

The Comparison of Adults' and Young Children's Perceptions of Website User Interface Pleasure based on their Metacognitive Awareness

Chien-Hsiung Chen, Chia-Ying Tsai, and Bo-Ching Chiou

Graduate School of Design, National Taiwan University of Science and Technology, Taiwan.

Abstract. With the progress of Internet technology, users are able to navigate in the Internet to acquire useful information and enhance their life quality. Because of this, affective Website interface design has become an ultimate goal that every interaction designer wants to achieve. The purpose of this study is to explore both research and design issues pertinent to the development of pleasurable Websites based on adults and young children's metacognitive awareness. This is because Internet users can range from various ages. It is hoped that the research results can benefit both user groups when interacting with Websites designed with pleasure considerations.

Keywords. Interface pleasure, Metacognitive awareness, Website, Interaction design.

1. Introduction

With the progress of advanced computer technology, the design of user interfaces for information products has become more important because they play an important role in our daily lives. Because of this, the frequent use of digital information especially from the Internet has been increasing daily. Kraut, Lundmark, Kiesler, Mukhopadhyay, and Scherlis (2003) investigated 100 households in the Pittsburgh area trying to understand people's use of the Internet at home. Their results demonstrated that people's foremost use of the Internet was for pleasure purpose (see Figure 1). However, most of the current research studies are primarily focused on product pleasure (Jordan, 1998, 2000, 2001; Jordan and Green, 2002; Jordan and Jordan, 2000; Norman, 2002) with emphasis on going beyond interface usability. More specifically, to design a pleasurable product, this product should be equipped with design factors like useful functions, easy-to-operate tasks, easy-to-understand user interfaces, etc. Nonetheless, very few research studies on interface pleasure are available. For instance, Malone (1981) argues that challenge, fantasy, and curiosity are the important factors in the design of computer games, which may affect a user's internal motivation and enjoyment. Marcus (2002) contends that if an interaction designer is able to create a "cute" user interface, it may be fun to interact with. Bailey (1996) also argues that in addition to achieving the task goal, a computer user will also like to have fun while interacting with the computer. Therefore, to an interaction designer, designing a pleasurable Website user interface is one of the design challenges that s/he faces in the 21st century. To meet this challenge, the researchers started to investigate Internet users' metacognitive awareness pertinent to their perceptions of interface pleasure while interacting with the WWW.

Metacognitive awareness refers to one's perception of his/her own cognitive process adopted for self-controlling of these processes. By investigating adults' and young children's

metacognitive awareness of interface pleasure when they are interacting with a Website, an interaction designer can generate potential Website design factors to facilitate the design of pleasurable Website user interfaces. By doing so, both adults and young children learning motivation and performance effects can also be enhanced.

Currently, adults are the primary user groups of the Internet. However, the Internet user groups have gradually extended to younger generations even when they are in the elementary schools. To most of the young children, acquiring information from the Internet has inevitably become part of their learning process. Because of this, it is important for an interaction designer to design a Website user interface that is fun to interact with and, at the same time, can enhance the young users' learning process. To reach this ultimate goal, this pleasurable Website should be created based on adults and young children's metacognitive awareness regarding their perceptions of interface pleasure.

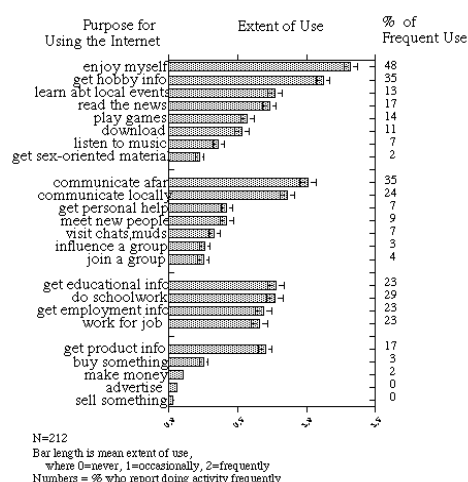


Figure 1. Frequency of using the Internet for different purposes

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2. Research Methods

This research study consisted of three experiments. In the first experiment both observation and think-aloud methods were adopted. Participants were invited to interact with 10 pre-selected Websites and, at the same time, spoke out their perceptions of interface pleasure occurred during their interacting processes. Both note-taking and voice-recording techniques were used to help collect the data. By doing so, the researchers could investigate the participants' metacognitive strategies used to help browse through the Websites. In the second experiment, three important Website design factors that might affect a user's perceptions of a Website's interface pleasure were adopted. Based on these factors, five Websites were created and used for the experiment including one from the previous experiment for the control purpose. The aim of this experiment is to validate if these design factors can actually affect a user's perceptions of a Website's interface pleasure. In the third experiment, young children were invited to interact with the same 10 pre-selected Websites and spoke out their perceptions of interface pleasure occurred during their interacting processes. The process is similar to that used in the first experiment. In addition, the design guidelines generated from the first experiment for creating pleasurable Website user interfaces were introduced to the young children one by one to obtain their opinions and reasons.

3. The Experiments

Before the experiments, participants were asked to interact with several pre-selected Websites. The Website design guidelines regarding interface pleasure were first generated and summarized based on this process. A total of seven important Website design factors were found, such as introduction animation, overall perceptions of the introduction page, the relationship between the introduction page and the content pages, music, button design, overall structure, additional functions, and others.

3.1. The first experiment

The purpose of the first experiment was to generate potential Website design factors that may influence a user's perceptions of interface pleasure. A total of 10 student volunteers were recruited from the Graduate School of Design in National Taiwan University of Science and Technology. None was paid for taking part in this experiment. They all have at least five years computer experience. They were asked to interact with 10 pre-selected Websites. These Websites were chosen because of their unique structures and they were all design-related. While interacting with the Websites, participants were required to think out loud their perceptions of interface pleasure and the metacognitive strategies they used to help them browse through the Websites. The participant's think-aloud protocols were further analyzed and a list of twelve pairs of polar adjectives was generated for the second experiment. These polar adjectives were displeasure vs. pleasure, dirty vs. clean, blurred vs. clear, colorless vs. colorful, formal vs. lively, static vs. dynamic, unlovely vs. lovely, uncomfortable vs. comfortable, dislike vs. like, ordinary vs. extraordinary, dull vs. vivid, and dark vs. bright.

In addition, three important Website design factors affecting the participant's perceptions of interface pleasure were generated. These factors are: (1) There should exist large and interesting dynamic images on the introduction page of the Website; (2) The Website should be designed with a simple and clean feel, and with fresh colors; (3) The Website should be equipped with dynamic icons.

3.2. The second experiment

In order to determine if the above-mentioned Website design factors do affect the user's perceptions of interface pleasure, the original content page from the first experiment was chosen as the control group in the second experiment for comparison purpose. This is because this Website is designed with one image and some description texts that are easy to be modified for further experiment. Furthermore, in order to know how large the dynamic image should be used on the Website introduction page, two smaller scales, 70% and 40% reduction from the original image of the control group, were adopted for the experiment. By reducing the image into smaller scales, the researchers would be able to verify if they might result in negative effects.

In the end, a total of five different websites was used in the second experiment (see Figure 2). Website 1 was the original content page without any modifications for control purpose. Website 2 was designed with 70% size reduction on its dynamic image from the control group. Website 3 was designed with 40% size reduction on its dynamic image from the control group. Website 4 was designed with simple, clean, and fresh colors. Website 5 was designed with dynamic icons.

In this experiment, fifteen student volunteers were recruited from the Graduate School of Design in National Taiwan University of Science and Technology. None was paid for taking part in this experiment, and they did not participate in the first experiment. They all have at least five years computer experience. The participants were asked to interact with these five different Websites in a random order to prevent possible sequential effects. After that, they were required to fill out a questionnaire and accepted a brief interview. The questionnaire was designed based on a 7-interval Likert Scale. By so doing, the researchers could investigate their perceptions of interface pleasure among these five Websites.

3.3. The third experiment

The aim of the third experiment is to validate design guidelines pertaining to interface pleasure generated from the first experiment by means of young children's perceptions. That is, the experiment results generated from the first experiment were used to help investigate young users' metacognitive awareness of Website user interface pleasure. In this experiment, 10 pre-selected Websites used in the first experiment were adopted again. They were shown to 7 young children who are in the fifth grade of an elementary school. Both observation and think-aloud techniques were also used to help collect their perceptions of Website user interface pleasure. Due to the fact that young children were not as patient as adults and their vocabulary was limited, the authors guided these participants to express their views slowly. After the experiment, a brief interview was conducted to ask their

opinions (e.g., agree or disagree) on general principles generated from the first experiment regarding Website user interface pleasure.

Website 1. Original content page



Website 2. Designed with 70% size reduction on its dynamic image



Website 3. Designed with 40% size reduction on its dynamic image



Website 4. Designed with simple, clean, and fresh colors



Website 5. Designed with dynamic icons



Figure 2. Five Website designs for the second experiment

4. Results and Discussions

4.1. Results generated from the first experiment

The results generated from the first experiment were mainly from the observation and think-aloud techniques. That is, the participant's metacognitive strategies used for interacting with testing Website were observed and recorded for further analysis. In addition, the participants' think-aloud protocols were first transcribed into written texts. After that, the contents of the protocols were analyzed and summarized. The important design factors regarding the participant's perceptions of interface pleasure were pointed out and the frequency of mentioning pertaining to interface pleasure or displeasure was also calculated. These Website design factors that affect a user's perceptions of interface pleasure were summarized as design guidelines to help create pleasurable Website user interfaces. Participants' detailed descriptions with mentioned frequency are provided as follows:

- A. Introduction animation
 - a.1 Require introduction animation
 - Need loading feedback (9)
 - Animation should be simple (6)
 - Need "Skip" button (4)
- B. The overall image of the introduction page
 - b.1 The perception of the introduction page
 - Should be simple, clear and understandable (18)
 - Users can read the whole page at one time (14)
 - Should provide eye focus (9)
 - b.2 The color of the introduction page
 - Need to have appropriate vivid colors (11)
 - Need to adopt fresh colors (7)
 - b.3 The perception of the primary image
 - The size of the image should be large (10)
 - The image should be consistent with the theme of the Website (7)
 - b.4 The figure and ground perception
 - The text visibility should be clear (42)
 - The description text should be of appropriate size (30)
 - The figure and ground should be simple, clean, and clear (10)
 - b.5 The frame and layout of the introduction page
 - The frame should be design with consistency (19)
 - The frame should be clearly presented (14)
- C. The overall perception of content pages
 - c.1 The design of content pages
 - Should be consistent with the introduction page (82)
 - Should be designed with clear visibility (6)
 - c.2 The color of content pages
 - Should be simple and clear (14)
 - c.3 The images and texts of the content pages
 - The images and texts should be in similar proportions (10)
 - c.4 The size of the texts
 - Should adopt an appropriate text size (30)
 - c.5 The dynamics of background
 - Should adopt a simple dynamic background, but should not affect users' text-reading activity (19)
 - c.6 Pleasurable animations
 - Better to have pleasurable animations (9)
 - c.7 The frame of the content pages
 - Users should be located in the same frame while browsing through pages (8)
 - c.8 The layout of the content pages
 - The content pages should be designed with consistency (18)
 - Avoid slow loading time (9)
- D. Screen buttons
 - d.1 The overall perceptions of screen buttons
 - The screen buttons should be sensed easily (31)
 - Provide clear functional indications (26)
 - Buttons should be designed with appropriate icons (23)

Need to provide interactivity and feedback (22)
The visibility of the button text should be clear (20)

4.2. Results generated from the second experiment

The results generated from the questionnaire of 7-interval Likert Scale were first analyzed. The mean, standard deviation and ANOVA results (under $\alpha=0.05$) of each pair of polar adjectives among these five Websites were summarized in Table 1. A subsequent Least Significant Difference (LSD) post-hoc test was conducted if the significant difference did exist. The results were described as follows:

Table 1. The means, (standard deviation), and one-way ANOVA results of each pair of polar adjectives among these five Websites

Polar adjectives	Website 1	Website 2	Website 3	Website 4	Website 5	F	P
Displeasure vs. pleasure	4.200 (1.207)	3.933 (1.033)	4.400 (1.352)	5.800 (0.775)	5.067 (0.961)	7.24	0.000*
Dirty vs. clean	5.667 (0.816)	5.067 (1.033)	5.667 (0.724)	5.933 (0.704)	5.000 (1.134)	3.14	0.020*
Blurred vs. clear	5.533 (1.246)	4.800 (1.265)	5.467 (0.743)	6.000 (0.875)	5.600 (1.121)	2.48	0.052
Colorless vs. colorful	3.867 (1.302)	3.267 (1.223)	4.200 (1.146)	5.267 (0.884)	4.333 (1.447)	5.43	0.001*
Formal vs. lively	4.067 (1.280)	3.267 (1.163)	4.467 (1.246)	5.467 (0.990)	5.333 (1.047)	9.45	0.000*
Static vs. dynamic	4.600 (1.595)	3.733 (1.335)	4.733 (0.961)	4.929 (1.439)	5.400 (1.056)	3.31	0.015*
Unlovely vs. lovely	3.533 (1.407)	2.867 (0.834)	3.667 (1.175)	4.933 (1.335)	4.200 (1.320)	5.93	0.000*
Uncomfortable vs. comfortable	5.200 (1.014)	4.533 (0.915)	4.867 (1.407)	5.800 (1.014)	5.067 (1.223)	2.58	0.045*
Dislike vs. like	5.467 (1.302)	4.667 (0.976)	5.067 (1.223)	5.467 (1.125)	5.400 (1.056)	1.39	0.246
Ordinary vs. extraordinary	4.733 (0.961)	3.667 (1.345)	4.333 (1.291)	5.400 (1.121)	5.133 (0.990)	5.28	0.001*
Dull vs. vivid	4.000 (1.069)	2.800 (1.207)	3.933 (1.335)	5.533 (0.834)	4.467 (1.187)	11.29	0.000*
Dark vs. bright	4.400 (1.454)	3.467 (1.302)	4.067 (1.280)	6.067 (1.387)	4.467 (1.125)	8.08	0.000*

* means $P<0.05$, statistically significant difference exists

4.2.1. Displeasure vs. pleasure

Based on the results from one-way ANOVA, there existed a statistically significant difference among these five Websites ($F=7.244$, $p=0.000<0.05$). The subsequent LSD test results suggested: (1) Website 1 is different from Website 4 and 5; (2) Website 2 is also different from Website 4 and 5; (3) Website 3 is different from Website 4. We may infer that if a Website is designed with simple, clean, and fresh feels, it may provide participants with pleasurable perceptions. Similarly, if a Website is designed with dynamic buttons, it may also increase its interface pleasure.

4.2.2. Dirty vs. clean

The ANOVA results indicated that there existed a statistically significant difference among these five Websites ($F=3.137$, $p=0.020<0.05$). The subsequent LSD test results indicated: (1) Website 1 is different from Website 5; (2) Website 2 is different from Website 4; (3) Website 3 is different from Website 5; (4) Website 4 is different from Website 5. The

post-hoc test results indicated that a large, dynamic, and interesting image will provide users with clean and clear feels, which will lead to their perceptions of interface pleasure. A small image will cause negative perceptions.

4.2.3. Blurred vs. clear

The ANOVA results indicated that there existed no statistically significant difference among these five Websites ($F=2.478$, $p=0.052>0.05$). Therefore, participants' interface perceptions regarding blurred vs. clear towards these five Websites were the same. This may be due to the fact that all the Website samples were recreated based on the control group, so the difference was not significant.

4.2.4. Colorless vs. colorful

The ANOVA results indicated that there existed a statistically significant difference among these five Websites ($F=5.428$, $p=0.001<0.05$). The subsequent LSD test results revealed: (1) Website 1 is different from Website 4; (2) Website 2 is different from Website 3, 4, and 5; (3) Website 3 is different from Website 4; (4) Website 4 is different from Website 5. The post-hoc test results showed that using simple and clean design strategies and providing the Website user interface with fresh colors will result in users' colorful perceptions, which will lead to their perceptions of interface pleasure.

4.2.5. Formal vs. lively

The ANOVA results indicated that there existed a statistically significant difference among these five Websites ($F=9.453$, $p=0.000<0.05$). The subsequent LSD test results showed: (1) Website 1 is different from Website 4 and 5; (2) Website 2 is different from Website 3, 4, and 5; (3) Website 3 is different from Website 4 and 5. The post-hoc test results revealed that using simple and clean design strategies and adopting fresh colors and dynamic buttons will provide users with vivid interface feels, which will lead to their perceptions of interface pleasure. A large, dynamic, and interesting image will also offer users with the same perceptions.

4.2.6. Static vs. dynamic

The ANOVA results indicated that there existed a statistically significant difference among these five Websites ($F=3.305$, $p=0.015<0.05$). The subsequent LSD test results suggested that Website 2 is different from Website 3, 4, and 5. The post-hoc test result showed that dynamic buttons would provide users with more dynamic feels, which will lead to their perceptions of interface pleasure. A large, dynamic, and interesting image will also allow users to have more dynamic interface perceptions.

4.2.7. Unlovely vs. lovely

The ANOVA results indicated that there existed a statistically significant difference among these five Websites ($F=5.927$, $p=0.000<0.05$). The subsequent LSD test results indicated: (1) Website 1 is different from Website 3; (2) Website 2 is different from Website 4 and 5; (3) Website 3 is different from Website 4. The post-hoc test results revealed that Websites designed with simple and clean strategies and with fresh colors may make users have feelings of loveliness, which will lead to their perceptions of interface pleasure.

4.2.8. *Uncomfortable vs. comfortable*

The ANOVA results indicated that there existed a statistically significant difference among these five Websites ($F=2.579$, $p=0.045<0.05$). The subsequent LSD test results showed: (1) Website 2 is different from Website 4; (2) Website 3 is different from Website 4. The post-hoc test results showed that Websites created with simple and clean strategies and with fresh colors may give users feelings of comfort, which will lead to their perceptions of interface pleasure.

4.2.9. *Dislike vs. like*

The ANOVA results indicated that there existed no statistically significant difference among these five Websites ($F=1.390$, $p=0.246>0.05$). Therefore, participants' interface perceptions regarding dislike vs. like towards these five Websites were the same.

4.2.10. *Ordinary vs. extraordinary*

The ANOVA results indicated that there existed a statistically significant difference among these five Websites ($F=5.283$, $p=0.001<0.05$). The subsequent LSD test results revealed: (1) Website 1 is different from Website 2; (2) Website 2 is different from Website 4 and 5; (3) Website 3 is different from Website 4. The post-hoc test results revealed that Websites designed by using simple and clean strategies and adopting fresh colors may give users extraordinary feelings, which will lead to their perceptions of interface pleasure. A Website designed with a large, dynamic, and interesting image will also cause users to have similar perceptions.

4.2.11. *Dull vs. vivid*

The ANOVA results indicated that there existed a statistically significant difference among these five Websites ($F=11.291$, $p=0.000<0.05$). The subsequent LSD test results indicated: (1) Website 1 is different from Website 2 and 4; (2) Website 2 is different from Website 3, 4, and 5; (3) Website 3 is different from Website 4; (4) Website 4 is different from Website 5. Based on the post-hoc test results, we may infer that Websites created with simple and clean strategies and with fresh colors may give users feelings of vividness, which will lead to their perceptions of interface pleasure. A Website designed by using a large, dynamic, and interesting image will also cause users to have similar perceptions.

4.2.12. *Dark vs. bright*

The ANOVA results indicated that there existed a statistically significant difference among these five Websites ($F=8.077$, $p=0.000<0.05$). The subsequent LSD test results showed: (1) Website 1 is different from Website 4; (2) Website 2 is different from Website 4 and 5; (3) Website 3 is different from Website 4; (4) Website 4 is different from Website 5. The post-hoc test results revealed that Websites designed with simple and clean strategies and with fresh colors may give users feelings of brightness, which will lead to their perceptions of interface pleasure. A Website designed by using a large, dynamic, and interesting image will also cause users to have similar perceptions.

Based on the statistical results, most of the participants felt that Website 4 was equipped with simple and clean feels, and with fresh colors, which offered them better perceptions

of interface pleasure than the control group, i.e., Website 1. In addition, Website 2 was created based on 70% size reduction and Website 3 was designed with 40% size reduction on the dynamic image of the control group. Because Website 2 had more size reduction, it might cause greater impact on users' perceptions of interface displeasure than Website 3. After comparing the average ratings of twelve pairs of polar adjectives, the means of Website 3 were all higher than those of Website 2. This means that most of the participants agree that adopting a large, dynamic, and interesting image on the Website can result in better perceptions of interface pleasure. Finally, though the size of the dynamic button only takes up a small interface portion, participants still can feel its existence. In fact, a dynamic button on the Website may increase users' perceptions of interface pleasure as well.

4.3. *Results generated from the third experiment*

The result generated from the third experiment showed that young children's perceptions of Website user interface pleasure were similar to adults'. Nonetheless, there exist some differences:

- (1) Most of the young children's perceptions of Website user interface pleasure mainly relied on interface usability. Their psychological feels of Website user interface design were less important. Because the texts shown on the Website may contain too much vocabulary, most of the young users' prefer to interact with the Website designed with vivid drawings or photos. These may seem more interesting to them.
- (2) Young children tended to be more subjective in judging the degree of Website user interface pleasure than adults. In fact, the content and style of the Website showed less influence on their perceptions of interface pleasure. For instance, during the experiment, one child revealed that he did not possess any preferred Website style or color. However, he would have a subjective perception regarding interface pleasure if he liked the color of the Website.
- (3) Young children tended to perceive commonly used Website user interface design principle as the basic style for Website user interface pleasure. Based on the interview, most of them preferred buttons located on top of the Web page, and followed by locating on the left. This is very similar to most of the commonly used Website design strategies.
- (4) Young children tended to be in favor of dynamic effects of Website information no matter what style it is. They will respond to this effect with their eye focus. They will not care if this dynamic effect blocks the content texts on the Web page.
- (5) Young children tended to like to click on the round buttons on the Web page. Doing so can provide them with better interface pleasure as well. Buttons designed with round corners have similar but less effect.
- (6) A Website user interface designed with surprising factors can better be accepted as well. Young users will repeatedly test the surprising design technique until they become less curious. The more surprising effects shown on the Web page will induce the more interface pleasures.

- (7) Interface usability is still the base for achieving interface pleasure when creating Website for children. That is, the Website should clearly reveal all its useful functions to the young users without letting them to guess how to interact with the Website. Otherwise, they will become frustrated and have less desire to use the Website even though it is designed with many surprising factors.

5. Conclusions

This paper is intended to investigate users' metacognitive strategies pertaining to their perceptions of interface pleasure when interacting with the WWW. This research study was conducted by means of three experiments.

The first experiment adopted both observation and think-aloud methods. Participants were invited to interact with 10 pre-selected Websites and think out loud their perceptions of interface pleasure occurred during the interacting processes. Both note-taking and voice-recording techniques were used to help collect the data. Based on the results, the important design factors regarding the participant's perceptions of interface pleasure were identified and summarized as design guidelines to help create pleasurable Website user interfaces.

In the second experiment, three important Website design factors that might affect a user's perceptions of a Website's interface pleasure were adopted to help create new Websites. Based on these factors, a total of five different websites were used for the second experiment. A 7-interval Likert Scale questionnaire was created to investigate participants' interface perceptions of twelve pairs of polar adjectives among these five different Websites. The results generated from the statistical analysis indicated that most users felt that a simple and clean Website designed together with fresh colors can give them better perceptions of interface pleasure. Furthermore, a Website designed by adopting a large, dynamic, and interesting image on the introduction page will also have the same effects. Finally, though the size of the dynamic button only takes up a small interface portion, participants still can feel its existence. A dynamic button on the Website may increase users' perceptions of interface pleasure as well.

In the third experiment, 10 pre-selected Websites used in the first experiment were adopted again. They were shown to 7 young children who were in the fifth grade of an elementary school. Both observation and think-aloud techniques were also used to help collect their perceptions of Website user interface pleasure. After the experiment, a brief interview was conducted to ask their opinions (e.g., agree or disagree) on general principles generated from the first experiment regarding Website user interface pleasure. The result generated from the third experiment showed that young children's perceptions of Website user interface pleasure were similar to adults'. Nonetheless, there exist some differences: (1) Most of the young children's perceptions of Website user interface pleasure were mainly rely on interface usability. Their psychological feels of Website user interface design

were less important; (2) Young children tended to be more subjective in judging the degree of Website user interface pleasure than adults; (3) Young children tended to perceive commonly used Website user interface design principle as the basic style for Website user interface pleasure; (4) Young children tended to be in favor of dynamic effects of Website information no matter what style it is; (5) Young children tended to like to click on the round buttons on the Web page; (6) A Website user interface designed with surprising factors can better be accepted as well; (7) Interface usability is still the base for achieving interface pleasure when creating Website for children.

It is hoped that by investigating both adults' and young children's metacognitive awareness regarding their perceptions of Website user interface pleasure, interaction designers are able to create better Website user interfaces specifically for these two different user groups and that are more fun to interact with.

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