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# An analysis of associations between residential and school mobility and educational outcomes in South African urban children: The Birth to Twenty cohort

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### ABSTRACT

Using data from Birth to Twenty, a cohort of South African urban children, the current paper investigates the relationships between residential and school mobility and a set of educational outcomes. The findings provide some evidence of a positive association between changes in residence and numeracy and literacy scores, and school mobility was found to be associated with grade repetition, however, no relationship was observed between changes in school and competency in numeracy and literacy. The South African study provides a counter example to trends observed in higher-income countries, while highlighting that associations are likely to be context specific.

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## 1. Introduction

### 1.1. General overview

Education has long been recognised as an important measure and indicator of children's well-being. As such, research into child welfare has included extensive explorations into the factors which impact on educational attainment. Children's living conditions, family circumstances, health status and physical and social environments have been identified as significant determinants of child well-being as well as educational achievement.

Mobility amongst children precipitates change and requires adjustment to a new environment; it therefore has the potential to improve or impair conditions for child well-being. Many international studies have emphasised the detrimental effects of the movement of children on health and development outcomes, including education. For instance, changes of residence during children's school careers have been shown to have a predominantly adverse effect on academic achievement, progression through school and completion of basic education (Haveman et al., 1991; Ingersoll et al., 1989; Simpson and Fowler, 1994; Wood et al., 1993). Similarly, school mobility (either accompanied by or independent of a residential relocation) has been observed in many studies to impact on children's academic performance and

progression (Heinlein and Shinn, 2000; Swanson and Schneider, 1999). Studies have shown that the strength and pattern of associations between educational outcomes and child residential and school mobility are likely to be influenced by a series of individual, family, household and school factors (Astone and McLanahan, 1994; Pribesh and Downey, 1999; Tucker et al., 1998; Wood et al., 1993). The effects of these are not necessarily uniform, for example, the impact of mobility on school progression has been observed to be detrimental for children whose parents had lower levels of education, but the opposite (or no) effect has been found for children whose parents had achieved higher levels of education (Long, 1975; Straits, 1987). Researchers have been alerted to the complexity of assessing the independent effects of movement on child outcomes given the number of potentially confounding factors (Alexander et al., 1996; Rumberger, 2002). In attempting to establish the sequence of causal pathways, circumstances surrounding mobility decisions are important as there may be unobserved factors which manifest in a move that ultimately impact on the child, rather than the event itself (Dong et al., 2005).

Research in this area has been conducted primarily in high-income countries and little is known about the effects of residential and school mobility on children's educational progression and achievement in low- and middle-income countries. Given the unique nature of population movements and education provision in these different settings, an exploration of their relationship is of interest, and relevant in light of the United Nations Millennium Development Goals targeting education provision and access (UNICEF, 2005).

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## 1.2. South Africa

South Africa provides an interesting context in which to investigate relationships between child mobility and education, particularly given its unique policy and political history. In post-Apartheid South Africa, the majority of the population continues to be marked by poverty and unemployment, and education has been emphasised as a vital component in moving toward a more equitable society. However, there is current significant under-achievement in primary education, particularly amongst disadvantaged groups (Fleisch, 2008). This has been substantiated in a number of studies identifying high levels of grade repetition and interrupted progression through school, as well as low competency in numeracy and literacy amongst South African learners (Anderson et al., 2001; Branson and Lam, 2009; Fleisch, 2008; Lam et al., 2008b; Liddell and Rae, 2001; Motala, 1995; Shindler, 2008).

As with education, population movements in South Africa have been significantly influenced by Apartheid policies, which restricted the free movement and settlement of Black<sup>1</sup> people (Wentzel and Tlabela, 2006). Following the new political dispensation in 1994, internal population movements have increased, particularly to and within the country's urban centres (Kok and Collinson, 2006; South African Cities Network, 2004). While mobility amongst adults is frequently prompted by relationship formation/dissolution, or the search for employment or adequate housing and services, children have also been observed to move or be moved independently of adults in order to increase their access to care or educational opportunities (Collinson et al., 2006; Ford and Hosegood, 2005; Paterson and Kruss, 1998; Wentzel et al., 2006).

This is suggestive of a relationship between education and mobility with education acting as a driver of movement amongst children. However, there has been little published research on patterns of residential or school mobility amongst South African children and, as far as we can ascertain, the association between residential and school mobility and educational outcomes has never been expressly investigated.

In order to begin to address this research gap, a study of residential mobility and schooling was undertaken amongst children enrolled in the Birth to Twenty (BT20) cohort. This urban-based birth cohort study, the recruitment and follow-up of which spans South Africa's transition to democracy, has yielded 15 years worth of longitudinal data on children's places of residence, as well as their school enrolment and progression.

Findings from preceding analyses conducted on residential mobility within the cohort have shown that by age 15, two thirds of children had moved residence at least once (Ginsburg et al., 2009). Child movement was also found to be associated with lower-resourced households suggesting that mobile children are potentially vulnerable (Ginsburg et al., 2010). Analyses of the patterns of schooling within the cohort have revealed high rates of grade repetition, particularly amongst male participants and especially in the early years (Fleisch and Shindler, 2009). Following from these findings, the aim of the current paper is to determine whether an association exists between residential and school mobility and a set of educational outcomes measuring progression through school and competency in numeracy and literacy. The paper will explore the relationship between mobility and

<sup>1</sup> The categories Black, Coloured (mixed ancestral origin), White and Asian are carried over from South Africa's Apartheid past. While they no longer have legislative force, they have so influenced South African society, and in many ways continue to do so, that there is consensus on the importance of retaining these categories for social analyses. In this paper we have used these racial categories in our analyses as opposed to ethnic categories (for example Zulu, Xhosa, Sotho, Afrikaans).

education within the context of a set of individual child, family background and household factors that have been identified as having a mediating effect in previous empirical studies. The study aims to test the hypothesis that residential and school mobility have a negative effect on educational outcomes, as has been observed in much of the international literature.

## 2. Methods

### 2.1. Study sample

The Birth to Twenty cohort study was initiated and developed by a group of researchers from the University of the Witwatersrand and the South African Medical Research Council. Commencing at the onset of South Africa's transition to democracy, the study aimed to track children's physical and social development in a context of rapid social change (Richter et al., 2007). The BT20 cohort comprised all singleton children born within a 7-week period between April and June 1990 at primarily public delivery centres in the Greater Johannesburg-Soweto area situated in the Gauteng Province, South Africa's most densely populated urban centre. The residential cohort of 3273 excluded those children whose mothers relocated from Johannesburg-Soweto within six months following their birth, on the basis that these families were only temporarily resident in the area. At enrolment, the cohort consisted of a majority of Black participants (78.5%) followed by 11.7%, 6.3% and 3.5% Coloured, White and Asian children respectively. Females, comprising 51.4% of the cohort, marginally outnumbered males (see Richter et al., 2004, 2007; Yach et al., 1991 for a more detailed description of the study's research aims and methods).

The study has focused on a set of multidisciplinary themes connected to children's well-being including health and nutrition, growth and development, household environments, and educational progression (Richter et al., 2007). Data collection has taken the form of physical and biological measures and questionnaires, administered to cohort children and their primary caregivers either annually or within a 2-year interval, at health care centres and through home visits. Over the course of the study, contact has been maintained with approximately 70% of the original cohort, with one third of the cohort identified as cases of cumulative attrition (Norris et al., 2007).

The study of mobility and education outcomes described in this paper is presented in two parts centred on two educational outcome variables, the first measuring grade repetition or school progression and the second, competency in numeracy and literacy. The educational progression component is based on data derived from a retrospective questionnaire administered to cohort members in their homes during the study's 15th year. The aim of this questionnaire was to capture information concerning participant's school attendance and progression through school from the commencement of primary education up until the age of 15. The retrospective schooling questionnaire yielded a response rate of 87.3% ( $n = 2001$ ) of the 2291 cohort members still in contact with the study in its 15th year. The analytical dataset for this study component is based on a sample of 1989 respondents as 12 participants who reported having attended special schooling because of learning disabilities were excluded.

The second part of the paper is based on results from a numeracy and literacy evaluation completed by cohort members at BT20's data collection site a year later, during the study's year 16 data collection wave. The evaluation utilised a standardised instrument that was developed through expert consultation with the Joint Education Trust for the Cape Area Panel Study (Lam et al., 2008a). Participants were given 20 min to complete the evaluation and it was invigilated by a research assistant. The numeracy and

literacy evaluation was administered to 1761 participants, 76.9% of the cohort still in contact with the study. A total of 17 participants with learning disabilities (and attending special education schools) were once again excluded from the sample, yielding an analytical sample of 1744 participants.

## 2.2. Variables

Outcome and explanatory variables employed in the analyses are described in Table 1. Both sections of the paper utilise residential mobility data derived from participants records, collected at each contact, and later verified in a Residential Move Questionnaire administered to primary caregivers during the study's 15th and 16th years. The residential mobility variables represent the total number of times the cohort members moved home, split between the number of moves that occurred from birth prior to the commencement of schooling, and the number of moves that occurred following the commencement of schooling until the age of 15 (i.e., calculated with reference to the age that the corresponding cohort member commenced school). The variable representing the number of school changes excludes the school change associated with the transition to secondary school; therefore this variable represents school changes outside of the normal educational progression from primary to secondary school.

The two components of the paper also make use of demographic data describing child, maternal and household characteristics, collected from participants' biological mothers at the onset of the study as part of BT20's routine data collection activities. The selection of the set of explanatory variables considered in the analyses is governed by theory, prior empirical findings and data availability.

## 2.3. Data analysis

A set of bivariate analyses was conducted for each of the study components presented in the paper. In the case of categorical

variables, chi-square tests were performed to establish significance of associations. For continuous variables, *t*-tests or one-way analysis of variance tests were used to compare means. The outcome variable representing grade repeats contrasted those participants who had never repeated a grade over the course of their schooling with those participants who had repeated a grade on one or more occasions. The categories contrasting participants who had repeated a grade on one occasion with participants who had repeated a grade more than once were also considered in analyses. Grade repetition was modelled using binary logistic regression analysis.

The numeracy and literacy scores were standardised by transforming raw scores into *z*-scores, for males and females. The *z*-scores were calculated by taking the raw numeracy and literacy score, subtracting the study population mean (by gender) and dividing the result by the study population standard deviation (by gender). The standardised scores allowed for comparison across the study population, which is justified by the lack of population norms that would enable comparability with the BT20 cohort. Standardised *z*-scores were modelled using multiple linear regression analysis. Data analysis was conducted using SPSS (SPSS, 2007). Unless stated otherwise, statistical significance was tested at the 5% level in all analyses undertaken.

## 3. Results

### 3.1. School progression

#### 3.1.1. Sample characteristics

Comparative analyses were conducted between the sample of 1989 cohort members who completed the school progression questionnaire (the analytical sample) and the 1284 remaining cohort members who were either receiving special schooling or were not in contact with BT20 and did not complete the questionnaire during the study's 15th year (see Table 2). The

**Table 1**  
Outcome and explanatory variables.

Variable	Description
<b>Schooling</b>	
Age at school entry	Age in years participant commenced schooling
Grade repeats	Never repeated, repeated/1 repeat, >1 repeat
Numeracy score	Standardised score on numeracy section of evaluation
Literacy score	Standardised score on literacy section of evaluation
Age at assessment	Participant's age on the date of evaluation
<b>Mobility</b>	
Total residential moves prior to school entry	Never moved, moved
Total residential moves following school entry	Never moved, moved
Total school changes (excluding transition from primary to secondary school)	Never changed, 1 change, >1 change
<b>Child, maternal and household characteristics</b>	
Child gender	Male, female
Child ethnicity	White, Black, Coloured, Asian
Hospital of birth	Public, private
Residential area at birth	Soweto/Diepsloot, former Coloured/Asian, inner city, suburban
Maternal age at delivery	≤18, 19–34, 35+ years
Maternal education at delivery	Grade 10 or less, grade 11–12, post-school training
Maternal marital status at delivery	Married/living with partner, single/widowed/divorced/separated
Household socioeconomic index at birth <sup>a</sup>	Constructed from the following binary items: Home ownership: owned, other House type: house, other Water indoor: yes, no Toilet flush: yes, no Electricity: yes, no TV: yes, no Car: yes, no Fridge: yes, no Washing machine: yes, no Telephone: yes, no

<sup>a</sup> This index was calculated using a probit factor model; estimated factor loadings for each item were then used to compute a "wealth index".

**Table 2**  
Characteristics of members of the analytical sample and cohort members excluded from the analytical sample.

		School progression sample Total (%)	BT20 participants excluded from analysis Total (%)
Child gender $\chi_{(1)}^2 = 0.042$ , NS, $n = 3273$	Male	964 (48.5)	627 (48.8)
	Female	1025 (51.5)	657 (51.2)
Child ethnicity $\chi_{(3)}^2 = 175.298$ , $p < 0.001$ , $n = 3273$	White	51 (2.6)	156 (12.1)
	Black	1662 (83.6)	906 (70.6)
	Coloured	241 (12.1)	142 (11.1)
	Asian	35 (1.8)	80 (6.2)
Hospital of birth $\chi_{(1)}^2 = 39.496$ , $p < 0.001$ , $n = 3272$	Public	1780 (89.5)	1051 (81.9)
	Private	208 (10.5)	233 (18.1)
Residential area at birth $\chi_{(3)}^2 = 274.832$ , $p < 0.001$ , $n = 3273$	Soweto/Diepmeadow	1642 (82.6)	787 (61.3)
	Former Coloured/Asian	244 (12.3)	188 (14.6)
	Inner city	11 (0.6)	58 (4.5)
	Suburban	92 (4.6)	251 (19.5)
Maternal age at delivery $\chi_{(2)}^2 = 11.647$ , $p < 0.001$ , $n = 3271$	≤18	235 (11.8)	107 (8.3)
	19–34	1542 (77.6)	1053 (82.0)
	35+	210 (10.6)	124 (9.7)
Maternal education at delivery $\chi_{(2)}^2 = 62.504$ , $p < 0.001$ , $n = 2932$	Grade 10 or less	227 (12.4)	228 (20.6)
	Grade 11–12	1430 (78.3)	719 (65.0)
	Post-school training	169 (9.3)	159 (14.4)
Maternal marital status at delivery $\chi_{(1)}^2 = 75.664$ , $p < 0.001$ , $n = 3251$	Married/living with partner	740 (37.4)	675 (52.9)
	Single/widowed/divorced/separated	1236 (62.6)	600 (47.1)
Household socioeconomic index at birth $t_{(2069,219)} = -1.037$ , NS, $n = 3181$	Minimum	-2.193	-2.216
	Maximum	1.699	1.673
	Mean	-0.170	-0.206

analytical sample comprised roughly equal numbers of male and female participants and there were no significant differences between the proportion of males and females in the analytical sample and those who were excluded. However, members of the analytical sample were more likely to be Black, born in the Soweto/Diepmeadow area and delivered in public health facilities. There was a higher representation in the analytical sample of biological mothers who were single at the time of delivery, while those mothers with grade 10 or less education, or post-school training were slightly under-represented in the analytical sample. There were no significant differences in the household socioeconomic index between the group that was analysed and the group for whom school progression data was not available.

3.1.2. Education and mobility

The education and mobility profile of participants who completed the school progression questionnaire is presented in Table 3. The majority of study participants commenced their

schooling in their 6th or 7th years (43.4% and 42.7% of the sample respectively), and by the age of 15, the majority of the BT20 study sample had completed primary school, and were enrolled in grade 9 or higher. While most of the study participants had not repeated a grade over the course of their schooling, just over a quarter of the participants had repeated a grade on one occasion, and approximately 5% of the sample had repeated grades more than once (where the maximum number of grade repeats in the sample was 4). All schooling variables differed significantly for males and females. While males and females were equally likely to have started school under the age of 6, males were more likely than females to have commenced primary school at the age of 8 or older (15.8% compared with 9.7%), and they were therefore less likely to have completed primary school or to be enrolled in grade 10 or higher by the time they were 15 years old. In addition, levels of grade repetition differed significantly for males and females in the sample, with males having repeated grades more frequently than females.

**Table 3**  
Education and mobility profile by gender.

		Male (%) $n = 964$	Female (%) $n = 1025$	Total (%) $n = 1989$
Age at school entry $t_{(1987)} = 5.168$ , $p < 0.001$ , $n = 1989$	Minimum	5 years	5 years	5 years
	Maximum	10 years	9 years	10 years
	Mean	6.774 years	6.601 years	6.685 years
Grade repeats $\chi_{(2)}^2 = 69.696$ , $p < 0.001$ , $n = 1989$	Never repeated	585 (60.7)	793 (77.4)	1378 (69.3)
	1 repeat	309 (32.1)	205 (20.0)	514 (25.8)
	>1 repeat	70 (7.3)	27 (2.6)	97 (4.9)
Total residential moves prior to school entry $\chi_{(1)}^2 = 0.054$ , NS, $n = 1989$	Never moved	663 (68.8)	700 (68.3)	1363 (68.5)
	Moved	301 (31.2)	325 (31.7)	626 (31.5)
Total residential moves following school entry $\chi_{(1)}^2 = 5.750$ , $p < 0.05$ , $n = 1989$	Never moved	635 (65.9)	622 (60.7)	1257 (63.2)
	Moved	329 (34.1)	403 (39.3)	732 (36.8)
Total school changes $\chi_{(2)}^2 = 1.029$ , NS, $n = 1986$	Never changed	390 (40.5)	419 (41.0)	809 (40.7)
	1 change	383 (39.8)	420 (41.1)	803 (40.4)
	>1 change	190 (19.7)	184 (18.0)	374 (18.8)

An analysis of the rates of residential mobility and school changes amongst the group of BT20 participants revealed that prior to the commencement of schooling, 31.5% of children had moved residence on one or more occasions (where the maximum number of moves was 4). In the period following school entry up until cohort members reached the age of 15, 36.8% of the children had moved home on one or more occasions (up to a maximum of 5 times). The majority of BT20 participants (59.2%) had transferred schools at least once outside of the normal transition from primary to secondary school. By the age of 15, 40.4% of children had experienced one non-promotional related school change, and 18.8% of children had transferred schools more than once (up to a maximum of 5 times). While the levels of residential mobility prior to the commencement of schooling and the rates of school change did not differ significantly by gender, a significantly larger proportion of females in the sample moved residence after the commencement of school as compared with males in the group.

3.1.3. Associations with school progression

Residential mobility prior to the commencement of schooling was not significantly associated with grade repetition ( $\chi_{(1)}^2 = 0.032$ , NS,  $n = 1989$ ), nor was residential mobility following school entry significantly associated with repeating a grade ( $\chi_{(1)}^2 = 0.349$ , NS,  $n = 1989$ ). Nevertheless, the association between grade repetition and school transfers was highly significant within the analytical sample ( $\chi_{(2)}^2 = 11.248$ ,  $p < 0.01$ ,  $n = 1986$ ).

To further explore the association between grade repetition and school and residential mobility, grade repeats were modelled using logistic regression. Because of the highly significant differences in the pattern of grade repeats for males and females in the sample, the logistic regression models were stratified by gender. The logistic regression models presented in Table 4 contrast participants who had never repeated a grade over the course of their schooling with participants who had repeated a grade on one or more occasions. Due to small frequencies of multiple repeaters in the sample, the ability of the logistic regression model to predict

multiple repeats within this group was limited, however, the substantive conclusions did not differ when contrasting the multiple and single repeaters. The explanatory variables ‘ethnicity’ and ‘residential area at birth’ were excluded from the final models on the basis that the frequencies of some categories of these variables were very low once the sample was split by gender (which led to validity issues when estimating the models).

Amongst the male participants, the residential mobility variables were not found to be statistically significant in predicting grade repetition, however, the odds of a grade repeat amongst males who changed schools on multiple occasions was 1.524 times the odds of a repeat amongst males who had not changed schools, and for males who had changed schools once outside of the transition to secondary school, the odds of repeating a grade was 1.707 times the odds of a grade repeat amongst males who had never changed schools. A significant negative relationship was found between household socioeconomic status and the probability of repeating a grade, while higher levels of maternal education reduced the probability of a grade repeat for males (the odds of a grade repeat for males whose mother’s had post-school education was 0.395 times the odds of a repeat for males whose mothers had grade 10 or less schooling). The model adjusted for the age at which participants commenced their schooling, revealing a negative association. For example, the odds of a grade repeat for a participant who commenced school at the age of 7, was 0.741 times the odds of a repeat for a male who began school at age 6. The model could correctly predict 61.2% of repeaters in the sample of males.

The logistic regression model applied to female participants revealed far fewer variables that significantly accounted for grade repetition. Residential and school mobility were not found to be associated with grade repetition amongst females. Nor was an association present between grade repetition and household socioeconomic status or any of the variables representing maternal characteristics. There was weak evidence of an association between hospital of birth (a proxy for socioeconomic status)

**Table 4**  
Logistic regression analyses: school progression.

	Grade repeats: males			Grade repeats: females		
	$\beta$	Std error	Exp( $\beta$ )	$\beta$	Std error	Exp( $\beta$ )
Age at school entry	-0.299	0.095 <sup>a</sup>	0.741	-0.284	0.116 <sup>b</sup>	0.752
Total residential moves prior to school entry (moved)	-0.004	0.156	0.996	-0.004	0.173	0.996
Total residential moves following school entry (moved)	-0.055	0.153	0.947	0.197	0.165	1.218
Total school changes (never changed)						
1 change	0.535	0.162 <sup>a</sup>	1.707	-0.114	0.180	0.892
>1 change	0.421	0.200 <sup>b</sup>	1.524	0.226	0.221	1.254
Hospital of birth (private)	-0.286	0.297	0.751	-0.668	0.353 <sup>c</sup>	0.513
Maternal age at delivery ( $\leq 18$ )						
19–34	0.107	0.230	1.113	-0.277	0.240	0.758
35+	0.545	0.322 <sup>c</sup>	1.725	-0.096	0.345	0.908
Maternal education at delivery (grade 10 or less)						
Grade 11–12	-0.740	0.221 <sup>a</sup>	0.477	-0.384	0.241	0.681
Post-school training	-0.930	0.329 <sup>a</sup>	0.395	-0.578	0.392	0.561
Maternal marital status at delivery (single/widowed/divorced/separated)	0.077	0.162	1.080	-0.085	0.183	0.918
Household socioeconomic index at birth	-0.203	0.100 <sup>b</sup>	0.816	-0.025	0.116	0.975
Constant	1.748	0.748 <sup>b</sup>	5.741	1.247	0.858	3.482
-2 log likelihood	1135.781			984.109		
	$\chi_{(12)}^2 = 50.274$ , $p < 0.001$			$\chi_{(12)}^2 = 22.313$ , $p < 0.05$		

<sup>a</sup>  $p < 0.01$ .  
<sup>b</sup>  $p < 0.05$ .  
<sup>c</sup>  $p < 0.10$ .

and the probability of grade repetition, with the odds of a grade repeat amongst females born in a private health facility 0.513 times the odds of a repeat for females born in a public hospital. As was observed in the sample of males, an increase in the age of school entry was negatively associated with grade repetition amongst females. The model could correctly predict 77.1% of repeaters in the sample of females.

### 3.2. Competency in numeracy and literacy

#### 3.2.1. Sample characteristics

The sample of 1989 participants in the school progression dataset dropped to 1744 participants who completed the numeracy and literacy evaluation. A series of chi-square and mean comparison tests was conducted to determine if the drop in sample resulted in any significant changes in the profile of participants described in the school progression study component. The proportion of male and female participants did not differ significantly between the two analytical datasets; similarly the distribution of maternal characteristics and household socioeconomic status was congruent across the school progression and reduced numeracy and literacy study samples. However, significant differences were present in the population group, hospital of birth and residential area profile across the two samples. In particular there was a drop in the proportion of White and suburban-born children (from 2.6% to 0.3% and 4.6% to 2.2% respectively), with the participants who completed the numeracy and literacy evaluation most likely to be Black (87.0% of the sample), born in public hospitals (91.8% of the sample) and resident in the Soweto/Diepsmeadow area at birth (85.6% of the sample).

#### 3.2.2. Numeracy and literacy

An exploration of the unstandardised results of the numeracy and literacy assessment revealed an average score for male participants of 7.538 (SD = 4.837) out of a possible 23 in the numeracy component of the assessment, and 15.987 (SD = 3.850) out of a possible 22 in the literacy component ( $n = 831$ ). Females obtained similar average scores to males in the numeracy component with a mean score of 7.629 (SD = 4.669) out of 23 ( $t_{(1742)} = -0.399$ , NS,  $n = 913$ ), however, females in the sample scored significantly higher than males in the literacy component of the assessment with an average of 17.104 (SD = 3.056) out of 22 ( $t_{(1581.582)} = -6.669$ ,  $p < 0.001$ ,  $n = 913$ ).

#### 3.2.3. Associations with numeracy and literacy

A series of analyses of variance was conducted on the numeracy and literacy test scores for males and females to determine if mean scores differed according to whether or not the participants had experienced a residential movement or changed schools. There were no significant differences in mean numeracy and literacy scores amongst the group of participants who had moved residence prior to the commencement of schooling as compared with those who had not experienced a move, nor did average test scores differ significantly for participants who had changed schools once, multiple times or not at all. However, average scores on the male literacy and the male and female numeracy components of the evaluation differed significantly amongst participants who had experienced a residential move following the commencement of school as compared with those who had not (numeracy (males)  $t_{(467.972)} = -2.308$ ,  $p < 0.05$ ,  $n = 804$ ; numeracy (females)  $t_{(871)} = -2.488$ ,  $p < 0.05$ ,  $n = 873$ ; literacy (males)  $t_{(802)} = -2.325$ ,  $p < 0.05$ ,  $n = 804$ ; literacy (females)  $t_{(871)} = -1.801$ , NS,  $n = 873$ ). In each case, the mean score amongst the group who had changed residence after the commencement of school was higher than the mean score of those participants who had not moved home. For

males, movers scored an average of 3.7% higher than non-movers on the numeracy component and 3.1% higher on the literacy component of the evaluation, while female movers obtained average scores of 3.5% higher than non-movers on the numeracy evaluation.

In order to explore the associations between the full set of explanatory variables and the numeracy and literacy scores, a series of linear regression models was run using the standardised z-scores as outcome measures (see Table 5). As was the case with the school progression regression models, variables 'ethnicity' and 'residential area at birth' were excluded from the final models because of unfeasibly small sample sizes; the vast majority of the sample were Black and born in the Soweto/Diepsmeadow area.

The results of the multiple regression model of standardised numeracy scores for males revealed that neither residential mobility prior to the commencement of schooling nor school mobility were significantly associated with competency. However, males who experienced residential mobility after the commencement of schooling fared moderately better (with z-scores or standard deviation units of 0.188 higher) in the numeracy evaluation as compared with those in the sample who had not moved. Of the child and maternal characteristics included in the model, a significant positive relationship was found between males born in private hospitals and numeracy scores. In addition, household socioeconomic status was found to be positively related to numeracy amongst males. There was also a significant negative relationship between grade repetition and numeracy with males who had repeated a grade achieving z-scores of 0.601 lower than those who had not repeated a grade (equivalent to a difference in raw test scores of 2.907 points). Increased age at school entry was negatively related to scores on the numeracy assessment, with males commencing school 1-year older achieving scores 0.543 standard deviation units below those who had begun school a year younger. The model's adjusted  $R^2$  value indicates that the set of explanatory variables included in the model explained 32.9% of the variation in numeracy scores amongst male participants. Residential mobility after the commencement of schooling described as significant in the numeracy model for males was also found to be significant in explaining literacy scores, with males who experienced a move after commencing school attaining z-scores of 0.197 higher than those who had not moved house. Maternal education and household socioeconomic status were significant in the model of male literacy scores with increased levels of maternal education and higher household socioeconomic indices associated with higher z-scores. For instance, a male whose mother had completed post-school training achieved z-scores of 0.621 higher on the assessment compared with a male whose mother had not received post-school education (with the difference equivalent to 2.391 raw test points). As was the case in the numeracy model, commencing school at an older age and/or repeating a grade were associated with reduced literacy scores. The set of explanatory variables in this model explained 32.1% of the variation in literacy scores amongst male participants.

The regression model of female numeracy scores revealed a similar set of significant predictors as was found in the model for males. Females in the sample who had experienced residential mobility following school entry achieved z-scores of 0.150 higher on the numeracy evaluation as compared with females who had not moved (equating to a difference in unstandardised test scores of 0.700). In addition, being born in a private health facility to a mother with post-school education and/or in a household with higher socioeconomic status was associated with higher relative assessment scores for females. As was the case in the male numeracy model, the variables 'grade repeats' and 'age at school entry' were negatively associated with numeracy scores, while the set of explanatory variables in this model described a slightly lower

**Table 5**  
Multiple linear regression analyses: numeracy and literacy.

	Numeracy: males		Numeracy: females		Literacy: males		Literacy: females	
	$\beta$	Std error	$\beta$	Std error	$\beta$	Std error	$\beta$	Std error
Age at school entry	-0.543	0.040 <sup>a</sup>	-0.414	0.044 <sup>a</sup>	-0.535	0.041 <sup>a</sup>	-0.566	0.044 <sup>a</sup>
Grade repeats (repeated)	-0.601	0.061 <sup>a</sup>	-0.513	0.073 <sup>a</sup>	-0.658	0.063 <sup>a</sup>	-0.494	0.072 <sup>a</sup>
Age at assessment	0.071	0.107	0.017	0.116	0.099	0.110	-0.106	0.113
Total residential moves prior to school entry (moved)	0.071	0.066	0.096	0.068	-0.038	0.067	0.060	0.067
Total residential moves following school entry (moved)	0.188	0.065 <sup>b</sup>	0.150	0.066 <sup>c</sup>	0.197	0.067 <sup>b</sup>	0.089	0.065
Total school changes (never changed)								
1 change	-0.063	0.068	-0.090	0.070	0.104	0.070	-0.038	0.069
>1 change	0.015	0.084	-0.077	0.090	0.039	0.086	-0.037	0.088
Hospital of birth (private)	0.473	0.128 <sup>a</sup>	0.392	0.128 <sup>b</sup>	0.094	0.131	0.377	0.125 <sup>b</sup>
Maternal age at delivery ( $\leq 18$ )								
19–34	-0.047	0.094	-0.030	0.097	-0.154	0.097	-0.046	0.095
35+	-0.087	0.132	-0.054	0.140	-0.100	0.135	-0.061	0.137
Maternal education at delivery (grade 10 or less)								
Grade 11–12	-0.117	0.092	0.088	0.103	0.195	0.094 <sup>c</sup>	0.272	0.101 <sup>b</sup>
Post-school training	0.272	0.143 <sup>d</sup>	0.625	0.155 <sup>a</sup>	0.621	0.147 <sup>a</sup>	0.618	0.152 <sup>a</sup>
Maternal marital status at delivery (single/widowed/divorced/separated)	0.052	0.067	-0.033	0.073	0.013	0.069	0.004	0.072
Household socioeconomic index at birth	0.209	0.042 <sup>a</sup>	0.200	0.046 <sup>a</sup>	0.173	0.043 <sup>a</sup>	0.092	0.045 <sup>c</sup>
Constant	2.777	1.812	2.488	1.955	2.091	1.861	5.338	1.918 <sup>b</sup>
Adjusted $R^2$	0.329		0.220		0.321		0.251	
	$F_{26.876, 14, 725}$		$F_{17.236, 14, 790}$		$F_{25.914, 14, 725}$		$F_{20.228, 14, 790}$	
	$p < 0.001$		$p < 0.001$		$p < 0.001$		$p < 0.001$	

<sup>a</sup>  $p < 0.001$ .<sup>b</sup>  $p < 0.01$ .<sup>c</sup>  $p < 0.05$ .<sup>d</sup>  $p < 0.10$ .

proportion of the variation in numeracy scores (22.0%) as compared with the model for males. A similar set of explanatory variables found to be significant in the numeracy model for females also achieved significance in the female literacy model, with the exception that no significant linear relationship was present between female literacy scores and residential mobility following school entry. The set of explanatory variables in the model described slightly more of the variation in female literacy scores (25.1%) than was found in the female numeracy model.

#### 4. Discussion

As far as we can ascertain, this is the first study to consider the association between residential and school mobility and educational outcomes in a cohort of South African learners. The analyses utilise two educational outcome measures, progression through school indicated by grade repetition, and competency in numeracy and literacy measured by scores on an assessment. The study considers the frequency of children's residential change prior to and following the commencement of schooling and also quantifies, for the first time, the degree of school movement occurring outside of the normal educational transition. The relationships between residential and school mobility and educational outcomes were found to differ from those observed in the prevailing international literature. While these studies predominantly link movement to disrupted schooling and lower levels of achievement, the South African study demonstrates no association between residential mobility and transition through school, and a positive relationship between residential mobility and numeracy and literacy scores. School mobility was found to be associated with grade repetition for males, but no relationship was observed between school changes and competency in numeracy and literacy. The South

African study provides a counter example to the trends observed in high-income countries, while highlighting the complexity and important influence of context on these relationships.

##### 4.1. School progression

Amongst this cohort of urban children, almost a third had moved residence prior to school entry and over a third of the sample had shifted households at some stage following the commencement of their school careers up until the age of 16. However, residential mobility was not found to be associated with progression through school as indicated by grade failure. The BT20 data provides, for what we think is the first time in a South African study, a quantum of the rates of non-promotional school mobility. Rates of school mobility in the sample were very high with 59.2% of participants changing schools outside of the primary to secondary school transition. While the reasons prompting school transfer were beyond the scope of the current study, it is feasible that a proportion of school mobility can be explained as a response (or a precursor) to grade failure. However, only 33.4% of the sample who had transferred schools on one or more occasions had also repeated a grade over the course of their schooling, suggesting that school changes within the cohort are taking place for other reasons, besides those related to grade retention. We would hypothesise that the high frequency of school change may be attributed to learners shifting schools in order to maximise or improve academic outcomes, as was suggested in Motala's (1995) study of a 1986 cohort of Soweto-based learners. In the context of Soweto, where the majority of the BT20 study sample is resident, a current over-supply of educational facilities (due to an expansion during the Apartheid era followed by an aging population) has resulted in a wide range of schooling options with schools incentivised to accept

new enrolments. Thus the local environment might offer learners a broad spectrum of choice around schooling. A proportion of learners are also known to be travelling outside of their immediate area to attend schools at a greater distance from their homes, in the interests of accessing schools perceived as superior (Sekete et al., 2001). In order to investigate this hypothesis, issues surrounding school quality and learner migration would need to be considered to determine whether learners are moving from low-achieving schools to higher-achieving schools.

The BT20 data provides further evidence of the large repeater burden in the South African schooling system, and the higher level of grade repeats amongst male learners as compared with females, a finding synonymous with research conducted by Anderson et al. (2001) and Branson and Lam (2009). The analyses revealed a larger set of predictors significantly associated with grade repetition amongst males as compared with females in the sample. For males, a significant relationship was found between grade repetition and school mobility. South African studies have not expressly investigated the relationship between school mobility and academic achievement, however, grade failure has been linked to negative in-school experiences (Department of Education, 2007). Further, international research has demonstrated negative associations between school mobility and school and academic functioning (Alexander et al., 1996; Nelson et al., 1996). Therefore, it seems plausible that males in the sample may shift schools as a response to grade failure at an existing school. Alternatively, a change in school may lead to adjustment issues or disruption, which may in turn result in males being held back a grade. An inverse relationship was found between grade repetition and socioeconomic indicators such as maternal education and household assets for males, and birth at a private hospital for females. This link between socioeconomic status and academic achievement has been well demonstrated in educational attainment literature. For both male and female participants, the higher the age of school entry, the lower the probability of a grade repeat. In previous research findings, BT20 cohort members who commenced school at younger ages (at age 6) were more likely to repeat grades earlier in their schooling with the pattern of grade repeats becoming more uniform for cohort members who began school slightly older (at age 7) (Fleisch and Shindler, 2009). This finding is consistent with provincial-level survey data indicating that grade failure is more common in under-age children, who may be perceived by teachers as immature (Perry and Arends, 2003).

#### 4.2. Competency in numeracy and literacy

One striking difference between the school progression analysis and the analysis of numeracy and literacy scores was the significant positive relationship between the later educational outcome and residential mobility following commencement of schooling. Males who had moved home after entering school achieved significantly higher average scores on both components of the assessment, while females in the sample scored significantly higher on the numeracy component if they had experienced residential change. As suggested in the international literature, an understanding of the effect of mobility on educational outcomes would be assisted by investigating the circumstances driving (and resulting from) movement (Alexander et al., 1996; Dong et al., 2005; Rumberger, 2002). In South Africa, residential mobility has been shown to enable children to gain access to potentially improved care structures and educational opportunities (Paterson and Kruss, 1998; Zimmerman, 2003). Studies have also demonstrated significant associations between educational outcomes and children's living arrangements and household structures (Anderson et al., 2001; Townsend et al., 2002).

In the BT20 study, detailed data describing children's living circumstances were not available, however, results of a longitudinal analysis of factors associated with movement linked residential mobility to lower socioeconomic proxies—suggesting movement within the cohort is more frequently driven by necessity (Ginsburg et al., 2010). Nevertheless we might hypothesise that even in these instances relocation may have the advantageous effect of offering stability to some children, possibly in the form of an alternative schooling or care arrangement, or an improved residential locality. A preliminary exploration of reasons for movement within the BT20 cohort revealed that moves associated with childcare or schooling comprised 14.9% of all reasons cited by caregivers for participants changing residence (Ginsburg et al., 2009). Reasons included moving to be in closer proximity to participants' schools, which would have the effect of reducing transport time and costs associated with travel. This example illustrates a positive consequence of residential movement, which may translate into improved educational outcomes for children.

Controlling for residential mobility, the analyses of BT20 participant's numeracy and literacy scores provided evidence of a positive relationship between household socioeconomic status and competency. In addition, being born in a private hospital, to mothers with higher levels of education was linked to higher outcomes in the assessment. The analysis of numeracy and literacy scores also controlled for aspects of school education, thus connecting the two study components. The relationship between school progression and competency was significant, with those participants who had repeated a grade scoring lower on the evaluation, and those progressing through school without a grade failure achieving higher scores. Nevertheless, while residential mobility was found to be positively associated with competency, the lack of association between school mobility and numeracy and literacy would suggest that changing schools is not translating into improved educational outcomes amongst this group of children, even if this is the intention. As with the school progression analysis, a measure of school quality is likely to have a mediating influence on these relationships and would be of interest. Older ages of school entry were associated with lower relative scores on the numeracy and literacy assessment reflecting the fewer years of schooling completed by learners who had commenced school later.

#### 4.3. Limitations and future research

The current study provides insight into the relationship between residential and school mobility and two educational outcomes, thus offering a new and original contribution to understanding the potential forces impacting education in an urban South African setting. The results reveal certain limitations with the current data and highlight a number of areas warranting further investigation. While the analyses identified some important factors explaining school progression and competency in numeracy and literacy, a number of confounding factors could not be included in the investigations because of a lack of available data. These explanatory models would benefit from the inclusion of school level variables such as measures of school quality in order to ascertain the extent to which movers are shifting from poorer to better quality schools. Neighbourhood and community related factors would also be of interest in understanding the context in which children are living and attending school. Further, knowledge of how residential moves reflect new household formation and composition, as well as the relationships between learners and household heads would add value. A more complete understanding of these dynamics would be greatly assisted by further exploration of the circumstances and reasons prompting both residential mobility and school change.



The educational outcome variables employed in such analyses may not always provide adequate or sensitive enough measures of educational achievement and academic ability. While grade repetition may be indicative of individual academic ability, it may also be a function of social processes occurring within schools themselves. Numeracy and literacy evaluations are subject to issues of validity and reliability, however, they are considered better proxies of educational attainment and have the advantage of providing a uniform means of comparison for learners attending a range of schools with diverse standards and methods of academic assessment. Finally, the current study provides an initial investigation of the frequency of residential mobility and school changes over time. Following from this paper, a longitudinal analysis incorporating the sequential placement of school and residence would be of interest. This approach would consider the patterns of interaction between residential movement and school change over time, while further incorporating the effects of the timing of a school or residential change on learners' educational outcomes, which has been found to be significant in international studies (Haveman et al., 1991; Swanson and Schneider, 1999). This would also allow for an investigation of the relationship between school mobility and grade repetition to gain clarity on the extent to which school changes are a consequence of a grade failure, and vice versa.

#### 4.4. Conclusion

The results of the analyses presented in the paper reveal that residential mobility amongst South African urban children does not appear to have an adverse effect on educational outcomes. On the contrary, the study provides some evidence of a positive association between changes in residence and educational outcomes, possibility as consequence of movement resulting in improved living circumstances, even amongst the more disadvantaged children. The study demonstrates a high frequency of school change occurring within this cohort of primarily Soweto-based children. While some school mobility may be a response or precursor to grade failure it is likely that a large proportion of this non-promotional school change is occurring as a result of the wide range of educational options available to these children. This environment of diverse choice would allow for children to maximise their schooling outcomes, however, the extent to which school change is linked to improved educational outcomes is not evident.

The South African study reveals a range of generative mechanisms linking residential and school mobility to educational outcomes. It also highlights the complexity of these relationships, illustrating that observed trends are likely to be highly context specific. Given the important role of education in developing human potential, alleviating poverty and unemployment, and promoting future economic growth, a broad understanding of factors that may impact on educational access and outcomes in South Africa and other transitional societies is a priority. This paper provides a new contribution to furthering the understanding of these issues, and proposes a direction for future research into these phenomena.

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