Towards Accessible Representations of Time: Learning from the Preferences of Children and Adults

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ABSTRACT

Representations of time are used in many contexts, yet the decoding of time can be challenging for users with various cognitive profiles. The digital representation of time is perhaps the most common. This study performed a simple study to explore the time representation preferences among children and adults. Children were chosen as they may have different cognitive profiles to adults. The results show that the opinion of children is more divided than among adults. Children generally prefer the analogue representation, while adults consistently prefer the digital representation. The results suggest that the digital representation of time using digits may not necessarily be the best choice.

CCS CONCEPTS

• *Human-centered computing → Accessibility → Empirical studies in accessibility*

KEYWORDS

Time representation, analog time, digital time, young users

1 INTRODUCTION

The notion of time is important in many aspects of life. Various representations of time exist and notably the two most common time representations are the traditional analog clock face and the more contemporary digital clock that uses digits to represent time. The digital time representation is probably the most commonly used in user interfaces. This may be because time can be displayed non-graphically using characters.

The digital time representation is no challenge for computer users with high literacy and basic education. However, in context of diverse users we argue that one cannot assume that all users are comfortable decoding digital time. Some users have limited education, other have reduced cognitive functioning, others have learning disorders. This study set out to explore this phenomenon. It is quite challenging to recruit individuals with diverse cognitive and educational profiles and we therefore decided to explore this problem using children. Children are not fully developed cognitively, and they have not yet completed their basic education. Moreover, children constitute an increasingly important group of computer users.

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2 RELATED WORK

A study of 240 schoolchildren's ability to decode time [4] found that first graders were able to successfully decode digital time, while this group only was able to decode full hour analog clock tasks. Even fifth graders struggled to decode some analog time representations. Boulton-Lewis, Wilss, and Mutch [1] found that schoolchildren generally found it easier to read digital times than analog times, but these children may not necessarily understand what they have read. Moreover, they found that at fourth grade children started to employ systematic strategies relating to the 60 minutes in an hour.

Vakali [5] addressed children's ability to decode and encode time. Encoding of time was more difficult than decoding, and the abilities were related to age. Decoding has also been connected to children's mathematics abilities [2] in that children who struggle with mathematics also have reduced time decoding skills. A comparison of Chinese and Flemish schoolchildren found that the Chinese children's time skills were two years ahead, and this difference was attributed to the school curriculum [3].

Although children's abilities to decode and encode time has been addressed, there appears to be no studies addressing children's preferences for representations of time.

3 METHOD

3.1. Experimental design

To probe the preferences of the participants a simple and short questionnaire was devised with two Likert questions with 5 alternatives where 1 indicated low, 3 indicated neutral and 5 high. The first question probed the participants preferences for the analog clock and the second question asked participants about their preferences for digital clocks. It was decided to keep the two questions separate for simplicity instead of employing a differential

scale. This allowed the participants to focus on one issue at a time.

3.2 Participants

A total of 59 responses were solicited, of which 28 were children and 31 were adults. The children comprised mostly 10-year old 4th graders recruited at Klemetsrud Elementary School in Oslo, Norway with the consent and advice from the head of the school. The adults were university students recruited from the authors own institution.

3.3 Procedure

Research involving children is more challenging than research involving adults, both in terms of the experimental design and for the access to participants. Responses to the questionnaire were therefore collected orally to minimize stress and to avoid any misunderstandings. Two of the experimenters collected responses from the children at the last 10 minutes of a class with the teacher present. The responses were collected individually, and the participants were rewarded with sweets. The ordinal responses were rank aligned transformed (ART) and analyzed using a repeated measures ANOVA in JASP 0.8.6.0.

4 RESULTS

Figure 1 summaries the results as a diverging stacked bar chart with neutral responses on the right. The histograms of the responses show a quite striking trend, namely that children expressed a preference for the analog clock (*mode* = 5), while the adults exhibited a preference for the digital clock (*mode* = 5). The between-groups difference between children and adults was statistically significant ($F(1, 57) = 24.93$, $p < .001$, $\eta^2 = 0.304$).

The within-groups difference of clock type was not significant ($F(1, 57) = 0.575$, $p = .451$). However, there was a significant interaction of age and clock type ($F(1, 57) = 15.648$, $p < .001$, $\eta^2 = 0.213$).

The children exhibit a lower preference for the digital clock (*mode* = 2). A Wilcoxon signed rank test reveals that the mean responses for analog ($M = 3.6$, $SD = 1.2$) and digital ($M = 2.6$, $SD = 1.3$) time representations are significantly different ($W = 240.5$, $p = .035$). This is interesting given previous studies that suggests that children are better at decoding digital time [2].

The adults' preference for the analog clock is more neutral (*mode* = 3). A Wilcoxon signed rank test shows that the mean preference is significantly different for the analog ($M = 3.4$, $SD = 1.1$) and digital ($M = 4.4$, $SD = 0.8$) time representations ($W = 33.0$, $p = .002$).

These results also show that the children have more neutral responses (25%) for the digital clock, while adults exhibit more neutral responses for the analog clock (38.7%). Moreover, the children's ratings of the digital time representation have the largest spread suggesting that this is associated with the largest disagreement.

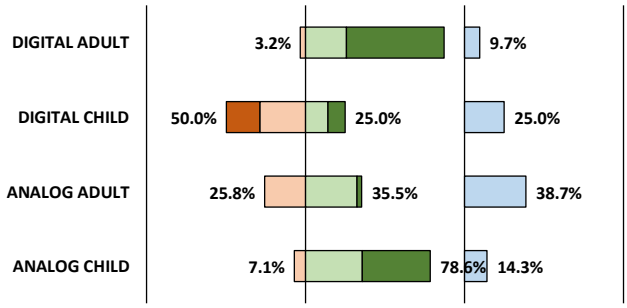

Figure 1. Results

In contrast, the adults rating of the digital time representation is associated with the smallest spread and the highest mean, signaling the strongest agreement in responses.

5 CONCLUSIONS

The preference for time representations among children and adults were compared. The results show that children have significantly different preferences to adults and that they are more in favor of analog clocks than digital clocks. Consequently, the representation of time should be carefully considered in relation to the audiences when designing user interfaces that involve time. One option is to employ redundant representations of time using both analog and digital representations. Future work includes exploring if children's preference for time representations are related to their time decoding skills.

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