

EXPLORING THE RELATIONSHIP BETWEEN ANXIETY AND USABILITY EVALUATION - AN ONLINE STUDY OF INTERNET AND WIKI ANXIETY

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ABSTRACT

Even though learning technology is becoming pervasive, there is evidence suggesting that many students feel anxious about using Information Technology resources such as computers and the Internet, with females generally being more anxious towards technology. Anxious people may still have to use IT as University courses promote the acquisition of transferable skills. The focus towards high IT usage may put anxious users at a disadvantage in education as traditional methods of knowledge dissemination are eroded. As anxiety affects the nature of interaction with a user interface, careful attention to usability design may hold the key to reducing this anxiety and allow students to comfortably interact with highly beneficial learning technology. As part of course requirements, 125 second year students in Psychology used a wiki system in support of the production of their final year group projects. A wiki allows users to add, edit and amend information, page design and navigational structure (via the use of in-text hyperlinks) through the use of wiki markup language or a simple text editor. This offered the opportunity to explore the relations between anxiety and usability of wikis using newly developed measures for this specific user interface. It was found that wiki anxiety, Internet anxiety and state anxiety scores were highly correlated providing validity to the anxieties being measured. Wiki anxiety had a strong negative relationship with usability evaluation of the wiki. Females were also found to be more Internet and wiki anxious and rated the wiki as less usable than males. Additionally higher anxiety was related with lower use of the wiki. The results are discussed in terms of their implications for usability evaluation, IT anxiety research and their implications on higher education drive to further utilize IT applications as learning aids. Limitations in the measure of self-reported usability are also discussed.

KEYWORDS

Wiki anxiety, usability, Internet anxiety

1. INTRODUCTION

Information Technology (IT) is now an integral part of our lives and this is one of the reasons why in higher education, improving skills is regarded as desirable. The Internet was the major drive for the changes in the delivery of learning material and form of interaction between students and teaching staff, and the new generation of Web 2.0 applications continue to shape changes. Although IT on campus is commonplace, a significant percentage of students find IT a source of anxiety and discomfort (Kohrman 2003; Todman and Day 2006; Joiner et al. 2007). Yet many students are forced to face their stressor daily as IT becomes essential to the learning process or face being left without the benefits of IT on campus and possibly even disadvantaged academically. Thanks to the success of the Wikipedia project, wiki applications are becoming

more widespread. However stereotypes and unfamiliarity are commonplace. Because of the novelty of the tool it is important that students' affective reactions are studied so that any potential anxiety can be identified and reduced early. Anxiety and usability are subjects which have rarely met in research but the link may hold vital repercussions in both subject areas. Usability may have an important role in enforcing and reducing any affective response towards wiki applications. Firstly we will discuss anxiety and frame it in the IT domain. We will then address how anxiety may manifest itself in the use of wikis and its relevance to usability.

1.1 Internet Anxiety

Recent research has suggested that almost 1 in 10 students suffer from Internet anxiety (Joiner et al. 2007). A definition is hard to find, but Presno (1998) proposed a model with four anxiety stimulating factors: *Internet terminology* (anxiety experienced because of jargon), *net search* (anxiety prevalent when having problems limiting search results due to the vast amounts of information on the web), *time delay* (occurring due to poor connection speed and large information-filled web pages) and *general fear of Internet failure* (a fear that learning and navigating the Internet is beyond their capabilities). As with computer anxiety it is likely that users experience increased cognitive load (Smith and Caputi 2007), mentally withdraw from tasks (Carver and Scheier 1986) and experience anxiety related symptoms similar to certain established phobias (Thorpe and Brosnan 2007). Speed and accuracy of task completion may also be affected in addition to amount of cognitive distress when interacting with the stressor (Brosnan 1998). In direct reflection of the computer anxiety literature, a gender difference also exists (Tsai et al. 2001; Chou 2003). Females feel less confident about Internet use than their male counterparts (Schumacher and Morahan-Martin 2001) as the Internet is seen as a stereotypically male domain (Morahan-Martin 1998), which may explain such a finding. Users with more experience with computers tend to have less Internet anxiety than those with less experience (Chou 2003), although explicit experience of the Internet and Internet anxiety has not been investigated previously.

1.2 Wiki Anxiety

A wiki is the simplest interface for a database. For users it looks like a hyperlinked set of web pages, which are created using markup language (either html or proprietary markup) and/or simple text editor. This allows users with a range of technical abilities to participate in the creation of content and the structure of wiki sites (Mader 2008). Although many users embrace the potential of wiki applications as valuable learning aids, they present some problems in a learning environment. Because any user can modify pages at any point, page structure and content are constantly evolving and content is public for the wiki users throughout the creation process (Wang and Turner 2004). For students this may create uncertainty over accuracy and flexibility of course content. This uncertainty may lead to anxiety among potential users (Rachman 2004). As all users may edit wiki information it is possible that peers' created content is not accurate or authoritative enough, causing stress. Content and information structure are also in a constant state of flux. Many users may be left feeling anxious about using wiki pages because of their fluidity in structure, information and navigation (in terms of the contextual hyperlinks supplied in text and the hierarchical structure applied to documents by users). Simply due to its *hyper-interactivity*, the wiki may serve as a stressor to certain people who will have to use such systems if they become integral to the learning process. In addition there are some users who find interaction with any IT system stressful because a lack of confidence in their ability to use systems effectively (Brosnan, 1998). This in combination with the fluidity and uncertainty of wiki spaces suggests that anxiety can be expected in some people towards wiki interaction.

1.3 Wiki anxiety and usability

Usability aims to ensure that the system fits the purpose and expectation of its users (Faulkner 2000). The ISO definition of usability is in reference to the "effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments". The aim of usability is to centralize the user and the task which those users face when designing the user interface (Nielsen 1993). In terms of its role in anxiety, usability has been generally ignored. Research has demonstrated that aspects which relate to usability such as perceived ease of use and perceived web quality are related negatively to system anxiety

(Hwang and Kim 2007). Computer anxiety was also significantly predicted by perceived ease of use (Saade and Kira 2007). It is clear that imperfect usability evokes an emotional response (Weir et al. 2006; Peevers et al. 2008) from the user about the system. To the authors it is thus surprising that usability has not been at the forefront of IT anxiety studies. This research aims to rectify this by focusing on usability in terms of its relationship to wiki anxiety.

As the wiki offers a minimal set of features, and users affect both content and structure, anxiety may relate to usability in three ways. It firstly may affect the existence and level of anxiety experienced. Bad usability practice (such as dead links to other pages on the wiki, poor navigation structure, poorly designed editing interface and poor page design) may influence anxiety levels experienced when anxious users interact with the wiki space. Users with wiki anxiety may experience more anxiety symptoms when using a badly designed wiki space than a more usable wiki system. Negative first interactions with a stressor (Weil et al. 1990) and faulty or badly designed software have been mentioned as causes for computer anxiety (Rosen and Weil 1994). A wiki with a user interface which is difficult to use or a design which is difficult to navigate and comprehend may be a catalyst for further anxiety symptoms when interacting with wikis in the future.

Secondly, wiki anxiety could also have important implications for usability evaluation. If a proportion of test subjects are anxious it may lead to overtly negative evaluation of the interface due simply to a predisposition to experience anxiety by the user. This negative evaluation may be misplaced simply due to the predisposition to be anxious about IT. In other words, it is possible that users who are higher in anxiety towards a certain IT related stressor may rate the usability of related interfaces as lower simply because of their anxiety towards that application.

Thirdly, wiki anxiety may affect the form of the wiki, its structure, page-design and information architecture to an irreversible point, leaving many anxious users to experience more anxiety symptoms as experienced, non-anxious users take control of the space. Anxious users may use the space less thus leading to a dichotomy in who is editing the wiki space.

A wiki is interesting in usability terms as it holds elements which are predominantly user-controlled (such as contextual hyperlinks, information presentation, structure and hierarchical control of information) but others (such as the editing interface and navigation of wiki site) which are predominantly developer or administrator-controlled. Elements which are in the users' control may move towards more frequent users' preferences (who will presumably be less anxious) as they take control of content. Coincidentally, if typical users of wiki interfaces are then tested in a usability capacity, editing tools will be specifically designed to their needs further discouraging anxious users from using the system. In other words, this dichotomy could further heighten anxiety in already anxious users who are forced (due say to University course requirements) to use the interface as editing tools and content design becomes more complex.

It is for these reasons that the relationships between IT anxieties and usability of relevant interfaces need to be addressed. Only when this occurs can the effect of usability on cause and "cure" of IT related anxieties be truly understood. Similarly, only with research can we identify anxiety's role on usability evaluation. This paper aims to validate wiki anxiety as an anxiety concept. The paper also aims to explore the relationship between wiki anxiety and wiki usability evaluation. Differences in males and females in usability evaluation and wiki anxiety were also investigated. The relationship between wiki usage and wiki anxiety was also observed. This paper also explores the relationship between wiki anxiety and Internet anxiety. It is likely that Internet anxiety and wiki anxiety may co-exist in participants due to wikis being user-led web pages. To do this three self-report questionnaires have been created to measure Internet anxiety, wiki anxiety and wiki usability, inspired by previous research into IT related anxieties and the usability subject areas.

2. METHOD AND RESULTS

2.1 Method

As part of course requirements, 125 (98 females and 27 males) second year students in Psychology used a wiki system (Atlassian Confluence – referred to as Psykowiki) in support of the production of their end of year group projects. An online survey composed of three measures (Internet anxiety, wiki anxiety and wiki usability) was administered 2 weeks after the introduction of Psykowiki to students. Because the creation of a

wiki page was a compulsory part of course work to be finished by the end of week 2, all users had at least some experience of creating and editing of wiki content and structure.

Three inventories were used. A 6-item short form of the State aspect of the State-Trait Anxiety Inventory (Marteau and Bekker 1992) was used to observe whether wiki anxiety and Internet anxiety were examples of state anxiety, a factor crucial to classification and validation as an anxiety concept. A short form of the STAI was used in order to avoid questionnaire fatigue and effects that may have on completion. The STAI short has been demonstrated to have high reliability ($\alpha = .82$) and be sensitive enough to determine differences in state anxiety across varying samples (Marteau and Bekker 1992). The scale consisted of 3 negative statements (such as “*I am worried*”) and 3 positive statements (such as “*I feel content*”) taken from the original STAI (Spielberger 1983). Again the positive items were reverse scored, with the score on each item summed to gain an overall *state anxiety score*.

The Internet Anxiety Inventory (IAI) was created using novel items based on comments from user interviews, previous research on computer anxiety (Heinssen et al. 1987; Rosen et al. 1987a) Internet anxiety (Presno 1998; Chou 2003; Joiner et al. 2007; Thatcher et al. 2007) and state and trait anxiety (Spielberger 1983). It is common in Internet anxiety research to use a limited number of items (Joiner et al. 2007; Thatcher et al. 2007) and often there is a direct transfer of terms such as “computer” with “Internet” to create a metric to measure this concept. Moreover, many of the items used previously have lacked use of the affective language that is present in most psychological self-report measurements of anxiety. It was therefore decided to use the emotive adjectives present in the State-Trait Anxiety Inventory (Spielberger 1983) in the creation of a new 24-item Internet anxiety scale based on the factors set out by previous qualitative research (Presno, 1998). The items included in the measure referred to anxiety related factors such as anxiety of interaction, technical anxiety, error solving, time delay, and information concerns. The measure includes 16 negative and 14 positive statements. Answers to positive statements (such as “*I am relaxed when I experience unexpected error messages on the Internet*”) were reverse scored so when item scores were summed a low total *Internet anxiety score* would equate to lower anxiety levels.

The Wiki Anxiety Inventory (WAI) was created through analysis of previous IT anxiety research areas such as Internet and computer anxiety (Presno 1998; Chou 2003; Joiner et al. 2007; Thatcher et al. 2007). After using a deductive process to select items, the measure consisted of 10 positive and 10 negative statements referring to wiki confidence, interaction anxiety, learning anxiety, control orientation and information concerns. Again positive statements such as “*I hope that soon everyone will be using wikis*” were reverse scored. All item responses were then summed to gain an overall *wiki anxiety score*.

The Wiki Usability Inventory (WUI) was inspired by previous research into self-report evaluation and satisfaction of system attributes (Weir et al. 2006; Chou and Hsiao 2007; Peevers et al. 2008). The questionnaire includes 31 items addressing elements important to the evaluation of computer-human interaction. The measure comprised of 16 positive and 15 negative statements referring to aspects of the wiki space such as structure and navigation, clarity, effectiveness and affective responses to the interface such as emotion and enjoyment of interaction. Negative items were negatively marked so that a large total *wiki usability score* from addition of the items indicated a positive overall evaluation of the wiki interface. All questionnaires used a 5-point Likert scale that ranged from “Strongly Disagree” (1) to “Strongly Agree” (5) to measure agreement with each item. All total scores were standardized into percentages before comparison.

Additional questions after the 3 self-report questionnaires were included to evaluate the trustworthiness of the information in the Psykowiki application (Psykowiki trust rating) and users rating of their experiences so far with Psykowiki (Psykowiki experience rating). Participants were asked to rate how much they trusted the information on the wiki and how they felt about their experiences on a 10 point scale from 1 (Low evaluation) to 10 (High evaluation).

Demographic data such as gender, experience using wikis (amount of hours per week spent on wikis) and experience using the Internet (number of hours per week spent on the Internet) were also collected.

2.2 Results

Details of the psychometric properties of the three scales can be found in Vigentini & Cowan (2008). Here it suffices to say that all the scales have a very high reliability (Internet Anxiety: $\alpha = .896$; wiki anxiety; $\alpha = .903$; wiki usability: $\alpha = .932$). Table 1 shows that the sample as a whole was moderately anxious about

the wiki (M= 38.61, S.D. = 15.94) and the Internet (M=40.16, S.D. = 14.28). The usability score (M=54.08, S.D. 14.26) of Psykowiki was also moderate.

Table 1. Mean scores of measured variables

	Gender	N	Mean	S.D.	Overall Mean	Overall S.D.
Wiki Anxiety (%)	Males	27	30.51	14.64	38.61	15.94
	Females	98	40.64	15.54		
Internet Anxiety (%)	Males	27	30.65	12.04	40.16	14.28
	Females	98	42.78	13.42		
Wiki Usability Score (%)	Males	27	61.77	14.49	54.08	14.26
	Females	98	51.97	13.58		
State Anxiety Wiki (%)		125			26.61	19.47
State Anxiety Internet (%)		125			24.2	18.77
Psykowiki Experience Rating (10 point scale)		125			5.37	1.75
Psykowiki Trust Rating (10 point scale)		125			6.55	1.58
Psykowiki Use Per week (Hrs)		125			2.14	1.47
Internet Use Per week (Hrs)		125			16.02	12.37

In terms of experience and trust rating of Psykowiki, the average ratings of experience (M= 5.37, S.D. = 1.75) and trust rating of information on the wiki (M=6.54, S.D. = 1.58) are moderate.

In relation to number of hours per week using the Internet and Psykowiki, as shown by Table 1, Internet use (M=16.02, S.D. =12.37) is larger on average than Psykowiki use per week (M=2.14, S.D. =1.47) in the sample. This is not surprising as the Internet is far more established as a tool for information dissemination at University and in society than wiki applications.

The state anxiety measures incorporated in both the Internet and wiki anxiety measures correlated positively with their respective anxiety scores (Internet anxiety: $r(123) = .644, p < 0.01$; Wiki anxiety: $r(123) = .697, p < 0.01$). In other words the higher a person's wiki anxiety and Internet anxiety, the higher the person's rating on state anxiety (i.e. the anxiety feelings at that moment). This suggests that wiki and Internet anxiety could be classified as examples of state anxiety.

Wiki usability score was positively correlated with experience rating of Psykowiki ($r(123) = .673, p < 0.01$), trust rating of the Psykowiki ($r(123) = .250, p < 0.01$) and wiki user per week ($r(123) = .309, p < 0.01$). Wiki usage per week was positively related to experience rating ($r(123) = .226, p < 0.05$). These findings suggest that usability scores accurately reflect user experience and evaluation of the wiki.

In terms of the relationship between wiki anxiety and wiki usability score, wiki anxiety is negatively and strongly related to wiki usability score ($r(123) = -.721, p < 0.01$). Significant and negative correlations were also found between wiki anxiety and Psykowiki experience rating ($r(123) = -.514, p < 0.01$), and between wiki anxiety and Psykowiki trust rating ($r(123) = -.199, p < 0.05$). Wiki anxiety also correlated negatively with hours of wiki user per week ($r(123) = -.308, p < 0.01$) and correlated positively and strongly with Internet anxiety ($r(123) = .71, p < 0.01$). Internet anxiety was not seen to be correlated significantly with amount of hours on the Internet per week ($r(123) = -.143, p > 0.05$).

As seen in Table 1 there is marked difference between average anxiety scores of men and women in both wiki and Internet anxiety variables, where males report less anxiety. This is statistically significant for both wiki ($F(1,123) = 9.223, p < 0.001$) and Internet anxiety ($F(1, 123) = 18.012, p < 0.001$). The mean ratings of each gender group on the usability scale also differ. Males on average rated Psykowiki as more usable than females (see Table 1). This observation was statistically supported by ANOVA analysis ($F(1, 123) = 10.708, p < 0.001$).

3. CONCLUSIONS

In summary, our correlation analysis has highlighted that our measures of wiki anxiety, Internet anxiety and wiki usability show high construct validity through their correlations with alternative self-report anxiety and usability measures. Our findings also show a strong significant negative correlation between self-reported usability evaluation and self-reported wiki anxiety for the Psykowiki application. Males were also found to be less wiki anxious, more Internet anxious and evaluate the wiki as more usable than females. Wiki anxiety also correlated negatively with wiki use per week. Internet anxiety is also strongly positively correlated with wiki anxiety and was not related to number of hours on the Internet per week.

From these results it is difficult to determine the cause of wiki anxiety. More anxious users may still use the interface (especially if made integral to the dissemination of knowledge on their course) but evaluate it as hard to use, unclear in layout and navigation purely due to the fact that they themselves feel uncomfortable with all wiki user interfaces. It may not therefore be a fair reflection of usability issues in the interface but due to a predisposition to nervousness and apprehension about using IT related technologies. This is not to say that anxious users' evaluations are to be ignored. It may be that anxious users are the most important in terms of their evaluation. Anxious users would presumably identify certain aspects of dissatisfaction which others non-anxious users may have. In addition there may be certain user interface aspects that derive particular emotional evaluation from anxious users but not from non-anxious users. Because of the statistical methods used, it is hard to reach a firm conclusion on these issues. A comparative experiment using different wiki editing interfaces could determine whether different interface attributes affect anxiety differently. A control group of non-anxious users could also shed light on the difference in usability evaluation due purely to anxiety levels.

Interestingly after two weeks, wiki use per week was already negatively related to wiki anxiety. Anxious users used Psykowiki less than non-anxious users in this time. Our data shows that only 8 participants (6.4%) in our sample did not use Psykowiki within the two weeks prior to testing. Almost all participants used Psykowiki initially but perhaps only the more confident, non-anxious users kept using the tool. To shed light on this issue a longitudinal study where all users had to create and maintain their own page would be useful in identifying in more detail the role of experience in wiki anxiety. It would also allow us to observe differences in interaction and page design between both user groups.

The gender effect found on both anxieties has been demonstrated in other IT anxiety research (Chua et al. 1999; Durdell and Hagg 2002; Chou 2003). This can be explained by the 'masculinisation' of technology where many females see technology as a stereotypically male domain (Shashaani 1994; Morahan-Martin 1998), which because it is outside their gender norms, would create anxiety. This can lead us to explaining our finding that females rated Psykowiki less usable than males did. As our correlations suggest, anxiety is related to user experience and evaluation of interface. This in combination with the gender difference in wiki anxiety may suggest that females, who are more anxious than males, may rate the interface as less usable because of their anxiety. Again further research is needed on the issue of wiki anxiety, usability and gender differences but these findings again add weight to the fact that anxiety may have a role in usability evaluation of interfaces.

As hypothesized, Internet anxiety and wiki anxiety could overlap conceptually. This is not surprising as a wiki space is a user created web page (Wang and Turner 2004). An anxiety towards the Internet is therefore likely to lead to an element of anxiety about wikis. They are however distinct. The measure used for Internet anxiety focuses on items based on time delay and technical anxiety whereas items used in the Wiki Anxiety Inventory refer to aspects of wiki confidence, learning, and editing. Using a wiki is a far more interactive experience than viewing a web page on the Internet. The user becomes the author and designer of their own page. Users can edit, link and create pages at will. A web site on the other hand is limited in its scope for users to alter and create content. It mostly involves a passive viewing experience. This is why these anxieties differ and should be treated individually. Anxiety with the wiki could be borne out of much more than time delay, search failures and failure to find the correct information although these may influence due to the Internet-related form of the wiki. Other users can view edits by users, comments and the user needs a certain element of technical competence with wiki markup language, all of which could elicit anxiety in the user. Wiki anxiety, although strongly related is certainly a distinct concept.

Interestingly, although not the main focus of our study, Internet anxiety was not correlated with the number of hours spent on the Internet per week. This lends support to findings which suggest that experience

does not reduce IT anxieties (Rosen et al. 1987a; Leso and Peck 1992) and that anxiety may not diminish with usage. This study also echoes recent publications into Internet anxiety which focused on students who, as a generation have had unprecedented exposure to Information Technology and the Internet (Chou 2003; Joiner et al. 2007). Especially at University, Internet use is necessary to fully engage with the learning experiences. Students have little choice than to interact with Internet resources or be at a learning disadvantage if they do not. It has in essence become a fact of University life which anxious users may have had to cope with. This does not suggest that there is no distress involved. In fact the distress may be more intense due to forced interaction, feelings of inadequacy because of lack of ability may manifest itself in cognitive withdrawal when using the Internet, again a common factor highlighted in computer anxiety (Smith and Caputi 2007). This finding has important implications for web usability. In our anxiety questionnaire, many items referred to usability issues such as unexpected error messages, dropped connections and time delays, all web usability issues (Nielsen 2000), which other research also highlights as important to Internet anxiety (Presno 1998). These anxious people are users of the system and usability is part of the problem and solution to alleviate their anxiety during interaction.

In terms of interface evaluation, a usability score may be a reflection of user satisfaction rather than a true assessment of interface characteristics which users may have found problematic. Although items referred specifically to aspects of the user experience it does not supply such rich data needed to make a correct assessment of what users find particularly problematic. It does however identify in general whether they felt using Psykowiki was a positive or negative experience. A combination of methods such as heuristic evaluation, cognitive walkthroughs, structured post interaction interviews and longitudinal diary based reports on user problems (Faulkner 2000) would help in observing the different user experiences anxious and non-anxious users have. This is integral to improving the experience for both sets of users and is again being undertaken in a further study due to commence soon.

Because a wiki allows users to create their own page structures, hierarchy and links to other content (Wang and Turner 2004) there may be an element of usability which is user controlled. Even though minimal, there is an interface which is used for accessing/managing wiki functionalities which is not user modifiable. The measure in this paper has focused mainly on usability measurement related to editing, but in some items the difference is not explicit. Wiki usability is a complex issue and further refinement is needed for a self-report measure to be more sensitive to these differences.

The initial findings presented here show a field of research which needs further exploration. An obvious implication of our findings is that Universities need to think about the affective responses of students to new IT systems used for learning. From our results, students clearly still hold anxious feelings about the Internet. Many of the potential problems are usability based such as poor navigational systems and trustworthiness in the system. The presence of wiki anxiety brings into question whether striving for a high usage of learning technology in higher education is really beneficial for all students. Much more research is needed to explore the effects that experience has on user interface usability and in alleviating wiki anxiety levels. However one thing is certain, if IT on campus is to be inclusive and accessible to all then usability remains integral to reaching that goal.

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