-active users, in that they may feel confident enough to try new tools like mashup editors, even if they also consider themselves to be "low" in technology initiative. While these users typically do not have programming skills, they may be confident enough to investigate new tools and environments.

6. CONCLUSION

In the last decade, Web 2.0 culture has become increasingly prevalent in many areas of online activity. Computer users have become more and more sophisticated in the way they interact with the Web. In particular, the average user has become more involved in end-user programming activities, where those with little or no experience with programming are leveraging available web resources to solve real world problems. With the progress towards more open web services and the increasing involvement in online interests – including social networking and multimedia

– the activities that users want to pursue can no longer be handled by system designers. More and more, users with programming skills are taking advantage of the technologies online to build tools tailored to their own goals. For example, programmers are encouraged by web services like Google Maps and Flickr to employ their APIs and adapt them for individual goals; essentially building mashups. However, while these trends have promoted the active use of online resources and idea of "helping users help themselves", many less sophisticated users are left out. In other words, there may be a large group of "have-nots" who could capitalize on these technologies, but do not have the necessary technical skills to do so.

This research has revealed that it may be possible to harnessing the excitement and energy surrounding all things Web 2.0 to promote the investigation of tools that could improve the interactions of end users. It would be practical to direct these users to the resources they need by focusing on their common activities as a way to motivate their curiosity. Here the key challenge is to identify situations that the user will find the benefits of working with a new tool to be greater than the cost of learning how to do it. In this case, web-active end users are an exemplary population to study in this context. These users are born into the age of the Internet and have been actively consuming and contributing content online for most of their lives. They already rely on the Internet for everyday problem solving, and are enthusiastically engaged in blogging and social networking activities. By appealing to these interests, designers can engage users encourage them to explore new tools.

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