

BRIEF REPORT

Smartphone apps can entertain and educate children aged two to six years but should be used with caution

Children prefer touch screen devices such as tablets and smartphone to other media (1), and some use them on a daily basis (2). The interactive nature of smartphones can facilitate informal learning (3) and foster creativity in young children (4), but apps are only useful if they are appropriate. This study estimated the effectiveness of 10 apps that we designed to entertain and educate children aged 2–6 years (Table S1).

We conducted the study on two groups of children at a combined playgroup and primary school in New Delhi in July 2017. The first group consisted of 30 children (15 male) aged 2–3 years, who were provided with a smartphone with six of the apps. The other 30 children (15 male) aged 4–6 years were given the other four apps. We observed the children as they used the apps, noting the number of times they used apps with well-defined end-points or the time they spent using apps that allowed continuous play.

Although some of the apps provide the children verbal instructions, they are designed to be used with the help of an adult. The apps typically encourage children with auditory and visual surprises such as applause, fireworks and congratulatory messages when they perform well. The apps are safe, do not require an Internet connection and do not reveal any personal user information. They do not contain any advertisements or require renewals or upgrades.

The following apps were tested by the children aged 2–3 years. *Mood Swings* explores common human emotions, and an audio clip related to that emotion is played when children tap on the relevant emoticon. *Baby's Balloons* allows children to inflate a balloon by touching the screen with their finger and then let it fly away by removing the finger. *Taste of Zoo* shows pictures of different animals and birds and plays their characteristic sounds when the child taps the pictures. *Baby's Fish* shows

brightly coloured fishes moving across the screen, and children can catch them by tapping on them. *Baby's Drawing App* lets children scribble and draw with different colours, using a simpler interface than conventional drawing apps and playing music that is synchronised to the child's finger movements. *Scribble & Learn* also allows children to scribble and draw and helps them learn about colours.

Our observations showed that children aged 2–3 years were interested in the apps and able to use them (Fig. 1A), with no differences between boys and girls. *Baby's Fish* was the most popular app, with all the children using it multiple times and many (60%) using it five times or more. *Baby's Balloons*, *Mood Swings* and *Taste of Zoo* were also popular, with most of them – 90% or more – using the apps for several times or for several minutes. Most of the

children showed no initial interest in *Baby's Drawing*, but the 73% who overcame their initial hesitation used it to scribble and draw for several minutes. *Lines & Letters* was comparatively less popular, with only half the children using it multiple times. We felt that the smartphone apps were more successful in entertaining children aged 2–3 than educating them.

The following apps were tested by the children aged 4–6 years. *Lines & Letters* uses artificial intelligence to help children to learn to draw lines and write uppercase English letters, while *Fun with Numbers* is a pop the balloon game that uses the same technology and helps children to recognise and write numbers. *Color Play* helps children recognise everyday objects and categorise them based on their colour. *Blocks & Colors* is a simple puzzle based on a

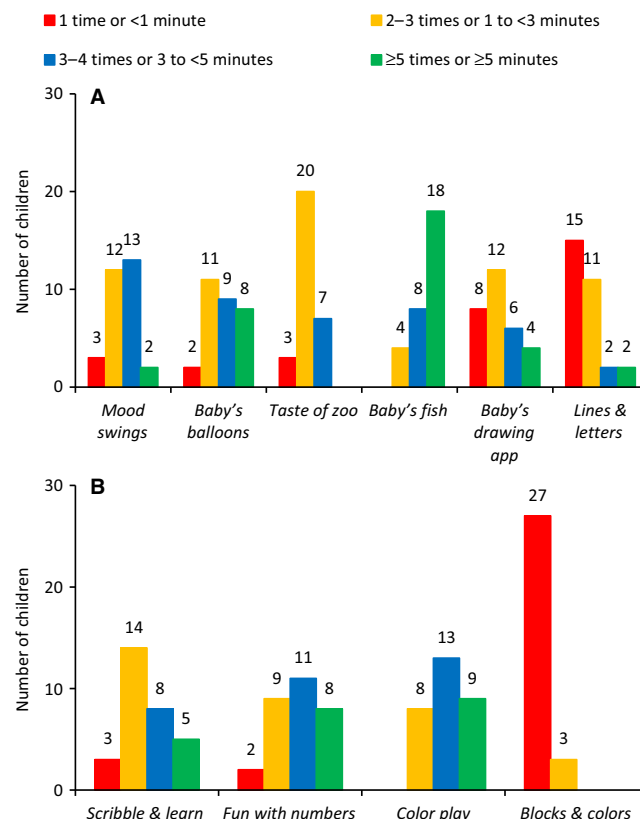


Figure 1 Use of the apps by (A) two- and three-year-old children and (B) four- to six-year-old children.

board with different coloured squares that need to be moved to create a board with just one colour. The apps have simple user interfaces that young children can interact with using one finger (Table S1).

The children aged 4–6 years were able to understand verbal instructions satisfactorily and were keen to try the new apps, with similar behaviour in boys and girls. *Color Play* was the most popular app with this age group, with all of them using it multiple times and some (30%) using it five times or more (Fig. 1B). *Scribble & Learn* and *Fun with Numbers* were used multiple times by many of the children, namely 90% or more. Although *Blocks & Colors* aroused initial curiosity among the children, only a few (10%) were able to solve the puzzle and used the app more than once. We felt that smartphone apps could be used to provide information to children aged 4–6 years and to quiz them. However, it was difficult to test problem-solving skills using smartphone apps at this age.

Young children saw the smartphones as attractive toys and were able to use simple apps with some adult help. Purpose-built smartphone apps can be used to entertain and sensitise

children aged 2–3 and facilitate informal learning in children aged 4–6 years. However, many apps marketed for young children are not actually suitable for them (5), and parents and teachers should exercise caution when recommending apps to young children.

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CONFLICT OF INTEREST

The authors have no conflict of interests to declare.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article:

Table S1 Details of the apps.

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