What are we downloading for our children?

Bestselling children's apps in four European countries

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Abstract

The present article provides an overview of the bestselling apps for the age range of 0-8 years old under various categories, including 'Kids', 'Books', 'Educational games', 'Family games' and 'Word games' in the two major application stores (Google Play and iTunes App Store) in four economically diverse European countries: Hungary, Turkey, Greece and the Netherlands. We conducted a content analysis to highlight the issue of fine-tuning of the apps on the local culture and language of non-English speaking countries and the educational value of the most popular children's apps. Results show that there is a large overlap between the bestselling apps in the four countries, in fact, half of the apps appear among the most popular lists in more than one country. Consequently, most children's apps do not include any oral language and, if so, they are not available in the local language. A substantial part of the apps supported early literacy skills. In the majority of apps teaching literacy, although advertised for the youngest, the mode of instruction was more suited for school-aged children.

Keywords: Children's Apps, Tablets, Educational Apps, Emergent Literacy, Content Analysis.

The ownership of tablet computers among adults has grown from 3% to 45% since computer tablets were first introduced in 2010 in the United States (Anderson 2015). Tablets have also started to find their ways into children's daily life more and more (Chiong & Shuler 2010). Common Sense Media, a nonprofit organization dedicated to helping kids thrive in a world of media and technology, reports that 80% of the children aged 2 to 10 in the U.S. use educational media that are offered on TV and computer and mobile devices at least once a week, including about one-third of the children who use them daily (Rideout 2014). According to the yearly Iene Miene Media report in the Netherlands, the ownership of tablets has grown till 65% of the households in 2015 (Statista 2015) and children go digital at an increasingly younger age. In 2014, 70% of Dutch children up to age 7 were reported to often use tablets (Iene Miene Media 2014). We expect similar growth in the three other target countries but reports about children's use of computer and mobile devices are not available for Greece, Turkey and Hungary.

The two major international online application stores, the App Store (iOS) and the Google Play Store (Android), offer increasingly more apps including games and electronic storybooks specifically designed for children (Guernsey, Levine, Chiong, & Severns 2012). In every country it is possible to download all available apps in all languages but a partly different set of featured apps appears when you enter the store. Many apps are promoted in more countries without localized content, which makes sense from a commercial point of view, in order to sell the same app in different countries without the costs of translation and localization. However, bringing out apps in a way that they are sold in different countries may go at the expense of fine-tuning on the specific culture and the local language. The aim of the present study was to raise awareness of this issue by testing to what extent there is overlap between the lists of the most popular children's apps across European countries and what the consequences are. When apps rank high on best-selling lists in different countries they may

not include the local language, especially when the language area is small as is the case for the countries included in the present study. This trend is of high significance because, considering the amount of time that young children spend with mobile devices, this may be a missed opportunity for language development as compared to other activities (e.g. watching television or films).

The number of apps that is available in the local language may differ as a result of fine-tuning, which might be related to prosperity. This would be another illustration of the finding that the quality of educational materials differs, at the expense of children growing up in less wealthy circumstances (Putnam 2015). In order to test this hypothesis we compared lists of most popular children's apps in four European countries: Hungary, Turkey, Greece, and the Netherlands. Among the most popular apps in the Netherlands, the most prosperous country of the four, we may expect more apps in the local language than in the other countries.

Potential of apps as an educational activity

Even though apps may provide an active, enjoyable and engaging context, the question is whether they attune to children's educational needs: Are the most popular apps designed to foster children's emergent academic skills including literacy, numeracy and science? There is an abundance of studies showing that children show interest in academic skills and develop those skills through various voluntary activities in the preschool period (e.g., Duncan et. al 2007; Ferreiro & Teberosky 1982; La Paro & Pianta 2000). Parents and teachers read storybooks to children which improves their vocabulary and reading skills (e.g., Bus, van IJzendoorn, & Pellegrini 1995); they practice writing their names and other words which contributes to letter knowledge and phonemic awareness (e.g., Both-de Vries & Bus 2010); they count objects in the surroundings which may foster number skills (e.g., LeFevre et. al. 2009); et cetera. Apps, if well-designed, may have the potential to elicit similar activities in

the preschool period and give a boost to early literacy and numeracy skills. They may even have the potential to involve the child in these activities without any adult support because they provide guidance and feedback that is similar to adult scaffolding (Falloon 2013; Kegel, Bus, & Van IJzendoorn 2011; Takacs, Swart, & Bus 2014).

There are quite a few apps that enable activities like cutting, decorating, cooking dishes, or using make-up, mostly promoted as "educational" in the online stores (e.g., Toca Boca apps). This and other app series are quite famous and rank high on the bestselling lists but the question arises: which skills do they stimulate? As reported on the official website of Toca Boca, these applications may improve "children's creativity" without further specification (Toca Boca n.d.).

In line with findings by the Joan Ganz Cooney Society we expect that a substantial part of apps (about 40%) will provide educational content related to basic academic skills and probably more to literacy than to math and science as children overall spend more time with literacy-related activities in daily life (Vaala, Ly, & Levine 2015). However, whether findings from the American market apply to the European market is so far an unanswered question.

In the present content analysis of the most popular children's applications in four European countries we aimed to answer the following questions:

(1) To what extent is there overlap between lists of popular apps for young children across European countries?

    We hypothesized that there is a significant overlap between the bestselling apps in the different countries. Consequently, we expected that most of these apps were developed by international companies, and accordingly, the majority of apps do not include any oral language and/or are not available in the local language. This is of high significance as such a trend means that applications do not provide any

stimulation in the local language, which is a serious issue for language development of children in the preschool age.

(2) Are apps available in the local language and more so in more prosperous countries?

We expected more apps in the local language on the Dutch market as compared to the other three countries; GDP (Gross Domestic Products) per capita for Greece, Turkey and Hungary ranges between 20-26.000$, but is about twice as high in the Netherlands (World Bank 2015).

(3) To what extent do apps serve educational aims?

In line with previous results regarding the U.S. market (Guernsey, et. al. 2012), we expected that a substantial part of the bestselling apps will not serve purely entertainment for children but will have educational content. In so far apps are educational, they were expected to relate more often to literacy than to other academic skills and are mainly developed for children in the preschool age rather than for school-aged children.

Method

Sample of apps

Popular online stores offer apps for children under various categories. According to the scope of our study, we selected from the two main app stores categories that might include educational apps for children. In the iTunes App Store we targeted: *Kids*, *Books*, *Education*, *Educational Games, Word Games* and *Family Games*. In the Google Play Store we focused on the categories *Books and References*, *Education, Family Games*, *Word Games* and *Educational Games*. We made a print screen of the top 50 bestselling paid and the top 50 most downloaded free apps in each category on the same day regarding the Dutch, the Turkish and the Hungarian markets (23rd March, 2015). The same procedure was applied with

the bestselling lists in Greece, but about half a year later (16th January, 2016). In some cases 2-5 apps were included in one package in the paid section of iTunes App Store as a bundle deal. We decided to include all these apps.

We focused on the top 50. The exact ranking in each category seems to change daily, but apps may stay for a longer period among the top 50. About a quarter of the apps were still on the bestselling lists one-and-half year after the first downloads. The number of same apps was for the Netherlands, Turkey and Hungary 22%, 30% and 25%, respectively (on 5th of December, 2016).

We excluded any apps that were not designed for children such as foreign language learning apps (e.g. *Duolingo*), word games, dictionaries, adult audio books, e-book readers, holy books (e.g. Bible, Quran), sky observation apps, topology apps, etc. When the same apps appeared in different categories we excluded duplicates. However, if the same app appeared in both stores, Android and iOS, both apps were included because the two versions are not necessarily the same. In the end, we analyzed 560 Dutch, 492 Hungarian, 532 Greek and 494 Turkish apps for children found in the Android and the iOS stores.

Coding

Each app was coded on the basis of the following dimensions:

1. **General Characteristics**

1.1. **Overlap across countries:** We coded for each app if it was unique on the bestselling list of the country or also appeared on the list of any of the other countries.

1.2. **Device:** We coded the app store where we found the app: iTunes (IOS) or the Google Play Store (Android).

1.3. **Developer:** We coded whether the company who developed the app was a local or an international developer.

1.4. **Series**: We coded whether the app was part of a series of apps (e.g. *Dr. Panda in Space* and *Dr. Panda Toy Cars*).

1.5. **Age range:** We coded if the app was recommended in the app store for infants (0-3 years old), preschool/kindergarten (4-6 years old) or children in primary education (6-12 years old).

1.6. **Price of the app:** We coded the price of every paid application in Euros. In case it was part of a bundle we divided the price with the number of apps in the bundle.

2. Oral language

We coded whether the app contained any oral language (at least 5 words) or not.

2.1. **Availability of oral language in the local language:** We coded whether the apps that contained oral language used the local language or a foreign language.

3. Educational content: We coded whether the app included any content that was relevant for basic academic skills, that is, language and literacy, math or science. In any other cases we coded the app as entertaining. For example, quite some of the most popular apps was designed by the company Dr. Panda Ltd. In the apps in this series there is hardly any dialogue or narration. Instead, these apps offer nonverbal games such as driving, cooking, and decorating, which we did not consider educational. Other apps that we considered purely entertaining typically included dressing and make-up games, activities like taking care of a pet or a baby, or decorating cakes or a room. These activities and games are not directly related to any basic academic areas like language and literacy or math and science skills.

3.1. Literacy content: We coded whether the educational content of the app was relevant for language and literacy development or not. We considered narrative stories in addition to games and activities identifying sounds or letter forms, teaching

vocabulary and letter-sound relationships or practicing emergent writing as related to language and literacy.

3.1.1. Direct/indirect literacy content: We coded whether the literacy skills were trained directly (e.g. games with words, letters and the alphabet), indirectly by means of stories and nursery rhymes (Goodman 1989) or a mix of the two approaches was utilized which meant that they included elements of both direct and indirect teaching. Finally, we included mixed approach apps into indirect apps because these apps typically had a focus on storytelling primarily and included some letter games, for instance, in addition to the stories.

Inter-coder agreement

The top 10 apps in all categories in the Dutch iTunes App Store were coded by two independent coders in order to calculate inter-coder reliability statistics. Coding these apps Cohen's kappa was satisfactory for all categories: ($k > 0.78$) whether the app was designed for children ($k = 0.97$), whether it was educational ($k = 0.78$), whether it was relevant for children's literacy development ($k = 0.82$), whether it instructed literacy skills in a direct or an indirect manner ($k = 0.78$), and whether the content of the app was available in the local language or only in another foreign language like English ($k = 1.0$). Findings were very similar for the three other countries where agreements between coders were also checked. All disagreements were settled by discussion between the two coders.

Results and Discussion

As shown in Table 1, there were similar numbers of apps on the bestselling lists that we coded as intended for children in the four countries: about five hundred in each country.

Somewhat more than half of these children's apps (on average 55%) were found in the iTunes App Store. Most apps were advertised for the youngest age groups, that is, for infants and preschoolers and less so for school-aged children. This was similar in all four countries. Note must also be taken of that the app stores provided very large age ranges the apps were meant for, and consequently, applications were often suggested for children between, for instance, 0 and 5 years of age. For educational applications this might be problematic as it is unlikely that what is educational for a toddler is also educational for a 5-year-old.

Fine-tuning on local culture and language

As predicted, there was a substantial overlap between the bestselling lists of the four countries: half of the children's apps appeared on the list of two or more countries as shown in Table 1. There was a significant effect of country on this variable (χ^2 (3) = 56.81, $p < .001$) with the largest percentage of unique titles in Greece (56%) and the Netherlands (49%), as compared to 34% in Hungary and 41% in Turkey. As a consequence of substantial overlap, one might expect that apps that are intended for the market of more countries will either have no oral language or, in so far there is language, it is not in the local language. In fact, we found evidence for these hypotheses. Overall, 43% of the children's applications included oral language. There was a significant effect of country (χ^2 (3) = 15.68, $p < .001$) with Hungary having the smallest percentage of applications including any oral language (36%) and Turkey the largest percentage (47%). On average only 27% of the apps included oral language in the local language. Regarding local language speaking apps there were significant differences between countries (χ^2 (3) = 56.81, $p < .001$). As expected, in the most prosperous country, the Netherlands, there were by far the most apps in the local language on the bestselling lists (50%) while in Hungary only 10% of the apps was in the local language. In the same vein, overall 10% of the apps was released by local developers and there were significant differences between countries (χ^2 (3) = 67.10, $p < .001$) with the most locally developed apps

appearing on the Dutch bestselling lists (18%) and the least on the Hungarian list (5%). It is tempting to attribute these differences between countries to differences between the countries' prosperity but these results might reflect either the preference of parents and educators (there are apps in the local language but those are not chosen), the availability of such applications (apps in the local language are not available) or both.

Availability of educational applications

Similar to the results of the American content analysis (Guernsey & Levine, 2015), 37% of the bestselling apps were categorized as educational regarding basic academic skills, meaning that 63% of the most popular apps were considered purely entertaining. There were significant differences between countries (χ^2 (3) = 27.22, $p < .001$) with the largest percentage of educational apps appearing on the Dutch bestselling lists (45%) and the lowest percentage on the Hungarian lists (30%).

It is important to note that whether the app was available in the local language and whether it was categorized as educational was highly confounded in all four countries (the Netherlands: χ^2 (1) = 26.19, $p < .001$, Hungary: χ^2 (1) = 10.33, $p < .001$, Greece: χ^2 (1) = 14.87, $p < .001$, Turkey: χ^2 (1) = 5.49, $p < .05$). Thus, 75-100% of the apps that were in the local language in the four countries were educational. This makes sense as letter sounds, and similar topics in educational apps, differ across countries. In line with our expectations, more educational apps were recommended for preschool-aged children (72%, $n = 339$) in contrast to apps advertised for school-aged children ($n = 113$). This finding was similar for all four countries.

When considering educational apps about 72% of the apps were relevant for children's language and literacy development. There were, again, significant differences between the countries (χ^2 (3) = 23.57, $p < .001$) with the largest proportion of literacy-related apps in Greece (80%) and the smallest percentage in the Netherlands (64%). This also suggests that

the largest proportion of math and science apps appeared on the Dutch bestselling lists. Within the category of literacy apps, 34% taught literacy skills in a direct manner (e.g., teaching letter knowledge). There was a significant effect of country (χ^2 (3) = 25.29, p < .001), with the smallest percentage of such apps on the Greek bestselling lists (19%) and the largest on the Dutch list (44%). It might be that there are less Greek apps because international literacy apps are not useful due to the Greek alphabet. The data support this hypothesis; overall 50% of the literacy apps were international, while in Greece only 23%. The rest of the literacy apps, included stories instead of or in addition to direct teaching of basic literacy skills.

Table 1. Descriptives of the characteristics of the most popular children's apps in the four countries.

	Overall	Netherlands	Hungary	Greece	Turkey
Total number of apps	2078	560	492	532	494
Device					
Apple (iOS)	55.15%	55.54%	56.10%	56.77%	52.02%
	(49.75)	(49.74)	(49.68)	(49.59)	(50.01)
Target Audience					
Infants (0-3 years old)	71.54%	74.83%	73.47%	68.32%	69.82%
	(45.14)	(43.48)	(44.26)	(46.61)	(45.99)
Preschool Age (4-6 years old)	71.64%	74.83%	73.47%	68.70%	69.82%
	(45.10)	(43.48)	(44.26)	(46.46)	(45.99)

Primary School Age (6-12 years old)	51.72% (49.10)	49.30% (50.08)	42.86% (49.61)	57.63% (49.51)	54.91% (49.84)
Percentage of unique titles	45.43% (49.80)	49.46% (50.04)	33.94% (47.40)	55.83% (49.71)	41.09% (49.25)
Created by local developer	9.67% (29.55)	18.21% (38.63)	5.08% (21.98)	7.14% (25.78)	8.10% (27.31)
Language					
Percentage of apps including oral language	42.77% (49.68)	45.71% (49.86)	35.57% (47.92)	41.92% (49.39)	46.76% (49.95)
Percentage of apps including oral language in the local language	24.80% (43.21)	50.39% (50.10)	9.71% (29.70)	15.21% (35.99)	16.88% (37.54)
Content					
Percentage of apps that are considered educational	37.48% (48.41)	44.64% (49.76)	29.67% (45.73)	39.47% (48.93)	35.02% (47.75)
Percentage of educational apps that are considered educational for language and literacy development	71.81% (45.02)	64.00% (48.10)	76.71% (42.41)	77.88% (41.60)	71.68% (45.19)
Percentage of educational apps that targeted language and literacy	33.51% (47.25)	43.75% (49.76)	38.39% (48.85)	18.52% (38.97)	35.48% (48.04)

skills directly (e.g., letter training)					
Average price of the paid applications (in euros)	2.51 (1.33)	2.59 (1.26)	2.54 (1.38)	2.79 (1.49)	2.07 (1.05)

International versus local trends

As a next step we investigated whether apps that appeared on the bestselling lists of more than one country (overlapping titles) and apps that we found on the lists of only one country (unique titles) were systematically different, in particular regarding the language input and educational content they provide for children. As shown in Table 2, there was no difference in the proportion of apps including oral language between overlapping and unique titles (χ^2 (1) = 0.45, p = .50). However, when only considering the apps that included oral language there were much more unique apps featuring the local oral language (85%) as compared to overlapping titles (15%), χ^2 (1) = 197.48, p < .001. In the same vein, more apps that were uniquely popular in one country were developed by a local developer (19%) as compared to overlapping titles (2%), χ^2 (1) = 177.30, p < .001. Additionally, country-specific popular apps were more likely to be educational (45%) than overlapping apps on the bestselling lists of more than one country (31%), χ^2 (1) = 42.57, p < .001. In other words, the unique apps are more fine-tuned on the specific culture and the local language. This set of apps is more often offered on the iOS platform than on Android. Surprisingly, this set of unique apps is cheaper than the set of overlapping apps.

Table 2. Differences between apps that are unique titles for one country and apps that are on the bestselling lists in two or more countries

	Unique	Overlapping	Difference
	M (SD)	*M* (SD)	(χ^2)
From iTunes App Store	63.88% (48.06)	47.88% (49.77)	53.27*
Local Developer	19.19% (39.39)	1.77% (13.20)	177.30*
With Educational content	45.12% (49.79)	31.14 (46.33)	42.57*
Oral language	41.87% (49.36)	43.52% (49.96)	0.20
Local Language	47.31% (49.99)	6.76% (25.14)	191.41*
Price	2.37 (1.41)	2.59 (1.27)	331.66*

Note. * $p < .01$.

Main conclusions and future directions

One consequence of the huge overlap in popular apps across countries (55%) is that most apps are not designed by local developers, which may have serious consequences for the content. They may, for instance, not include local characters, typical visualizations and local language thus preserving cultural heritage and fostering children's developing language and literacy skills. In the current study we tested whether the set of apps that is available in more than one country is less fine-tuned to children. We found that the majority of apps that are on

the lists of popular apps in more than one country and that include language are not available in the local language (75%). This is a serious issue particularly when we consider that children spend a substantial amount of time with apps. This effect is stronger the less prosperous a country is. The trend of children's apps that do not contain any language might be explained by considering the ease of adaptation of the apps to other countries. Apps without any language can be easily offered in all the countries without the additional cost of translating the app. Although this makes sense from a commercial point of view, it is a loss from the educational perspective, as these apps provide no language input for children. To illustrate this, in comparison, even television programming that is not educational or designed for children provides language stimulation for children.

About 30-40% of the popular apps are educational according to our definition: they practice skills that are related to literacy, numeracy and science. This is not a change compared to the pre-computer era: since the seminal work of Ferreiro and Teberosky (1982) we are aware that preschoolers spend substantial time on practicing academic skills. It is a reaction to the fact that adults are continuously modelling academic skills and children respond to that by showing interest in doing the same activities and making attempts to imitate. Purcell-Gates (1996), for instance, gives numerous examples of activities in the home environment that include literacy skills and that contribute to literacy. We do not know whether educational apps outweigh the benefits of traditional activities that relate to academic skills. We have the impression that activities promoted by educational apps often include assignments that are not age-appropriate. Many apps advertised to preschoolers utilize direct teaching, for instance letter training by making children click on the letter that matches the name, while it is doubtful that this kind of practice matches the interest of children in that age range. According to emergent literacy research children in that age range do show interest in reading and writing, however, in a particular way. From the research it can be derived that

when, for instance, they make attempts to write they are more interested in "drawing" writing: they often produce writing-like scribbles or strings of pseudo letters and they mix writing with drawing (Levin & Bus 2003). More in-depth content analysis is needed to test whether apps reflect such interests. From what we have seen it is our impression that among the popular educational apps there are no apps promoting this kind of age-appropriate writing and reading activities. Note that computer programs like Kid Pix that came out in the eighties to elicit writing and reading activities by young children are no longer available (see Labbo 1996). It is more common to practice school-like subskills of reading and writing as in the school curriculum. The echoes of thirty years of research into emergent literacy and numeracy raise the need of developmentally appropriate assignments. However, these echoes do not seem to reach the domain of educational apps maybe because the development of apps is the exclusive domain of computer experts and designers and does not include educators or educational experts. This might provide an explanation for previous findings showing an ambiguous effect of tablet use on children's emergent literacy skills (Neumann 2014).

Limitations

We may assume that the lists of bestselling or most downloaded apps indicate how popular apps are. The exact ranking seems to change daily. However, after several attempts we could not figure out how the bestselling lists are constructed and which underlying parameters are considered. For instance, it is not known exactly how many downloads are behind the rankings. Furthermore, the ranking might change the exact time when someone downloads an app or ranking is based on daily or weekly data. Additionally, the high overlap between countries might be a result of how the lists are constructed: it might be that it is not only the local sales that affect the ranking on the best selling lists. Also, we do not know how the lists relate to what is available in the stores. There may be few popular apps in the local language because these apps are not selected or they may not be available. The low

percentage of apps with educational content could be both a result of availability and/or preference of parents and educators. Lastly, the download of the Greek list was not done at the same time as the other downloads which probably resulted in an underestimation of overlap between the bestselling lists of Greece and the other countries.

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