Icons for Kids: Can Young Children Understand Graphical Representations of App Store Categories?

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ABSTRACT

This paper proposes the use of graphical representations – colloquially referred to as "icons" – of app-store program categories and provides evidence via a user study that these icons can be understood by young children (aged 4-8). Given the rapid growth of this user base, providing such graphical representations is important to aid young children in navigating (under usual parental supervision) and understanding the large number of apps available. This work further provides an initial set of candidate graphical representations that have been evaluated with children, which serve as a starting point for future implementations and exploration.

Keywords: Children and technology; categorization; icons

Index Terms: H.5.m. Information interfaces and presentation: Miscellaneous.

1 Introduction

With over 1.2 million apps in each of the Apple and Google app stores, labeling schemes such as categories or genres are used to aid people in browsing applications, finding what they need, or even understanding what to expect from an application. These categories are overwhelmingly portrayed using textual labels such as, for example, "Sports" or "Adventure" on the Google Play store. However, such representations may be less comprehensible to young children with still-developing reading skills, one of the most rapidly growing user bases on mobile platforms [13]. For example, a 2013 US-based survey reported that up to 75% of children under the age of eight had access to a mobile device at home, an increase of 23% over the 2011 data [6].

Prior research suggests that parents want to give even their young children a voice when it comes to selecting content from app store repositories [11]. For example, parents with children aged 6-8 have expressed a desire to work with their children to select appropriate content and to use such interactions as a platform for discussions on family-specific views of content appropriateness [11]. To facilitate such discussions, we propose investigating ways to improve the understandability of app-store categorization systems for children. There is initial evidence that app-store categories, and perhaps graphical representations, may be understandable by children [4]. However, there has not yet been a formal, methodological testing of this question: can graphical representations be used to represent common categories found in app-stores in a way that young children (i.e., 8 and under) can readily identify and understand? If so, then adding such graphical representations could be an important step in improving the usability of app stores for this rapidly growing user base.

In this paper, we provide support for using graphical category representations for young children. We surveyed major app stores to develop a representative sample of categories, created an original, initial set of corresponding graphical representations ("icons"), and conducted a laboratory study with twelve children aged 4-8. We found that the children in our study were able to understand our graphical representations with accuracies over 80%. This finding suggests that graphical representations could be added to app stores to increase the accessibility of their content classification to young audiences.

2 Related Work

Child-computer interaction is an emerging field that examines how children and adults differ cognitively and physically, and investigates the need for child-specific technology and interaction techniques [2]. A core of this work has sought to create guidelines for designing technology for children (e.g., [5,7,12]), with a sweeping recommendation being to increase the use of graphical representations rather than relying on interface text [8,12]. We follow this approach and further examine the feasibility of icon-like graphical representations of common app-store categories.

A body of prior work surrounds children's use of internet-connected mobile devices and even app stores (e.g., [1,3,11]). One finding from this work is that children access these stores frequently and that up to 70% have difficulty finding the content that they want [3]. We extend this work by proposing a child-targeted method that can help to mitigate this navigational challenge. We note that this approach is not advocating that children have free-reign in downloading content. Rather, we propose graphical representations to enable children to make more informed decisions under the assumption that existing parental control strategies would remain in effect [11].

Research in developmental psychology highlights that young children as early as ages two or three are able to categorize ideas and objects thematically and/or taxonomically [10]; this highlights the importance of improving the accessibility of app-store categories for children. We are aware of only one previous child-focused work on app classification, which tasked children ages 8-10 with grouping existing apps thematically [4]. The results suggest that children within this age group readily develop app groupings, further suggesting the use of categories in app stores. Our work builds directly from this by proposing a method to expose the existing app-store categorization in a child-friendly way, using graphical icon representations, and by providing evidence for the feasibility of this approach.

3 Representative App-Store Categories

We selected a set of app-store categories that are representative of the general categories used, and designed a set of graphical representations ("icons") to represent those. For this initial

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Category	Definition
Action	Fast moving games where there is fighting and danger.
Adventure	Games where there is a story and you complete activities to reach the end.
Arcade	Short and usually easy games where you need to be fast and good with the controls.
Board or Card	Board games or card games.
Casino	Games where you need to have luck to win money or tokens. Games played by adults only.
Learning	Games that are meant to teach you things.
Music	Games related to music, sound, or dance.
Puzzle	Games that include matching words or numbers, and puzzles.
Racing	Games where you race with/against others.
Role Playing	Games where you pretend be a character or play with imaginary characters.
Sports	Games about sports.
Strategy	Games where you need to think hard and plan ahead to win.

Table 1: The categories used in our study and their child-friendly definitions.

exploration we work with games only, given their relevance to children. Although there is no standard classification system for game content, we developed a representative set by surveying the existing categories used in four major app stores: Apple, Google, Samsung, and Microsoft. We selected a final set of twelve categories that appeared in all or most stores, and combined overlapping ones (e.g., "board" and "card"): action, adventure, board or card games, music, puzzle, role playing, sports, strategy, learning, racing, arcade and casino. The twelve categories and their descriptions are listed in Table 1.

3.1 Icon Design

We designed an initial set of representational icons for our categories under guidance from knowledge in child development: we aimed for child-friendly images (e.g., violence-free), avoided region- or culture-specific conventions, and strived for child-understandable references. For example, we avoided weapons or fighting for the "action" category, and did not use an arcade machine for "arcade" as today's children are less likely to be familiar with the reference. After developing concept sketches, we hired a professional graphic designer to create the final icons. We note that we do not propose this as a final or even strong set that could be used in commercial practice, but rather as an initial set that serves the purposes of our exploratory study; further icon development should follow a full iterative design process to find stronger icons. Our icons are listed in Table 2.

4 Study

We conducted a laboratory study to investigate if children could readily identify which icons are associated with their intended categories. We verbally presented children with a category name and definition, and tasked them with selecting the icon they felt best represented that category.

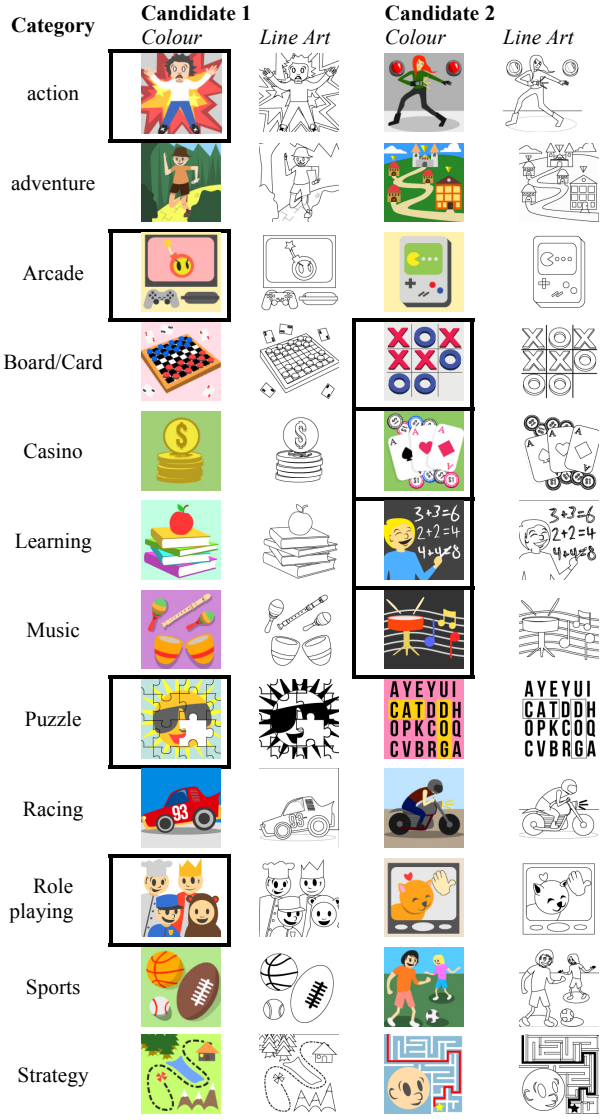

Table 2: The icons that we developed for our study in collaboration with a graphic designer. The bolded cells represent children's preference, if any, that emerged in our study (a minimum of 70% agreement).

4.1 Participants

Thirteen participants between four- and eight-years old completed the study, recruited via signs posted throughout a university campus and the surrounding community. We removed one child's data from our analysis – from a six-year old boy who consistently selected images with material he liked (i.e., spies) for all categories. The remaining 12 participants (8 girls, 4 boys) had a mean age of 6.0. We included 8 children in the 6-8 age range, which we view as the primary target audience for this type of graphical approach. As a stress-test for the understandability of the icon set, we also included 4 children ages 4-5. We acknowledge that this is a small sample; however, given the specialized nature of our study population, we aimed to provide initial evidence of the merit of the approach (and the icons themselves) prior to moving towards larger-scale studies. We provided children with a small toy and their parent with a $10 gift card for their participation.

4.2 Method

We based our study tasks on the validated and widely-used Peabody Picture Vocabulary Test (PPVT) [9], an instrument for assessing young children's vocabulary. The PPVT works as follows: the child is verbally supplied with a word and asked to select, from a candidate set of four images, the image that best represents that word. We adapted this test to our problem of category icon identification by providing children with the category name and description (see Table 1 for the definitions provided) and asking them to select the icon that best represents that category from a set of four candidates.

One concern with our study was that a particularly poor icon design – that children do not understand – could skew the results. Given our purpose of investigating if children could understand icons that represent categories, we provided two candidates for each category. That is, in each round of the Peabody test, children were provided with two correct (but different) category icons and two randomly selected incorrect distractors. While including two plausible choices limits the power of our study by increasing the likelihood of being correct by chance, it also avoids the pitfall of a particularly bad icon design skewing the results on the bigger question. We had explored the idea of increasing the number of distractors present, but were advised against it by those with experience using the PPVT with this age group (namely the paper's fifth author). A second concern was that children may simply choose icons that are more colourful and visually engaging. To rule out this possibility, we further added a study condition with line-art versions (no colour) of the icons, as explained below. At no point were colour or line-art icons mixed.

Children completed our study individually (but with their parent next to them). We started each child with three practice trials with familiar categories not related to the main study (pets, shoes, and play structures). The child then completed 12 selection tasks (one per category) – where a task consisted of receiving verbal stimulus and selecting a category icon from a set of four (two correct and two distractors). This set of 12 was completed twice, once with the line art and once with colour icons. To mitigate potential learning effects, the order of icon-style presentation was counterbalanced.[1]

The trials were conducted via a 7-inch Android tablet, which recorded selections and times. All icons were displayed in a common 1.5x1.5cm size.

4.3 Results

Our primary dependent measure of interest was accuracy, or in other words, the percentage of trials where the child correctly identified one of the two "correct" icons given the supplied app category and description (i.e., a continuous variable measured on a per-participant basis). On average, the children selected one of the two correct icon candidates (of the four given) 84% (se: 3.6%) of the time, which was better than the 50% expected by chance alone (one-sample t-test, $t_{11} = 9.245$, $p < .001$). In two thirds of the cases, a clearly preferred icon variant (one of the two) emerged for a category, including 4 categories with perfect or near perfect (>90%) agreement (board or card, learning, casino, and role playing), and another 4 with strong agreement (>70%) (action, arcade, music, puzzle). These preferences are outlined in Table 2.

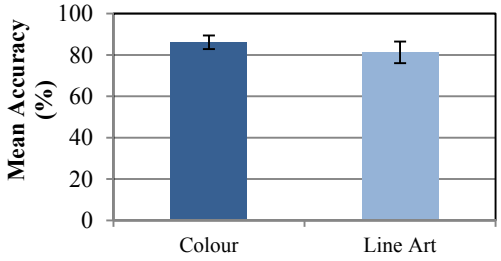

Figure 2: Mean accuracy for each Icon Style. Error bars represent standard error.

We found no difference in accuracy between the *Colour* (86%, se 3.3%), and *Line Art* variants (81%, se 5.2%; $t_{11} = 1.00$, $p = .339$, $\eta^2 = 0.08$, observed power = 0.15). These results are depicted in Figure 2. Similarly, we found no difference in time taken to make a selection between the *Colour* (5.14s, se 0.32s) and the *Line Art* icons (5.11s, se 0.42s; $t_{11} < 1.00$, $p = .957$, $\eta^2 = 0$, observed power = 0.05).

Across conditions, selection accuracy was positively correlated with age ($r^2 = 0.64$, $p = 0.002$). Figure 3 displays the results by age, and raises the possibly that, in addition to a general positive correlation, our four- and five- year olds had difficulty identifying the *Line Art* icons. We are careful to note, however, that our sample sizes for these age groups are small and that further data from children in each age group would be needed to verify this trend.

4.3.1 Impact of Category

Dissecting the overall accuracies into individual categories, we gain insight into whether or not there were any particularly problematic icon-to-category pairings. These results are illustrated in Figure 4. Most categories had relatively high accuracy, with 8 of the 12 categories having an overall accuracy of at least 80%. Only one category had an accuracy that was less than 75% – the arcade category (63%). One potential explanation is that this is a somewhat dated cultural reference that lacks meaning for young children, a finding consistent with prior work [4].

5 Discussion

Our results provide some initial evidence that, when presented with a category description, young children can associate icons with the categories commonly utilized by app stores. Children in our study as young as five correctly matched an icon with its category over 80% of the time, while the children who were six to eight achieved accuracies of over 90%. This suggests that the addition of icons to existing textual representations may be a powerful way to increase the usability of app stores for children, in similar ways that categories help adults, by supporting app browsing and searching.

Further study is required to both verify that the results generalize to a larger sample, and to determine how high accuracy should be

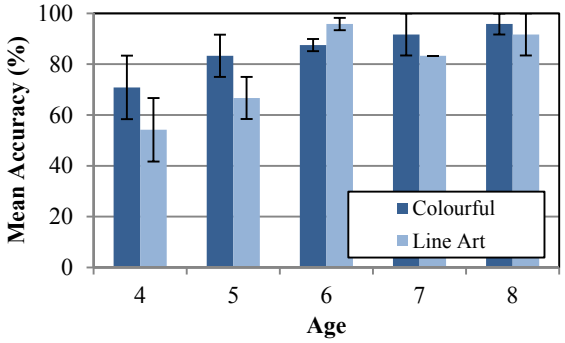

Figure 3: Mean accuracy for each by Age by Icon Style. Error bars represent standard error.

[1] Due to a recording error, 7 children started with colour icons and 5 with line art icons; however, no order effects were found.

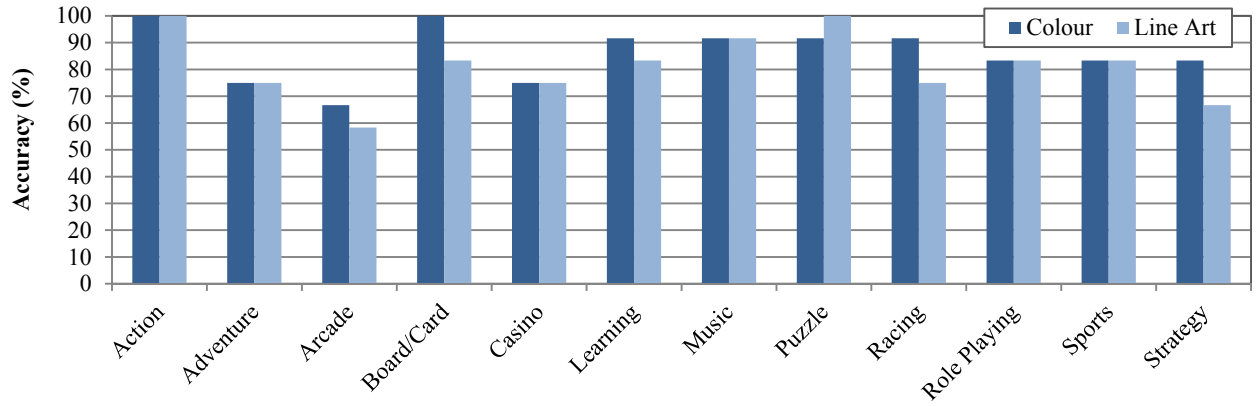

Figure 4: Total percentage of correct selections for each category.

in practice, for the icons to serve as useful browsing tools. There may also a concern over safety, where children may navigate to inappropriate topics. As described earlier, however, prior work highlights that parents already have a number of mechanisms for content control [11], which we expect to remain in place. We would argue that relying on categorization schemes that children cannot understand is likely not the solution to access control – parental control mechanisms will need to remain in place regardless of whether or not children are able to understand how an app how been categorized. Finally, given that our use of the Peabody Picture Vocabulary Test with only two distractors, further study is need to verify that children can identify the intended icons among a wider set of available options.

Looking at when our icons did not work, sources of confusion were primarily isolated to a few specific categories. Perhaps some categories may be difficult for young children to understand (e.g., the dated reference to "arcade"), but we also have to consider that our particular icons – and not the categories themselves – may not work as well as intended. We reiterate that iteratively designed icons (with testing) would likely be more robust, but highlight that even our initial proposals achieved high accuracy, lending support to our approach.

Whether an icon was coloured or not had little impact on how accurately children associated it with the intended category. This finding is encouraging as it suggests that designers have flexibility to tailor colour schemes to suit the context in which icons are used, with less concern over how distracting an engaging scheme may be. Children may be focusing on icon content and not the colour.

6 Summary

Overall, we propose the use of icons to represent app-store categories in a way that is accessible and recognizable by children, and presented study results that lend support to this direction. We believe that children, a rapidly growing user segment for mobile technologies, deserve to have their devices tailored to their specific needs and abilities, and that interfaces should provide mechanisms that help improve usability and their user experience. Our technique provides one such method, and we hope that this can serve as a catalyst for more work on developing child-friendly mobile interfaces.

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