



Digital natives?

New and old media and children's language acquisition

Michael Bittman, Leonie Rutherford, Jude Brown and Leonard Unsworth

Growing Up in Australia: The Longitudinal Study of Australian Children (LSAC) presents a rare research opportunity. Not only does the study allow us to see how children's language develops as they grow, but it also provides information specific to the generation of children known as "digital natives". The children in the study are "native speakers of the digital language of computers, video games and the Internet"; in contrast to their parents, who are "digital immigrants", having largely grown up in a world without personal computers or the Internet (Prensky, 2001).

There are differing opinions about the nature of "new media". Proponents of the "digital natives thesis" posit a radical discontinuity between the modern environment shaped by digital media and the past environment shaped by older media. Other historians of technology emphasise the continuities between older media platforms and the new media that challenge and, sometimes, eventually, completely displace them (Silverstone, 1999; Livingstone, 2002; Silverstone, 1999). Much

recent theory articulates a "convergence" of media forms rather than a radical opposition (Jenkins, 2006; Spiegel & Olsson, 2004).

In response to developments in new media, some educationalists have evolved theory concerning new and multiliteracies (Coiro, Knobel, Lankshear, & Leu, 2008; Kress, 2003; Martin & Madigan, 2006). Traditional literacy is taken as the ability to read and write in the shared language of a culture (Hague & Williamson, 2009). Multiliteracy theory suggests that there is a plurality of literacies; that different technological platforms and environments may require different constellations of literacy skills (Cope & Kalantzis, 2000). In an extensive review of research literature, digital literacy is defined as "critical thinking in the context of technology use", of which there are two components: "digital skills and critical thinking skills" (Newman, 2008, p. 5). Summing up the focus of this research trajectory on outcomes for children, digital literacy is linked with the goal of social participation: "the knowledge, skills and understanding that are required

to be involved socially, culturally, politically and economically in everyday life” (Hague & Williamson, 2009, p. 3). However, research still suggests that early language development is foundational for later traditional literacy skills and cognitive processing (Saxton, 2010). A primary goal of our paper is to examine the influences of “old” and “new” media technologies on the development of language and the relation of these media to children’s educational outcomes.

Pages and screens, old and new

There has been little study of the longitudinal effects of children’s new media use on language acquisition, literacy and school performance. However, there is a voluminous literature on the effects of older screen (television) and page media (reading) on children’s learning. While clear links have been found between the amount of time children spend reading and academic achievement (Hofferth & Sandberg, 2001), the literature on television suggests that mediating variables such as parental education/socio-economic status (Bianchi & Robinson, 1997; Hofferth & Sandberg, 2001; Baxter & Hayes, 2007), the social context of media consumption (Kubey, 1990; Christakis & Zimmerman, 2009), types of content (educational or commercial), and age at which educational content is viewed by disadvantaged children (Anderson, Huston, Schmitt, Linebarger, & Wright, 2001; Bickham, Wright, & Huston, 2001), may be at least as important as measures of simple time use.

Negative effects of television on children’s cognitive development and educational achievement have been associated with displacement of cognitively more valuable activities, especially in infancy (Anderson & Pempek, 2005) and early childhood (Schmidt & Anderson, 2007). Television has also been associated with disruption of concentration (background television) (Foehr, 2006; Rideout & Hamel, 2006), reduced parental mediation/guided interaction enabled by active co-viewing (Kirkorian, Wurtulla, & Anderson, 2008; Linebarger & Vaala, 2010), and sleep disturbances (Paavonen, Pennon, Roane, Valkonen, & Lahikainen, 2006). Increased hours of viewing have also been attributed to the presence of a television in a child’s bedroom (Vandewater et al., 2005). It has been argued that excessive hours of viewing by itself leads to overconsumption of inappropriate types of content (Hancox, Milne, & Poulton, 2005; Millwood Hargrave & Livingstone, 2006).

Evidence suggests that digital natives’ digital media use does not replace but instead operates in tandem with older forms (Roberts

& Foehr, 2008), such as print. Studies of adult populations, including six national time use diary studies (Robinson & Martin, 2010), found higher levels of reading among Internet and information technology users compared to people who did not use the Internet or information technology. US studies have also correlated home computer ownership and Internet use with academic performance, particularly reading performance (Jackson et al., 2006; Roberts, Foehr, & Rideout, 2005). All “new” or digital media, however, may not be alike in their effects on educational achievement. For example, time spent by 8–18 year olds playing video games is negatively associated with school performance, measured by grade point average (Roberts et al., 2005). Thus, while it has become common to celebrate children’s engagement with digital media in their recreational activities (such as video gaming; use of social networking websites; video, image and music sharing; music/image editing and animation using online and other resources), the skills obtained by doing so might not necessarily equate to the skills and competencies associated with either traditional or digital literacy (Hague & Williamson, 2009). Prior acquisition of text-based literacy (whether texts are distributed by print or screen “page”) may be crucial for the critical thinking skills associated with all “new” literacies.



Negative effects of television on children's cognitive development and educational achievement have been associated with displacement of cognitively more valuable activities, especially in infancy and early childhood.

Research questions

The research reported here tests the hypothesis that access to digital technology alone guarantees development of vocabulary and language acquisition, and that “new media” are more critical in the developmental process than older electronic and print media (the “digital natives” thesis). Secondly, it tests the hypothesis that the context of access and mediation provided by parents (as “digital immigrants”) is no longer crucial in guiding the acquisition of foundational literacy skills, including ICT literacy.

There is very little research on young children and new media. In the absence of large-scale empirical data, some writers have assumed that new media will resemble television in its effects on the development of a child's language abilities. The research presented in this paper used longitudinal data to disentangle the effects of access, context and time “exposed” to different media (including reading) on the child's language skills at different stages of their development, while controlling for differences in family socio-economic resources.

Methods

Data for LSAC are obtained in “waves” (see Table 1) and this paper uses data from the first three waves (Waves 1–3) as well as Wave 2.5 (Soloff, Lawrence, & Johnstone, 2005; Siphthorp & Misson, 2009).

Data were obtained using a combination of face-to-face interviews, self-completed questionnaires, children's time use diaries and, for the K cohort, teacher reports. Additional data about the stocks of digital devices, and the monitoring and regulation of digital technologies, were collected in a supplementary postal survey in Wave 2.5 (B cohort $n = 3,246$; K cohort, $n = 3,252$) in 2007.

Measures

Outcome measures (Wave 3)

For both cohorts, language ability was measured at Wave 3 using a specially adapted short form (40 items) of the Peabody Picture Vocabulary Test—Third Edition (PPVT-III). The PPVT-III measures receptive vocabulary (the extent to which children recognise the meaning of words used by others) and is frequently used to measure language acquisition in the early years—most famously used to demonstrate the benefits of the TV program *Sesame Street* (Wright et al., 2001).

For the K (1999/2000) cohort, the Language and Literacy Academic Rating Scale (ARS) was also used. The ARS is a highly reliable (Cronbach's $\alpha = 0.94$) rated measure of academic performance at school. Teachers scored the study child on whether they were able to:

- convey ideas clearly when speaking;
- use various strategies to gain information using print materials;
- read fluently;
- read grade level books (fiction) independently with comprehension;
- read and comprehend informational text;
- compose multi-paragraph stories/reports;
- reread and reflect on their writing, making changes to clarify and elaborate;
- make editorial corrections when reviewing a written draft; and
- use the computer for a variety of purposes.

Explanatory variables (Waves 1–3)

Independent variables of interest were (a) a cumulative measure of the time spent in media use and (b) measures of parental efforts to manage circumstances of the study child's use of media. Time spent reading, viewing television or using a computer were each assessed using a “light” time use diary of a random weekday and a weekend day. Children were then classified into one of three groups:

Table 1 LSAC cohorts, children's ages and waves of data collection

Year	B cohort (born 2003–04)				K cohort (born 1999–2000)			
	0–1 years	2–3 years	3–4 years	4–5 years	4–5 years	6–7 years	7–8 years	8–9 years
2004	Wave 1				Wave 1			
2006		Wave 2				Wave 2		
2007			Wave 2.5				Wave 2.5	
2008				Wave 3				Wave 3

consistent low use, mixed use and consistent high use.

Parents were also asked (in Wave 2.5 collected in 2007) about their child's access to digital devices—whether the child had a television or computer in their bedroom, or whether there was a computer, Internet access or a games console (e.g., PlayStation, Xbox, Game Boy) in the home.

Parental mediation was also assessed, asking:

- whether the child turns on the television by themselves (B cohort only);
- whether the television is “always/often” on while no one is watching (B cohort only);
- whether a parent “always/often” watches television with the child (B cohort only);
- whether the parent wishes the child would spend less time watching television, and DVDs, or playing computer games (K cohort coded only); and
- how “easy” or “difficult” the parent finds it to manage the child's television, video and DVD viewing (both cohorts).

Controls (Wave 1)

Previous research suggests that the family's socio-economic resources and the mother's education are regularly found to have a strong influence on both media use and outcomes. These were controlled for in this study. Family resources were measured in bands for gross income adjusted for family size (equalised household income). Mother's education was measured in years.

Data analyses

The sample was restricted to those participants with 2 days of good quality time use diary data from at least two waves, with complete data on digital devices and regulation (Wave 2.5 postal survey) and teacher academic ratings (Wave 3 for the K cohort). The final analytic sample for the B cohort was 2,335. For the K cohort, the final sample for the analysis of effects on language acquisition (PPVT-III) was 2,233, and for teachers' ratings of academic performance (ARS) the sample was 1,892.

Longitudinal associations between media use (Waves 1–3), parental practices (Wave 2.5) and the outcome variables (Wave 3) were determined for each of the cohorts using linear regression after adjusting for equalised household income and mother's education (Wave 1).

Results and discussion

Table 2 shows the results of the regression analysis of the PPVT-III scores for the younger (B, 2003/2004) cohort. The model presented here tested the effects of access, context, time “exposed” to electronic media and time spent reading, while controlling for family resources on the child's vocabulary at age 4.

Children allocating sustained time to the oldest media (reading) exhibited significantly higher PPVT-III scores (i.e., $p < .001$) than those with a consistently low investment of time, which is consistent with earlier studies (Anderson, Wilson, & Fielding, 1988).

Table 2 Regression model for receptive vocabulary, B cohort (born 2003–04)

Variable	Coefficient	SE
Child has ... (Wave 2.5)		
Television in bedroom	-1.172 **	0.415
Computer in bedroom	-1.160	0.794
Computer in home	0.507	0.435
Internet in home	1.408 **	0.424
Electronic games system		
Yes	0.097	0.378
Missing data	0.811	0.421
Parental mediation (Wave 2.5)		
Study child turns television/DVD on by themselves	-0.311	0.282
Is television on while no one is watching?	-1.015 **	0.373
How easy is it to manage child's use of electronic/computer games?		
Easy/very easy	2.001	1.124
N/A	1.834	1.130
Watch programs with child (co-viewing)	0.535 *	0.254
Patterns of media use (Waves 1 to 3)		
Television viewing		
Mixed	-0.338	0.340
High consistent use	-0.162	0.481
Reading		
Mixed use	0.950 *	0.386
High consistent use	1.731 **	0.532
Control variables (Wave 1)		
Mother's education (years)	0.185 ***	0.052
Equalised household income (\$A10,000)	0.456 ***	0.081
Intercept	57.682 ***	1.536

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3 Regression model for receptive vocabulary, K cohort (born 1999–2000)

Variable	Coefficient	SE
Child has ... (Wave 2.5)		
Television in bedroom	−1.144 ***	0.296
Computer in bedroom	−0.009	0.312
Computer in home	1.643 *	0.686
Internet in home	−0.607	0.560
Electronic games system		
Yes	−0.389	0.263
Missing data	−0.489	0.345
Parental mediation (Wave 2.5)		
How easy is it to manage child's use of electronic/computer games?		
Easy/very easy	−0.081	0.427
Missing data	−0.256	0.720
Parent wishes child would spend less time watching television	0.328	0.282
Patterns of media use (Waves 1 to 3)		
Television		
Mixed	−0.431	0.312
Consistently high	−0.408	0.457
Computer		
Mixed	0.505	0.257
Consistently high	0.326	0.416
Reading		
Mixed	0.283	0.375
Consistently high	1.317 *	0.524
Controls		
Mother's education years (Wave 1)	0.207 ***	0.046
Equalised household income (\$A10,000)	0.326 ***	0.077
Intercept	73.967 ***	1.051

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$.

Access to new and older electronic media also matters. After controlling for the child's time spent reading, having access to the Internet was positively related to recognising words. In contrast, the results for a television in the child's bedroom were significantly ($p < .005$) associated with poorer vocabulary at age 4. The other measures of the context of media use also showed a significant effect, in the expected direction. Having the television running while no one was in the room, indicating little attempt to manage the child's viewing (Wiecha, Sobol, Peterson, & Gortmaker, 2001), was

associated with lower receptive vocabulary. Co-viewing, in contrast, is associated with better vocabulary. Parental management of the child's game-playing seems to have had no significant influence. At this early age, the context that parents create for television usage appears to be the major determinant of the child's receptive vocabulary.

As previous research suggests (Duncan & Brookes-Gunn, 1997; Garrett, Ng'andu, & Ferron, 1994; Rowe, Pan, & Ayoub, 2005), high income security and stocks of cultural capital (a broad array of linguistic competencies, knowledge of refined social manners, preferences and orientations) powerfully promote language acquisition. The findings presented in Table 2 show a significant ($p < .001$) positive association between both income and mother's years of education and the child's PPVT-III score.

After controlling for context, in addition to customary controls for socio-economic advantage and parental mediation of media use, the amount of time spent watching television was not significantly associated with receptive vocabulary at this stage of the child's development. This is noteworthy given the convention of paediatric advice on limiting television in the child's early years (American Academy of Pediatrics, 2012).¹ Our findings indicate that among preschoolers, perhaps, any dose of media is safe provided the protective factors—a stimulating home environment provided by sufficient family income, combined with interactive demonstration of vocabulary associated with high stocks of cultural capital and, importantly, a supportive parental context for the use of media (especially television)—are all in place. This implies that the children most at risk of delayed language acquisition are those from low socio-economic backgrounds whose parents are not involved in their child's use of media.

As Table 3 shows, factors affecting language acquisition, as measured by receptive vocabulary, remain remarkably similar as the child matures. For the K (1999/2000) cohort at age 8 years, family resources, time spent reading and the parental context of the child's media use continued to be significantly related to the child's mastery of vocabulary, and effects sizes were broadly similar. A TV in the child's bedroom was associated with a 1 point decline in PPVT-III score for both cohorts when the other influences were held constant. Similarly, each year that the child's mother spent in education was associated with an improvement of the child's PPVT-III score by about 0.2 points in both cohorts, while a \$10,000 increase in

annual household income (adjusted for family size) was associated with an improvement of between 0.3 and 0.4 in PPVT-III scores for each cohort. Conversely, time spent reading had a powerful effect in the early years. In the older cohort only, a sustained pattern of time devoted to reading significantly affected PPVT-III score at age 8, and the associated predicted effect was slightly smaller.

For this cohort, the only measure of child viewing context was the presence of a television in the child's bedroom (other questions were not asked). Having a TV in the bedroom remains negatively associated with receptive vocabulary ($p < .05$). Conspicuously, among the older cohort, having a computer in the home ($p < .05$) is significantly associated with a better mastery of vocabulary at age 8 years, although Internet connectivity is not significant. Our findings suggest that at certain stages of the child's development there is a positive association between language and computer access. Interestingly, exposure to the much-maligned older media of television, as measured by child's time spent watching over the three waves, did not appear to be significantly related to vocabulary acquisition, once other influences have been taken into account.

PPVT-III is a measure of receptive vocabulary (the recognition of words); it does not imply that a child will use these words in speech (expressive vocabulary), and is not an all-round measure of literacy, in the broader sense outlined earlier in the paper. However, teacher ratings (ARS) assess extra dimensions of traditional and ICT literacy as well. Table 4 shows that, at age 8 years, the results for this broader measure of literacy closely resembled those for the PPVT-III measure of receptive vocabulary.

Parental socio-economic capital had significant ($p < .001$) association with language acquisition and literacy. In contrast to children with a history of consistent low time spent in reading, those with a history of mixed or consistently high time spent reading had higher language and literacy scores. The improvement in the scores was monotonic. The effect size of a pattern of consistently high time spent in reading over the 4-year period was almost 50% higher than effect size for the children with a mixed pattern of reading.

The subtle differences between results for Table 3 (receptive vocabulary) and Table 4 (Academic Rating Scale) centre on the substantial positive association of ARS and consistent computer use² and the lack of influence of or access to (and perhaps parent mediation of)

Table 4 Regression model for Language and Literacy Academic Rating Score, K cohort (1999/2000)		
Variable	Coefficient	SE
Child has ... (Wave 2.5)		
Television in bedroom	-0.105	0.069
Computer in bedroom	-0.006	0.076
Computer in home	-0.020	0.136
Internet in home	0.048	0.107
Electronic games ownership		
Yes	-0.109 *	0.048
Missing data	-0.046	0.067
Parental mediation		
How easy is it to manage child's use of electronic/computer games?		
Easy/very easy	-0.096	0.093
Missing data	-0.262	0.154
Parent wishes child would spend less time watching television	-0.014	0.062
Patterns of media use (Waves 1 to 3)		
Television		
Mixed	-0.103	0.063
High consistent	-0.193	0.100
Computer		
Mixed	0.161 **	0.060
High consistent	0.208 **	0.078
Reading		
Mixed	0.285 ***	0.067
High consistent	0.418 ***	0.096
Control variables (Wave 1)		
Mother's education years	0.036 **	0.010
Equivalised household income (\$A10,000)	0.055 ***	0.015
Intercept	2.945 ***	0.222

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$.

media use on the broader ARS measure of language skills. Whether the child had access to a computer in their bedroom or home or had a home Internet connection had no effect on the teacher's rating of the child's language and literacy, when time spent in computer use and other independent variables are held constant. Similarly, there was no significant net effect on ARS scores for the 8-year-old children having a television in their bedroom. However, there was a significant negative effect ($p < .05$) of having a games console (or functionally similar device) in the house.

Parents' characteristics and the context that they create for the child's media use in the early years (0–4) have more influence on the child's acquisition of vocabulary than raw "exposure" to television, or the supposedly transformative new media environment purported by the "digital natives thesis".

Perhaps the most striking feature of Table 4 is the positive ($p < .05$) relationship between time devoted to computer use between ages 4 and 8, and improved literacy as measured by the ARS scores. While the coefficient of association for continuous access to computers is roughly half that of continuous exposure to reading, the increase associated with a continuously high level of computer use compared to mixed use is proportionally the same. Moreover, the effects of access to computers go in the opposite direction from the alleged effects of sustained exposure to television. However, the opposite holds true of access to electronic games consoles that are associated with lower ARS scores. These findings also suggest that if children devote anything higher than the lowest time to reading or computer use over the 4 years, regardless of amount of time devoted to television, their literacy in the early years of schooling will be advanced.

Conclusions

Our results indicate that parents' characteristics and the context that they create for the child's media use in the early years (0–4) have more influence on the child's acquisition of vocabulary than raw "exposure" to television,³ or the supposedly transformative new media environment purported by the "digital natives thesis". Indeed, our findings point to the significance of the context of viewing and the parent's role ("digital immigrant") in negotiating media with the child. Our results suggest that attention should be paid to encouraging the child's use of the oldest media of all—print (or at least text-based reading material)—as this is closely associated with receptive vocabulary at age 4 years. Similarly, among children aged 4–8 years, there appears to be no developmental advantage in avoiding exposure to television. Parents' socio-economic resources and time devoted to reading and/or using a computer (over the previous 4 years) are all associated with more advanced abilities with language, comprehension and literacy. Conversely, providing partial refutation of the idea that games or multimedia-based resources are preferable to text-based, our results indicated that ownership of games consoles and functional equivalents is associated with lower linguistic abilities. In contrast to the conventional image that time spent watching television displaces activities that promote literacy, it seems that computer use (but not electronic game use) does not displace activities necessary for the development of print literacy.

Taken together, these findings are consistent with the idea that there may be distinct developmental stages in the ability to use digital devices. First, our data indicated that use of computers in infancy appears to be negligible and therefore plays no part in explaining the development of receptive vocabulary, at the population level.⁴ Second, the growth of vocabulary as the child develops appears to be unaffected by old electronic media (television) and more by the parents' education and participation in their child's media use. Third, computer (but not games) access at later ages was associated with increased traditional literacy. The timing of the effect of computers suggests a developmental sequence—that certain levels of linguistic capacity are necessary to facilitate use of this platform.

This pattern seems consistent with Vygotsky's (1987) scaffolding theory of learning. Even co-viewing television with parents seems to promote verbal abilities, especially when parents have significant cultural capital and material resources available to transfer. Our results raise the intriguing prospect that it is not "exposure" to media that harms language acquisition and development of traditional literacy, but the absence of age-appropriate "guided interaction" (Plowman, McPake, & Stephen, 2008) by parents. Although not directly measured in this study, it may be that instructional scaffolding is important in the process of increased digital literacy as well.

Endnotes

- 1 It may be that the American Academy of Pediatrics has over-interpreted the literature, which contains inconsistent findings on this issue (Schmidt, Rich, Rifas-Shiman, Oken, & Taveras, 2009; Schmidt & Vandewater, 2008; Sharif & Sargeant, 2006).
- 2 Sensitivity testing showed that omitting the item "uses the computer" does not reduce the significance of association between computer use and ARS.
- 3 It may be that children with a television in their own bedroom spend more time watching television without their parents' knowledge, which is thus the equivalent of having the television on at all times, and is indicative of parental boundary-setting as well as "exposure time".
- 4 However, the child's parents' use of the Internet does seem to be positively related to the child's acquisition of vocabulary.

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Professor Michael Bittman and **Jude Brown** are adjunct researchers in Sociology at the University of New England, **Dr Leonie Rutherford** is in the School of Communication and Creative Arts at Deakin University and **Professor Len Unsworth** is Professor in Education at Griffith University.

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