Göteborg Papers in Economic History

No. 36. February 2024 ISSN: 1653-1000

Numeracy and the legacy of slavery

Age-heaping in the Danish West Indies before and after emancipation from slavery, 1780s-1880s

Klas Rönnbäck, Stefania Galli and Dimitrios Theodoridis

DEPARTMENT OF ECONOMY AND SOCIETY

UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

UNIT FOR ECONOMIC HISTORY

Numeracy and the legacy of slavery: Age-heaping in the Danish West Indies before and after emancipation from slavery, 1780s-1880s

Klas Rönnbäck, Stefania Galli and Dimitrios Theodoridis

Corresponding author: klas.ronnback@eocnhist.gu.se

Abstract: In many slave societies, enslaved persons were barred from acquiring much education. What skills the enslaved persons nonetheless were able to acquire, and how this changed following emancipation, is not well known. We study quantitatively how a legacy of slavery impacted upon the development of basic numeracy skills. Our results show that numeracy skills started to improve in the population under study well before emancipation from slavery. We also show that the formal public and private schooling seems to have played a marginal role in this process. We therefore conclude that much of this learning was acquired in informal ways.

JEL:

Keywords: Numeracy, age-heaping, slavery, colonialism, human capital

ISSN: 1653-1000 *online version*
ISSN: 1653-1019 *print version*

University of Gothenburg
School of Business, Economics and Law
Department of Economic History
P.O. Box 720
SE-405 30 GÖTEBORG
www.econhist.gu.se

1. Introduction

It is well-established in much previous research that the education of a population is a crucial ingredient for economic development (Prados de la Escosura 2022). Investing in education for all members of a population could, however, many times be highly contentious. Education was a controversial issue not the least in slave societies. An educated enslaved person, many masters feared, was potentially a rebel or a runaway. Educating an enslaved person could, at the same time, mean higher productivity and thus increased profits for the master (see for example Webber 1978; Span and Anderson 2005; Gundaker 2007). Educating the enslaved at least in religious doctrine could, furthermore, be a step towards amelioration of slavery (see for example Blouet 1990; Luster 1995, chap. 6). This ambivalence created tensions in many slave societies, with different interests pushing in opposite directions. The eventual outcome of such processes were reflected in the government policies in slave societies, where some outlawed all education of enslaved persons, whereas others tolerated or – in time – even supported it. But even in cases where the authorities tolerated the education of the enslaved, investments in slave education were generally very limited.

To what extent the people in slave societies really were able to acquire any useful learning, has not received much attention in previous research. Most importantly, there is to our knowledge no previous research which has attempted to study how this changed with the process of emancipation from slavery.

In this article, we study one crucial aspect of education, namely the attainment of basic numeracy skills, and we do so for a quite typical Caribbean cash-crop colony; the island of St. Croix, in what is today the U.S. Virgin Islands. We study how numeracy developed on the island prior to and following slave emancipation on the island in 1848. We study this issue quantitatively using the conventional method of age-heaping as a proxy for numeracy. We employ a unique dataset, based on a series of consecutive censuses from the island. The censuses cover the total population on the island, and have been digitized in full for the creation of the Danish West Indies Population Panel.

The results from our estimates using this dataset suggest that the level of numeracy – as proxied by age-heaping – was quite high in international comparison; by the middle of the nineteenth century, numeracy levels on St. Croix were substantially higher than they were in most other countries or colonies in Latin America and the Caribbean, with the exception of the British colonies in the West Indies. Numeracy levels furthermore increased quite substantially over time on St. Croix, for both men and women. Persons born after emancipation were thus much more likely to be numerate than those born prior to the emancipation from slavery. The evidence does, however, not suggest that the legal abolition of slavery constituted a clear-cut break in this process: the levels of numeracy started to increase several decades prior to emancipation, and continued to do so well after emancipation. As we can find no evidence that religious affiliation (and consequently the chances of gaining access to missionary-run schools) mattered, our conclusion is that many members of the population successfully acquired these basic numeracy skills in informal ways.

2. Previous research

That education is of crucial importance for economic development is nowadays widely recognized. A key issue for many economists has been the association between education and productivity – and, by extension, economic growth (Rosen 2018). Previous empirical research has shown that there is a strong association between investments in education and economic growth, using various data samples from different historical contexts (Romer 1989; Krueger and Lindahl 2001; Glaeser et al. 2004; Cohen and Soto 2007; Bolt and Bezemer 2009; Barro and Lee 2013; 2015; Lee and Lee 2016). Other scholars have argued that education might also have positive effects other than just raising the productivity of individual workers. One such effect is that a higher degree of education in a population can contribute to a virtuous cycle of institutional development, which in turn can be beneficial to socio-economic development (Sokoloff and Engerman 2000; Engerman and Sokoloff 2012).

Much previous empirical research on this topic has been dedicated to the development of literacy (see for example van Leeuwen and van Leeuwen-Li 2014). In recent years, however, the issue of historical numeracy has gained increasing attention. Some scholars argue that numeracy was extremely important, and perhaps more important than literacy per se, for the development of modern capitalist societies, as the functioning of markets is intimately associated with numeracy (A'Hearn, Baten, and Crayen 2009, 784; Crayen and Baten 2010b, 453).

Estimating numeracy, however, does not come without challenges as testified by the numerous indicators employed to estimate historical numeracy. One such indicator that has gained prominence in recent years is the level of age-heaping in a population, i.e. the frequency of rounded age reporting in the population (Spoorenberg 2007; Tollnek and Baten 2016). Several studies have established a relationship between numeracy as measured by age-heaping and other measures of human capital (A'Hearn, Baten, and Crayen 2009; Crayen and Baten 2010a; Hippe 2012; Cappelli and Baten 2021; Baten, Benati, and Ferber 2022; Baten and Nalle 2022). Historical age-heaping has consequently received much attention in recent years from most parts of the world, including several countries in Europe (A'Hearn, Baten, and Crayen 2009; Crayen and Baten 2010b; De Moor and Van Zanden 2010; Szoltysek, Poniat, and Gruber 2018; Tapia et al. 2022; A'Hearn, Delfino, and Nuvolari 2022), North America (Zelnik 1961; A'Hearn, Baten, and Crayen 2009; Crayen and Baten 2010b), Latin America (Manzel and Baten 2009; Baten and Mumme 2010; Manzel, Baten, and Stolz 2012; Juif and Baten 2013; Calderón-Fernández, Dobado-González, and García-Hiernaux 2020; Llorca-Jaña et al. 2022; Pérez-Artés 2023), Africa (Baten and Fourie 2015; Cappelli and Baten 2021), and Asia (Baten et al. 2010). Albeit still in its infancy, attempts at global comparisons have also been made (Crayen and Baten 2010a).

What has been lacking in previous research is studies on the development of numeracy in slave societies quantitatively both prior to and following emancipation from slavery. Previous studies of historical levels of numeracy that include data from the Caribbean have a late start, observing at the earliest the cohorts born in the 1880s (Manzel and Baten 2009; Crayen and Baten 2010a). This is well after slavery was abolished in the region, leaving the question of how numeracy developed over the period of emancipation in the region still unanswered.

It is well-established in the historiography that formal education often was constrained – many times outright illegal – for enslaved persons in several slave societies, such as in the United States (Genovese 1976; Span and Anderson 2005). The limited education of the enslaved population has also been shown to have had long-lasting consequences for socio-economic development, long after slavery was abolished (Bertocchi and Dimico 2014). In other slave-societies, however, education of the enslaved was tolerated. Missionary societies were, for example, allowed to operate missionary schools on Barbados already in the eighteenth century (Blouet 1980, 127). Following the abolition of the British slave trade, attempts were made to ameliorate the conditions of the enslaved. There has been much previous research into various consequences of the process of amelioration, most importantly into the health and demographic effects, as this was a key concern driving the process (e.g. Higman 1984; Ward 1988; 1989; 2018; Jabour 1994; N. T. Jensen 2012). There has been less research into how the process of amelioration came to impact the education of the enslaved. What research there is on this topic, shows that attempts were made to establish schools for the enslaved population, as a means for preparing them for life as free subjects of the colonial state (Blouet 1980; 1990; 1991; Luster 1995, chap. 6; Glen 2011). The education provided in these schools included elementary skills in reading, writing and arithmetic (Blouet 1991, 396).

But little or no formal education does not necessarily equate with no skills. Modern-day scholars make the crucial distinction between schooling and learning. Being enrolled in a school does not necessarily translate into actually acquiring much skills, and it has been shown in previous research that school enrolment often is a poor proxy of the learning acquired by the students (Angrist et al. 2021; Hanushek and Woessmann 2012; Pritchett 2013). It is, vice versa, also possible to acquire learning despite the absence of formal schooling. This is of crucial importance not the least for slave societies. Some scholars have studied how enslaved persons acquired skills and learning clandestinely in various ways, often being self-taught, when education of the enslaved was unavailable or illegal (Webber 1978; Cornelius 1991; Williams 2005, chap. 1; Gundaker 2007). Much of this previous research has employed qualitative research methods to study the attainment of education among enslaved persons. There is also some quantitative research on numeracy in countries where slavery historically was widespread, such as the United States and Brazil. The formerly enslaved individuals have here been found to exhibit lower levels of numeracy compared to other members of the population, as would be expected (Crayen and Baten 2010b; Baten and Mumme 2010; Manzel, Baten, and Stolz 2012; Juif and Baten 2013). The issue of slavery is, however, dealt with mostly in passing in this previous research. The only study paying more explicit attention to the issue of slavery is a study of numeracy in the Cape Colony (in current-day South Africa). When focusing on the slave population, the study finds that Cape-born slaves exhibited a higher degree of numeracy than slaves born outside the colony (Baten and Fourie 2015).

3. Contribution of the paper

This study aims to contribute to filling the existing research gap by studying numeracy development in a typical Caribbean slave society. Our focus is on how levels of numeracy changed over time prior to and after slave emancipation. The expectation is that this drastic institutional change would have had a significant impact upon the development of numeracy. This is to our knowledge the first attempt to study this topic quantitatively. In the present paper, we contribute with novel research on this topic by focusing on the Danish West Indies (current-day U.S. Virgin Islands) and specifically on the island of St. Croix. The economy of St. Croix was dominated by plantation agriculture, heavily focused on cane sugar production for exports (Sveistrup and Willerslev 1945; Hall 1994; Dookhan 1994; Olsen 2017), similar to many other colonies in the region. This territory provides us with a uniquely rich set of data covering the whole population on the islands over the long run, allowing us to study numeracy for the entire population for well over a century, both before and after the institutional break of emancipation.

In terms of education, Danish authorities had opened the first public school for white children on the island already in 1788. Education of the enslaved population was, in contrast, by this time not considered to serve any "useful purpose" (Hall 1994, 191–92). The colonial authorities did, however, allow missionary societies to operate schools for enslaved children, as long as their focus was upon religious education (Lawaetz 1980; Hall 1994, 192–95; Highfield 2018, 195–96). Following the decision to abolish the Danish slave trade (effective from 1803) attitudes started to change, and attempts were made to ameliorate the institution of slavery on the islands. This included attempts to reform the educational system. The process was protracted so as not to provoke skeptical planters, but reforms eventually paved the way for investments in the public schooling of enslaved children beginning in the early 1840s (Hall 1994, 197–207; N. T. Jensen, Simonsen, and Olsen 2017, 238–39; Highfield 2018, 140–41). By the 1850s, all children in the country districts were in theory subject to compulsory education (P. H. Jensen 1998, 216). The education was to a large extent focused upon religious education, but also included teaching the students basic literacy and numeracy skills (N. T. Jensen and Olsen 2017, 292).

4. Empirical strategy

In the present study, we analyze trends in numeracy over time by calculating the level of age heaping in the population. The idea behind calculating age-heaping is intuitively easy. Historically, many people were not able to tell their actual age – possibly because of ignorance as to the exact year of birth, but not unlikely due to one's inability to calculate one's age. If the latter was the case, age-heaping would be a clear sign of a low numeracy. It has been observed in empirical studies that, when asked about their age, certain segments of society tend to respond with a rounded number – often a multiple of five. By calculating the overrepresentation of reported ages of such rounded numbers, it is possible to quantitatively estimate the level of numeracy in a society (Spoorenberg 2007; Tollnek and Baten 2016).

Age-heaping has been employed as a proxy for numeracy in a number of previous studies. Critics have, however, pointed to problems with using age-heaping as proxy for numeracy, or as a proxy for human capital more broadly. This view argues that the general relationship between age-heaping and human capital does not necessarily holds true in every historical setting. A recent study, for example, found examples of age-heaping even among educated members of a population (A'Hearn, Delfino, and Nuvolari 2022). In another case, despite modest increases in literacy that could be interpreted as a sign of improved human capital, the authors saw no corresponding decrease in age-heaping (Tapia et al. 2022). In yet another study, scholars found that some people indeed misreported their age, but not necessarily rounded to a multiple of five (Blum and Krauss 2018). Patterns of age-heaping must therefore be interpreted with caution and analyzed in close connection with their respective historical contexts. Despite its limitations, however, the age-heaping methodology, has become a staple in economic historical research.

We calculate the, by now conventional, Whipple- and ABCC-indices for the whole population, as well as for sub-samples of our population over time (Spoorenberg 2007; A'Hearn, Baten, and Crayen 2009; Tollnek and Baten 2016, 139–40).

$$Wh = \frac{\sum(n_{25} + n_{30} + n_{35} \cdots + n_{60})}{\frac{1}{5}\sum_{i=23}^{62} n_i} \times 100$$

Equation 1 above shows the calculation of the Whipple index, summing up the number of persons reporting a rounded age (multiples of five) relative to the number of persons we would expect reporting such an age (i.e., 1/5 of the total population of interest). The index would conventionally fall between 100 and 500, where 500 would be the extreme if everyone in the sample reported a rounded age, and 100 would mean that only the expected share reported a rounded age. As the index can be somewhat complicated to interpret intuitively, A'Hearn, Baten and Crayen proposed what they have called the ABCC-index (A'Hearn, Baten, and Crayen 2009), shown in equation 2:

$$ABCC = \left(1 - \frac{(Wh - 100)}{400}\right) \times 100 \text{ } if \text{ } ABCC \leq 100, else \text{ } 100$$

The ABCC-index is thus a linear transformation of the Whipple Index, which intuitively can be interpreted as the percentage numerate in the sample studied.[1] The closer the ABCC index is to 100 the lower the level of age-heaping and thus the higher the numeracy level of the underlying population. In this study, we only report figures for the intuitively more accessible ABCC-index.[2]

We furthermore aim to contribute to the identification of explanatory factors leading to the observed levels of numeracy. Albeit issues of endogeneity prevent us from determining causation, the study allow us to discuss factors associated with age-heaping. Specifically, we test a model of factors associated with the probability of an individual reported as not being of an age-heaping age. We specifically test a number of hypotheses generated from our reading of previous research (H1-H7). In the appendix to the paper, we discuss two additional hypotheses related to our specific dataset.

Hypothesis 1: Most previous research has found that numeracy, as measured by age-heaping, has improved considerably over time. This is the case globally (Crayen and Baten 2010a, fig. 3), as well as in Latin America and the Caribbean specifically (Manzel and Baten 2009, fig. 3; Manzel, Baten, and Stolz 2012, fig. 7). Hypothesis 1 therefore stipulates that we expect the probability to heap on age to decrease over time (as measured by birth cohort). We are particularly interested in studying whether we can detect any sharp break in numeracy for generations born prior to and after emancipation, respectively, as education for the enslaved was very limited prior to emancipation. In our case, that means identifying if there is any sharp break in the numeracy levels for generations born before and after 1848. For that reason, we use the birth cohort from the 1840s – the last generation born under slavery – as the benchmark cohort for the regression estimates.

---

[1] Previous research on age-heaping has been focused upon excess reporting of rounded ages. It is theoretically possible that the Whipple Index falls below 100, if there are fewer people reporting their age as a multiple of five than would be statistically expected. A Whipple Index below 100 would lead to an unadjusted ABCC-index above 100, which seems counterintuitive if we interpret the ABCC-index as a percentage, hence the assumption in equation 2 that the ABCC cannot reach a value above 100.

[2] The corresponding Whipple Index easily can be calculated from that index, for anyone who would be interested.

Hypothesis 2: another hypothesis that emerges from previous research is that there is an association between numeracy and the skill-levels necessary for the occupation held by the individual in question. If age-heaping is a good proxy of numeracy, as argued in much previous research (A'Hearn, Baten, and Crayen 2009; Crayen and Baten 2010a; Hippe 2012; Cappelli and Baten 2021; Baten, Benati, and Ferber 2022), we expect to find a lower degree of age-heaping among members of the population holding more skilled occupations. We test this hypothesis across four different skill levels.

Hypothesis 3: previous research has, in contrast, found no universal pattern when it comes to gender gaps in numeracy, as proxied by age-heaping. The association has varied substantially between the samples and historical contexts studied (A'Hearn, Baten, and Crayen 2009; De Moor and Van Zanden 2010; Calderón-Fernández, Dobado-González, and García-Hiernaux 2020; Tapia et al. 2022). Our third hypothesis is, therefore, that there is no statistically significant relationship between gender and the probability to age-heap.

Hypothesis 4: some previous research has found that married women exhibit a lower degree of age-heaping than unmarried or widowed women (Földvári, Van Leeuwen, and Van Leeuwen-Li 2012; Calderón-Fernández, Dobado-González, and García-Hiernaux 2020; A'Hearn, Delfino, and Nuvolari 2022; Tapia et al. 2022). An interpretation of this has been that numeracy might be overreported among married women when proxied by age-heaping, as the data on the married women's ages might be reported by their husbands (who, the interpretation holds, might have been more numerate than the women), rather than by the married women themselves. Our hypothesis 4 thus assumes a similar relationship for our population.

Hypothesis 5: previous research has shown substantial differences in numeracy between different regions of the world (Crayen and Baten 2010a). Since our dataset includes data on the place of birth of the individuals in the sample, we are able to test whether place of birth is associated with numeracy. Out first sub-hypothesis (H5a) is that persons born in Europe (in our sample primarily of Danish origin) had a better chance of acquiring some learning, and therefore be more numerate than those born in the Danish West Indies. Our second sub-hypothesis (H5b) is that people born in Africa – who presumably all had been enslaved during the era of slavery – were less likely to have acquired any numeracy skills.

Hypothesis 6: is concerned with the place of residence of the individuals. Previous research has shown that there often exists an urban/rural gap in educational attainment, both in historical (Tapia and Martinez-Galarraga 2018) and modern-day samples of data (van Maarseveen 2021, app. A). Previous research on the case under study in this article has, furthermore, suggested that some of the early missionary activities, including the schools they operated, were limited to the two towns on the island, Frederiksted and Christiansted (Hall 1994, 193). Our hypothesis 6 is, therefore, that we can find an urban/rural gap in numeracy in our sample, with the urban population being more numerate.

Hypothesis 7: is that there is a higher probability that individuals belonging to the Moravian and/or Lutheran faiths would be numerate than individuals belonging to other denominations, as the missionary societies operating many of the early schools on the island – including schools for enslaved children – belonged to these two denominations, and prioritized educating children of the families in the respective congregations (Lawaetz 1980; Hall 1994, 192–94; Turnbull 2009, 153; Highfield 2018, 195–96). If these missionary schools had any impact in their teaching of students, individuals adhering to a protestant confession ought then to exhibit a higher level of numeracy.

TABLE 1 *Summary of hypotheses of factors associated with age-heaping*

	Hypothesis	Independent variable(s) in dataset	Hypothesized association with numeracy
H1	Improved numeracy over time, particularly after emancipation.	Birth cohort	a. *Higher* probability of numeracy over time. b. Distinct improvement in odds for cohorts born after emancipation.
H2	Higher numeracy for persons holding occupations requiring higher	Skill level (imputed from occupational title)	*Higher* probability of numeracy for persons holding occupations requiring higher skills.

	level of skills		
H3	Gender gap in numeracy	Gender	Not significant.
H4	Lower degree of age-heaping among married women.	Marital status # gender	a. *Higher* probability of numeracy for married women than for unmarried women. b. Non-significant for married men.
H5	Differences in numeracy associated with place of birth	Place of birth	a. *Higher* probability of numeracy for persons born in Europe. b. *Lower* probability for persons born in Africa (in both cases compared to those born in the Danish West Indies).
H6	Urban/rural education gap	Place of residence (urban vs rural)	*Higher* probability of numeracy in urban areas.
H7	Differences in numeracy associated with religious affiliation.	Religion	*Higher* probability of numeracy among protestants.

All hypotheses to be tested are summarized in table 1. It is noteworthy that the dependent variable in the analysis is the probability of not reporting a rounded (potentially age-heaping) age, and that our dependent variable thus is to be interpreted as a proxy for numeracy, similar to previous research in the field (Pérez-Artés 2023, tbl. 4). The model to be estimated in the core regression is therefore the following:

$$\text{Numerate}_i = \alpha + \beta_{1\text{-}11}\,\text{birth cohort X}_i + \beta_{12}\,\text{skill-level}_i + \beta_{13}\,\text{gender}_i + \beta_{14}\,\text{married\#gender}_i + \beta_{15}\text{place of birth}_i + \beta_{16}\,\text{urban residence}_i + \beta_{17}\,\text{religious affiliation} + \textit{controls} + \varepsilon_{itr}$$

where X stands for all decadal birth cohorts from 1780 to 1880. In an alternative model, we include the birth cohort as a numerical variable instead of as dummy variables (along with birth cohort squared, in order to allow for a non-linear relationship). The control variables are discussed further in the appendix to the paper.

5. Data

The relevant age-data for the present study is gathered from historical censuses undertaken in the Danish West Indies at semi-regular intervals. The study is delimited to the larger, most populous and economically most important island of the Danish West Indies, St Croix. The study is based on eight full-population censuses – 1846, 1850, 1855, 1860, 1870, 1880, 1901 and 1911 – all digitized for the Danish West Indies Population Panel (DWIPP). Despite the relatively long-time frame, the source remains remarkably consistent in its structure as well as on the set of core variables that are included in each census (Galli, Rönnbäck, and Theodoridis 2023). All eight censuses related to the island of St Croix have been manually transcribed in full by the authors. The censuses report information on several variables, including the age of individuals. Other variables reported in the censuses are gender, place of birth, occupation, religion of the individuals along with household-related variables, i.e., family relations and marital status, and who the census-taker was. The census of 1846 also distinguishes between enslaved and free members of the population. The censuses from the period after emancipation do, in contrast, not include information on whether a person previously had been enslaved or not.

A crucial factor when calculating age-heaping is that age is reported by the individuals, and not cross-checked against other sources (Tollnek and Baten 2016, 136). The data in the censuses in the main seems to meet these requirements, albeit some caveats are necessary. Census-takers were instructed to enter the running year of each person's age. The census data was recorded on pre-printed forms. In the countryside, the owner or manager of an estate was to be supplied with the form and was asked to fill in the information. Other informants could be asked to fill in the form, if necessary. In the urban areas, two to four "respectable inhabitants" were appointed by the authorities to collect the census information on each street. The instructions for the very first censuses instruct these "respectable inhabitants" to go door to door and fill in the form with the assistance of the owner or principal tenant. The rules for later censuses, from 1860 onwards, instead lay the primary burden of filling in the forms upon the owners or principal tenants of a house, and the "respectable inhabitants" are primarily instructed to attest to the correctness of the information, and to assist the owners or principal tenants in filling in the information only if necessary.

Many of the census records have a signature from the census-taker at the bottom, allowing us to determine the identity of the individual reporting the information in that record. It is not possible to ascertain whether the persons signing these records then actually recorded the information themselves, or whether they only attested to the correctness of the information recorded by someone else (who, nevertheless does not appear as signatory in the form). It is possible in some cases to make an informed guess – based for example on the handwriting or the color of the ink used – that the individuals signing the records were not the same as those who recorded the information in the record in question. For the majority of the records, however, this cannot be determined with certainty.

The instructions do not spell out exactly how the census-takers were to gather the information from individual members of a household. Whether they in practice asked all members of the household, or only some (e.g., only adults, or only the heads of each respective household) is not possible to tell from the instructions. As children and young adults, below the age of 23, are conventionally excluded from estimates of age heaping (Tollnek and Baten 2016, 139–40), they pose no problem for the analysis in our study. Potentially problematic is, however, adults who are not household heads and in particular married women, as mentioned previously. This will be controlled for in the analysis below.

There is no evidence that the information reported in the censuses was cross-checked against any other source. We can, nonetheless, not rule out the possibility that the owners or managers of an estate might have done so against records kept on the estates (e.g., slave-rolls from the time prior to emancipation). In the paper, we therefore include the identity of those who recorded the information in the censuses as control variables in the analysis.

We also include the census years as control variables, as the quality of the censuses might have differed. We discuss these variables in further depth in the appendix to the paper.

The oldest person reported in the census of 1846, was a woman called Minerva, reported to be 106 years old, i.e., born in 1740. Studies of age-heaping truncate the sample at a maximum age, as the chances of surviving decreases substantially with age. In early studies in the field, scholars conventionally truncated the sample at the age of 72 (Tollnek and Baten 2016, 139). In more recent studies, many scholars have instead opted for a more conservative approach, truncating the sample at the age of 62. Following the latter approach to truncation, our dataset allows us to estimate numeracy for cohorts starting in the late eighteenth century. As the conventional minimum age requirement for inclusion in the sample for studies of age-heaping is 23 years of age, we can estimate age heaping for cohorts up until the 1880s. We divide the sample into decadal birth cohorts for robustness, based on the age groups (23–32, 33–42, 43–52 and 53–62 years of age) in each census. As the censuses were undertaken somewhat irregularly, we do not have a perfect match for some of the cohorts between all censuses, but the overlap is perfect for several of the censuses (the 1850, 1860, 1870 and 1880 censuses), close to perfect for two others (the 1901 and 1911 censuses), and reasonably good for the two final censuses (1846 and 1855, respectively).

The resulting dataset of individual-level data includes 86,906 observations. Table 2 reports descriptive statistics of the dataset.

TABLE 2 *Descriptive statistics of the sample*

Panel A. Age-variable					
	Obs	*Mean*	*S.d.*	*Min*	*Max*
Age	*86,906*	*39.00*	*10.93*	*23*	*62*

Panel B. Categorical variables		
Birth-cohort	Freq.	Percent
1780	1,803	2.07
1790	6,446	7.42
1800	11,498	13.23

1810	14,652	16.86
1820	14,241	16.39
1830	8,739	10.06
1840	8,291	9.54
1850	7,050	8.11
1860	4,997	5.75
1870	6,426	7.39
1880	2,763	3.18
Gender	Freq.	Percent
Male	40,231	46.29
Female	46,605	53.63
Missing	70	0.08
Skill-level	Freq.	Percent
Unskilled	43,810	50.41
Lower skilled	11,004	12.66
Medium skilled	13,998	16.11
Higher skilled	854	0.98
Unknown	17,240	19.84
Place of birth	Freq.	Percent
DWI	72,988	83.98
Other Caribbean	8,628	9.93
Africa	1,759	2.02

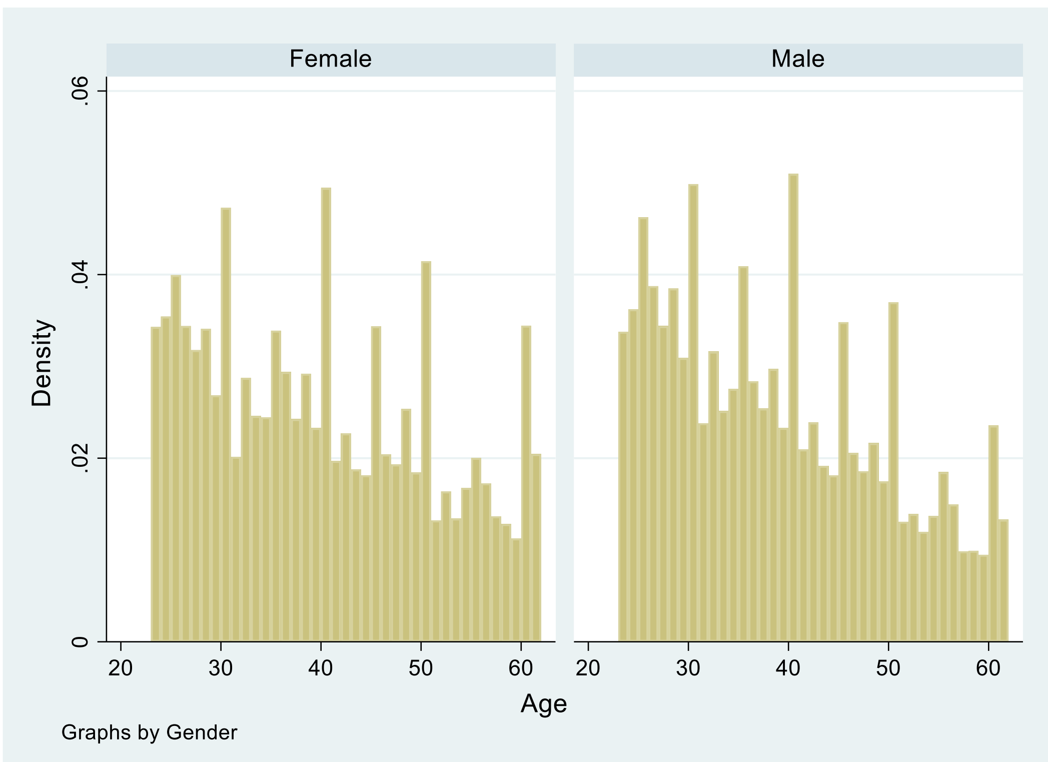
Europe	2,557	2.94
Other	974	1.12
Place of residence	Freq.	Percent
Rural	55,603	63.98
Urban	31,303	36.02
Religious affiliation	Freq.	Percent
Protestant	62,831	72.30
Roman catholic	23,537	27.08
Other	538	0.62
Census-taker	Freq.	Percent
Unrelated (but known)	20,977	24.14
Self-reported	1,149	1.32
Co-habitant	26,085	30.02
Owner of location	8,610	9.91
Unknown	30,085	34.62

Source: Danish West Indies Population Panel.

As age is the most fundamental variable for our analysis, we are unable to include an individual in our sample if data is missing on this variable. We consequently also know the birth cohort of all individuals in our sample. Because of the truncation of the sample, furthermore, the age in our sample ranges from 23 to 62, with a mean age of 39 years. For most of the other variables of interest, we have complete or almost complete information for the observations in our sample, with very few observations missing data on any variable. The only exceptions are the variable of occupation (which is used to infer the skill-level associated with the occupation), where information is missing for almost 20 per cent of the sample (most of these are women), and the identity of the census-taker, where information is missing for a third of the sample (with some overrepresentation of this information missing from later censuses, and for records from the urban areas). As for the other variables, our sample is largely made up of unskilled workers, born in the Danish West Indies, living in the rural areas of the island at the time of the respective censuses, and belonging to a protestant church. We do, however, have sizeable minorities of people in the several other categories of these variables.

6. Results

FIGURE 1. *Frequency of reported age of total population on S:t Croix, by gender, 1780s–1880s*



Source: DWI Panel.

Figure 1 is a histogram of the age of the population in the total dataset, including all eight censuses. Ocular inspection suggests that age-heaping was quite frequent, particularly on multiples of 10 (ages 30, 40, 50 and 60), but to some extent also on other multiples of 5 (ages 25, 35, 35 and 55).

FIGURE 2. *ABCC of the total population on St Croix, by gender and birth cohort, 1780s–1880s*

Source: DWI Panel.

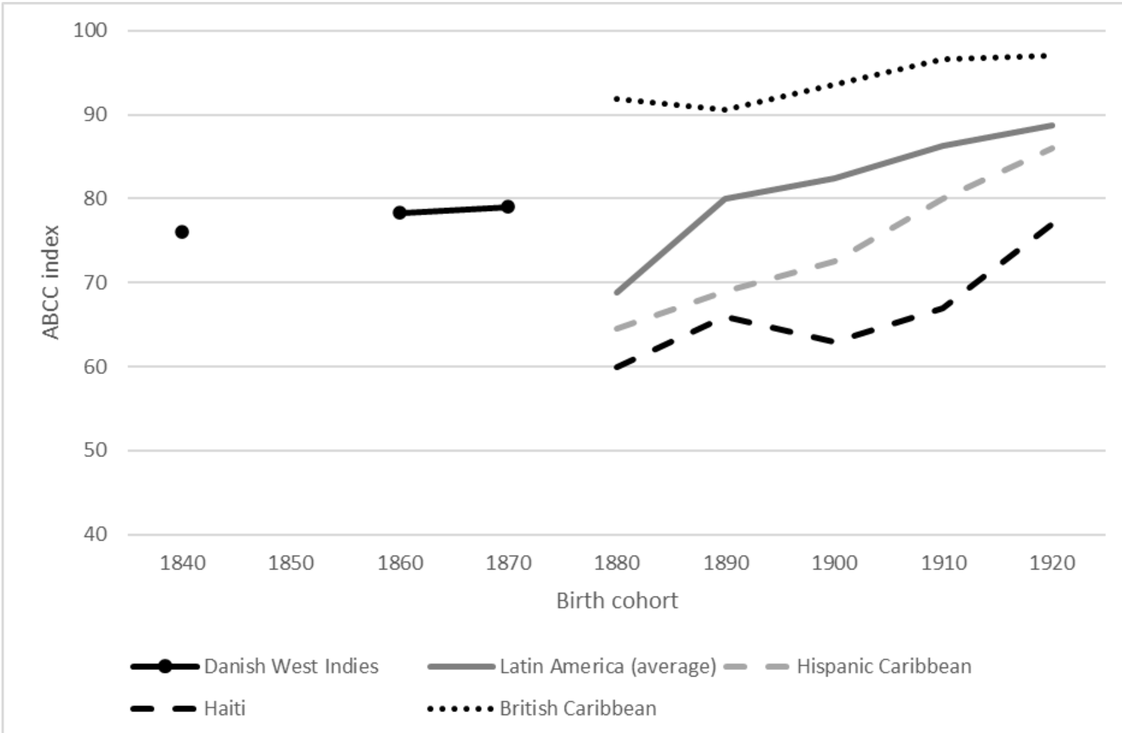
Figure 2 shows the ABCC-index (the proxy for the numeracy level) in our sample, disaggregated by birth cohort and gender. Both the levels and the pattern over time are very similar for the two genders, so the evidence from our sample does, on the face of it, not suggest that women had markedly lower numeracy rate than the men. Further disaggregating the data for women by marital status does not lend support to hypothesis 2, that married women exhibited a lower degree of age-heaping (see appendix figure A1 for a graphic representation of this).

What is more, the data suggests that numeracy might have decreased over time. For birth cohorts from the 1780s to the 1820s, the estimated ABCC index hovers around 90 (with the exception of the outlier of female numeracy for the birth cohort of 1780). This would be a quite remarkably high level of numeracy, given that the vast majority of these people would have been enslaved. If taken at face value, this would suggest that the enslaved population had been quite successful in attaining basic numeracy skills, even though they were not able to access formal education at this time. But this might also, at least partly, be the effect of measurement error in our sample. Since these people were all born during the period when slavery was legal on the island, it is possible that births records had been kept by the slave masters, and that many of these masters might have consulted such records rather than asking the individuals when, years later, they had to fill in the census-information for their respective plantations. Disaggregating the sample by place of residence (urban vs rural, see appendix figure A2 for a graphic representation of this), by who the census-taker was (see appendix figure A3) or by the skill-level necessary for the occupations held by the individuals (see appendix figure A4) lends support to this suspicion. We thus need to control for this aspect in our multivariate analysis below.

The data thus suggests very high levels of numeracy for birth cohorts until the 1820s, after which the estimated numeracy levels seems to decrease. The estimates reach a nadir, with an ABCC-index around 80 for the two birth cohorts where everyone was born free (those born in the 1850s and 1860s). The two last birth decades in our sample exhibit a drastic recovery in the numeracy levels, so that the numeracy estimated for those born in the 1880s again approaches an ABCC-index of 90.

Since all people born after 1848 were born free, there are no slave-rolls or similar records against which anyone could have checked the age of the individuals. It therefore seems reasonable to assume that at least these figures are reliable enough for a direct comparison with results from previous research. Figure 3 puts the data from these cohorts into comparative perspective, comparing the numeracy levels for this age-group in our sample with those for other territories in Latin America and the Caribbean (numeracy level proxied by age-heaping in all series in the figure).

FIGURE 3. *Numeracy levels in the Danish West Indies in international comparison (ABCC-index), 1840s–1920s*



Sources: Danish West Indies Population Panel for data on the Danish West Indies. (Crayen and Baten 2010a, fig. 3) for data on Latin America. (Manzel and Baten 2009, appendix table A.1) for data on the Caribbean.

Note: The data from the Danish West Indies has been standardized in the manner proposed by (A'Hearn, Baten, and Crayen 2009, 798) to allow for international comparisons (i.e., including only males aged 33–42 from the census records).

As can be seen in figure 3, the numeracy levels found in our sample are high when compared to most other parts of the Caribbean and Latin America, with an estimated numeracy level approaching 80 already for the birth cohort of the 1870s. Countries in Latin America did not reach the same level until the 1890s, and several of the Caribbean colonies did not reach this level until the birth cohorts of the 1910s or 1920s. The striking outliers here are the British Caribbean colonies, which already by the 1880s had reached numeracy-levels exceeding 90 per cent. It is beyond the scope of the present study to analyze why the British colonies performed so much better than many other countries or colonies in the region, but early investments in education already during (the process of amelioration of) slavery might have played an important role (Blouet 1990; Luster 1995, chap. 6).

We now turn to a multivariate analysis to better examine the factors associated with age-heaping in the form of a logistic regression. Our dependent variable is a dummy variable taking the value of 1 for persons reported as not being of an age-heaping age, i.e. a person who has a high chance of being numerate. Model 1 only include the birth cohorts as explanatory (dummy) variables. Model 2 also include dummy variables for the respective censuses as control variables, as the quality of the censuses might have differed. Model 3 then includes all other explanatory variables relevant for hypotheses 2–7 (i.e., those specified in our core model), as well as the identity of the census-taker as a further control variable. Model 4, finally, include birth cohort as a numerical variable, instead of as dummy variables as in model 3.

TABLE 3 *Explaining numeracy in the Danish West Indies, 1780s–1880s, logistic regression, odds ratios*

	Model 1	Model 2	Model 3	Model 4
Birth cohort = 1780	1.34***	0.54***	0.56***	
	(0.079)	(0.039)	(0.041)	
Birth cohort = 1790	1.10***	0.54***	0.53***	
	(0.040)	(0.026)	(0.027)	
Birth cohort = 1800	1.18***	0.60***	0.58***	
	(0.037)	(0.026)	(0.026)	
Birth cohort = 1810	1.24***	0.67***	0.64***	
	(0.037)	(0.027)	(0.027)	
Birth cohort = 1820	1.19***	0.76***	0.74***	
	(0.036)	(0.029)	(0.028)	
Birth cohort = 1830	1.07**	0.82***	0.80***	
	(0.036)	(0.030)	(0.029)	
Birth cohort = 1840		(benchmark)		
Birth cohort = 1850	0.87***	1.31***	1.33***	
	(0.030)	(0.052)	(0.088)	

Birth cohort = 1860	0.81***	1.53***	1.57***	
	(0.030)	(0.080)	(0.12)	
Birth cohort = 1870	1.02	1.94***	2.01***	
	(0.037)	(0.098)	(0.15)	
Birth cohort = 1880	1.14***	2.47***	2.56***	
	(0.055)	(0.16)	(0.22)	
Birth cohort (numerical)				0.70***
				(0.042)
Birth-cohort (numerical) squared				1.00***
				(0.000017)
Era of birth = Born prior to emancipation				1.01
				(0.066)
Skill-level = Unskilled				(benchmark)
Skill-level = Low skilled			0.99	0.98
			(0.025)	(0.025)
Skill-level = Medium skilled			1.03	1.02
			(0.024)	(0.024)
Skill-level = Highly skilled			1.32***	1.29***
			(0.12)	(0.11)
Skill-level = Unknown			0.95**	0.91***
			(0.021)	(0.019)
Gender = Female			1.00	1.01
			(0.019)	(0.019)
Married			1.03	1.04*

			(0.025)	(0.026)
Female # Married			1.04	1.05
			(0.035)	(0.035)
Place of birth = Danish West Indies			(benchmark)	
Place of birth = Other Caribbean			0.90***	0.91***
			(0.024)	(0.024)
Place of birth = Africa			0.81***	0.80***
			(0.044)	(0.043)
Place of birth = Europe			1.23***	1.24***
			(0.062)	(0.063)
Place of birth = Other			0.84**	0.85**
			(0.058)	(0.059)
Urban			1.08***	1.08***
			(0.021)	(0.021)
Religious affiliation = Protestant			(benchmark)	
Religious affiliation = Roman catholic			0.99	0.99
			(0.017)	(0.017)
Religious affiliation = Other			0.95	0.95
			(0.092)	(0.091)
Constant	2.13***	2.85***	2.63***	1.37e+197***
	(0.050)	(0.084)	(0.10)	(1.35e+199)
Controls	None	Census-year (dummy)	Census-year (dummy), identity of	Census-year (numerical) and census-year

			census-taker	squared, identity of census-taker
Observations	86,906	86,906	86,836	86,836

Source: DWI Panel.

Hypothesis 1 proposed that there would be an improvement in numeracy over time, as much previous research on numeracy from other parts of the world suggests such a pattern. We furthermore expect that the amelioration of slavery and, most importantly, emancipation from slavery, enabled more people to acquire some degree of education. As shown in figure 2 above, the average ABCC index for the whole sample did not to exhibit any such trend, neither for men nor for women in our sample, when the data was disaggregated simply by birth-cohort and gender. This is also in line with the results found in model 1 in table 3: when we only include the birth-cohort as explanatory variable, the results are somewhat ambiguous, but would if anything tend to suggest that the trend over time is negative for the whole period from the 1780s to around the 1860s, i.e., with a lower probability of a person being numerate the later the person was born. This is, however, the consequence of a challenge arising from the primary data: age-heaping within a particular birth-cohort is in several cases higher in later censuses than in earlier ones (a graphic representation of this can be seen in appendix figure A5, along with a further discussion of the issue). We deal with this complication by including both the birth-cohort and the census-year in the following two models, with the census-year used as a control variable when estimating the coefficient for the explanatory variable of interest, the birth cohort (in essence we thus employ a census fixed-effects model). The result of including just the census-year as a control variable (model 2) is that the effect of birth-cohort is reversed: when controlling for differences between the censuses, the estimates for the different birth cohort indicates a clear positive association with the probability of being numerate: the later a person is born during the period under study, the higher the probability of not reporting a rounded age. The effect is furthermore quite substantial: the persons born in the 1880s is more than two times as likely to not report a rounded age, compared to the benchmark birth cohort (those born in the 1840s). Vice versa, those born in the 1780s are much less likely to report a non-rounded age, so chances are that numeracy levels also were lower in this birth cohort, compared to the benchmark birth cohort. Our tentative conclusion is therefore that our estimates do lend support to hypothesis H1a of a positive trend for numeracy over time.

The estimates thus show that the probability of being numerate was much higher following emancipation than prior to this process. These results are also robust if we include a number of additional explanatory variables into our model (model 3 in table 3): the exact odds ratios estimated differ somewhat when additional variables are introduced to the model, but the changes are comparatively small, and all estimated coefficients that were statistically significant in model 2 remain statistically significant at conventional levels of confidence also in model 3. The positive trend is, however, not linear, as model 4 in table 3 shows. Here, we include the cohort and the cohort squared as numerical values, instead of as categorical variables as in previous models. The estimated coefficients are statistically significant for both these variables, but the estimated co-efficient is negative for the non-squared cohort variable. This in line with the results of model 3, which suggested the probability of being numerate decreased somewhat during the first two birth cohorts, and only started to increase from around the turn of the nineteenth century. But it is, at the same time, important to note that we find no evidence that this development started with emancipation (hypothesis H1b): numeracy levels were seemingly improving among cohorts born long before emancipation and continued to do so after emancipation. The estimated coefficient for a dummy variable for all individuals born prior to emancipation does in model 4 not differ from the odds ratios for those born after emancipation.

Further explanatory variables also allow us to test the other six hypotheses set out in table 1 above. Hypothesis H2 proposed that the skill-level necessary for holding a particular occupation would be positively associated with numeracy. This would show as a higher probability of being numerate if holding a highly skilled occupation. This hypothesis is supported by the evidence from our sample, but only for the small group holding highly skilled occupations: these individuals in our sample had about 30 per cent higher chance of not reporting a rounded age compared to unskilled individuals. There is no statistically significant difference in the odds of being numerate for persons holding neither low nor medium skilled occupations compared to those holding unskilled occupations. Our conclusion is, nonetheless, that our sample lends some support for H2.

Hypothesis H3 concerns gender-differences in numeracy. Our hypothesis is that we would find no relationship between gender and numeracy. This is in fact also what we find:

women do not show statistically significant difference in their probability of reporting a non-rounded age than the men. We also do not find any support for hypothesis H4 on differential age-heaping among married women than among unmarried women in our sample: married women were neither more nor less likely to report a non-rounded age than unmarried women were.

Hypothesis H5 was concerned with the association between numeracy and place of birth. People born in Europe – in the case studied here, many of them came from Denmark– were hypothesized to have had a better chance at acquiring basic numeracy skills than those born on the Danish West Indies (many of whom had been enslaved at birth for all birth cohorts until the 1840s). Vice versa, we expected that people reported as being born in Africa would exhibit a significantly lower level of numeracy; we can be reasonably sure that all these people had been enslaved at one time, and therefore would have had fewer chances to attain much learning. Both these hypotheses find support in our data: persons born in Europe had a 24 per cent higher chance of being numerate, and those born in Africa had a 20 per cent lower chance of being numerate, than those born in the Danish West Indies.

Hypothesis H6 dealt with urban/rural divide in education, something that can be found in many societies. Comparing only the urban vs rural ABCC indices does not show any clearcut divide throughout the period (see appendix figure A2). Once we control for a number of other variables as in table 3, however, there is a significant urban/rural divide, with people living in the urban areas of the island having a 8 per cent higher chance of being numerate.

Hypothesis H7, finally, was concerned with the religious affiliation of the individuals. Since the missionary schools established from the late 18th century onwards were operated by protestant missions, the hypothesis was that individuals of a protestant confession would have greater chances at accessing such education, and thereby exhibit a higher degree of numeracy. The results from our estimates do not support this hypothesis: we find no statistically significant different odds ratio for those of roman catholic (or other) faith than for those of a protestant faith.

6. Discussion

One argument put forth in the historiography has been that slavery might have been an obstacle for long-term economic development in the regions or countries where people were enslaved, and that those that profited from the exploitation of enslaved people as a rule lived somewhere else. One factor that has been suggested as creating such an obstacle for development in slave societies is exactly the role of the education of the enslaved. We know from much previous research that education has a strong association with economic growth and development. Limiting or even outlawing the education of a large segment of the population, as many slave societies did, ought therefore to have had considerable negative effects upon the long-term development of these societies. What little research there is on this topic has to a large extent focused upon the experience from the United States (Bertocchi and Dimico 2014; Wright 2017, 170–72).

But some slave societies were not as prohibitive towards education of the enslaved population as many parts of antebellum southern United States were. In the Caribbean, several colonies – not least the British colonies – at least in time came to view the education of the enslaved as part of a broader process of amelioration of the institution. Education of the enslaved was therefore tolerated, and in time even to some extent supported, by colonial authorities (Blouet 1980; 1990; 1991; Luster 1995, chap. 6; Glen 2011). The same was the case for the Danish West Indies studied in this paper (Hall 1994, 191–207; N. T. Jensen, Simonsen, and Olsen 2017, 238–39). This more tolerant view of education for the enslaved created positive opportunities for the latter to acquire basic skills. The evidence presented in this article also suggests that many of those enslaved did do so, as numeracy levels of the population under study were quite high in regional comparison, and furthermore seems to have increased substantially over time. Limitations on the education of the enslaved was thus not an integral or universal feature of the institution of slavery, but a specific feature of how this institution came to develop in certain slave societies.

Explaining why numeracy levels increased to such an extent as our estimates suggest is more complex. Our findings suggest that numeracy levels started to increase long before emancipation in 1848. They also started to increase long before any public investments in schooling for the enslaved was made, starting in 1841. Public schooling does therefore not suffice for explaining the findings in our study. Religious affiliation does not seem to have mattered much either: the numeracy levels were strikingly similar regardless of whether the individuals were of catholic or protestant faith. The effects of the missionary schools, all operated by protestant churches, is therefore seemingly quite limited. This stands in sharp contrast to the findings from other historical settings, where missionary activities seem to have had a measurable impact upon the education of the population (see overview in Meier Zu Selhausen 2019). Neither public nor private schooling would thus be a sufficient explanation for the development we observe. Our interpretation is that large parts of the population instead acquired the basic numeracy skills that we observe in informal ways as tacit knowledge, either from being self-taught or from hidden forms of education (for example by friends and family), similar to the processes studied in the United States (Webber 1978; Cornelius 1991; Williams 2005, chap. 1; Gundaker 2007).

While the key focus of this article has been whether there was any positive trend over time, and/or whether emancipation improved the chances for the emancipated persons to acquire learning, our dataset has also allowed us to explore a number of additional hypotheses. Our estimates support the existence of a positive relationship between the probability of being numerate and holding an occupation requiring higher skills. This might seem highly intuitive. Much previous research in the field has shown a positive relationship to other proxies for education and learning. Our conclusion here is that our estimates add further support for the validity of age-heaping as a proxy for learning. In addition, our estimates show that the numeracy levels for migrants to the Danish West Indies appear as would be expected from what we know about numeracy levels in the respective societies from which they migrated (Crayen and Baten 2010a). Two issues that, in contrast, have been controversial in previous research is whether there is a gender gap in numeracy, and in particular whether married women exhibit different levels of age-heaping than unmarried women. We find no support for either of these hypotheses in our sample.

7. Conclusion

In this article, we have studied the development of basic numeracy skills in a quite typical cash-crop colony in the Caribbean over a century. During the century under study, slavery was abolished, and formerly enslaved people were set free. The aim of this research was to study how this major institutional change impacted upon the skills acquired by the population in the colony. We employed a unique dataset – based on several consecutive censuses digitized in full – in order calculate the level of age-heaping, as a proxy for numeracy.

The results show that the level of age-heaping was comparatively low in this society compared to the levels found in many other countries and colonies in the region around the same time. Age-heaping furthermore decreased over time. Interpreted as a proxy for the numeracy skills of the individuals, we thus find that numeracy levels increased quite substantially over time. There was, however, no distinct break by the time of emancipation in 1848. Numeracy levels had seemingly started to increase long before this event, and long before colonial authorities started to invest in public education of enslaved people. We can furthermore not find any support for the hypothesis that people belonging to the same faith as the missionary societies operating missionary schools prior to the emergence of formal public schooling would have had any higher levels of numeracy than those belonging to other faiths. Formal schooling, neither private nor public, can therefore not explain the increasing numeracy levels in our sample. Our conclusion is therefore that the population of this predominantly slave-society acquired these basic numeracy skills through informal means, with the help of friends or family.

References

A'Hearn, Brian, Joerg Baten, and Dorothee Crayen. 2009. "Quantifying Quantitative Literacy: Age Heaping and the History of Human Capital." The Journal of Economic History 69 (3): 783–808.

A'Hearn, Brian, Alexia Delfino, and Alessandro Nuvolari. 2022. "Rethinking Age Heaping: A Cautionary Tale from Nineteenth-Century Italy." The Economic History Review 75 (1): 111–37.

Angrist, Noam, Simeon Djankov, Pinelopi K. Goldberg, and Harry A. Patrinos. 2021. "Measuring Human Capital Using Global Learning Data." Nature 592 (7854): 403–8.

Barro, Robert J., and Jong-Wha Lee. 2013. "A New Data Set of Educational Attainment in the World, 1950–2010." Journal of Development Economics 104: 184–98.

———. 2015. Education Matters: Global Schooling Gains from the 19th to the 21st Century. New York: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199379231.001.0001.

Baten, Joerg, Giacomo Benati, and Sarah Ferber. 2022. "Rethinking Age Heaping Again for Understanding Its Possibilities and Limitations." The Economic History Review 75 (3): 960–71.

Baten, Joerg, and Johan Fourie. 2015. "Numeracy of Africans, Asians, and Europeans during the Early Modern Period: New Evidence from Cape Colony Court Registers." The Economic History Review 68 (2): 632–56.

Baten, Joerg, Debin Ma, Stephen Morgan, and Qing Wang. 2010. "Evolution of Living Standards and Human Capital in China in the 18–20th Centuries: Evidences from Real Wages, Age-Heaping, and Anthropometrics." Explorations in Economic History 47 (3): 347–59.

Baten, Joerg, and Christina Mumme. 2010. "Globalization and Educational Inequality during the 18th to 20th Centuries: Latin America in Global Comparison." Revista de Historia Económica-Journal of Iberian and Latin American Economic History 28 (2): 279–305.

Baten, Joerg, and Sara Nalle. 2022. "Age Heaping and Life Course Reckoning." Vierteljahrschrift Für Sozial-Und Wirtschaftsgeschichte 109 (3): 337–50.

Bertocchi, Graziella, and Arcangelo Dimico. 2014. "Slavery, Education, and Inequality." European Economic Review 70 (August): 197–209. https://doi.org/10.1016/j.euroecorev.2014.04.007.

Blouet, Olwyn M. 1980. "To Make Society Safe for Freedom: Slave Education in Barbados, 1823-33." The Journal of Negro History 65 (2): 126–34. https://doi.org/10.2307/2717051.

———. 1990. "Slavery and Freedom in the British West Indies, 1823–33: The Role of Education." History of Education Quarterly 30 (4): 625–43.

———. 1991. "Earning and Learning in the British West Indies: An Image of Freedom in the Pre-Emancipation Decade, 1823–1833." The Historical Journal 34 (2): 391–409.

Blum, Matthias, and Karl-Peter Krauss. 2018. "Age Heaping and Numeracy: Looking behind the Curtain." The Economic History Review 71 (2): 464–79.

Bolt, Jutta, and Dirk Bezemer. 2009. "Understanding Long-Run African Growth: Colonial Institutions or Colonial Education?" The Journal of Development Studies 45 (1): 24–54. https://doi.org/10.1080/00220380802468603.

Calderón-Fernández, Andrés, Rafael Dobado-González, and Alfredo García-Hiernaux. 2020. "Numeracy in Central New Spain during the Enlightenment." Revista de Historia Economica-Journal of Iberian and Latin American Economic History 38 (2): 369–403.

Cappelli, Gabriele, and Joerg Baten. 2021. "Numeracy Development in Africa: New Evidence from a Long-Term Perspective (1730–1970)." Journal of Development Economics 150: 102630.

Cohen, Daniel, and Marcelo Soto. 2007. "Growth and Human Capital: Good Data, Good Results." Journal of Economic Growth 12 (1): 51–76. https://doi.org/10.1007/s10887-007-9011-5.

Cornelius, Janet Duitsman. 1991. "When I Can Read My Title Clear": Literacy, Slavery, and Religion in the Antebellum South. Columbia, S.C.: University of South Carolina Press.

Crayen, Dorothee, and Joerg Baten. 2010a. "Global Trends in Numeracy 1820–1949 and Its Implications for Long-Term Growth." Explorations in Economic History 47 (1): 82–99.

———. 2010b. "New Evidence and New Methods to Measure Human Capital Inequality before and during the Industrial Revolution: France and the US in the Seventeenth to Nineteenth Centuries." The Economic History Review 63 (2): 452–78.

De Moor, Tine, and Jan Luiten Van Zanden. 2010. "'Every Woman Counts': A Gender-Analysis of Numeracy in the Low Countries during the Early Modern Period." Journal of Interdisciplinary History 41 (2): 179–208.

Dookhan, Isaac. 1994. A History of the Virgin Islands of the United States. Kingston: Canoe Press.

Engerman, Stanley L., and Kenneth L. Sokoloff. 2012. Economic Development in the Americas since 1500 : Endowments and Institutions. Cambridge ; Cambridge University Press.

Földvári, Peter, Bas Van Leeuwen, and Jieli Van Leeuwen-Li. 2012. "How Did Women Count? A Note on Gender-Specific Age Heaping Differences in the Sixteenth to Nineteenth Centuries 1." The Economic History Review 65 (1): 304–13.

Galli, Stefania, Klas Rönnbäck, and Dimitrios Theodoridis. 2023. "Reconstructing a Slave Society: Building the DWI Panel, 1760-1914." Working paper. University of Gothenburg. https://hdl.handle.net/2077/78393.

Genovese, Eugene D. 1976. Roll, Jordan, Roll : The World the Slaves Made. New York: Vintage.

Glaeser, Edward L., Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer. 2004. "Do Institutions Cause Growth?" Journal of Economic Growth 9: 271–303.

Glen, Robert. 2011. "Methodists in the Caribbean: Educational Initiatives in the Slave Era." Wesley and Methodist Studies 3: 135–45.

Gundaker, Grey. 2007. "Hidden Education among African Americans during Slavery." Teachers College Record: The Voice of Scholarship in Education 109 (7): 1591–1612. https://doi.org/10.1177/016146810710900707.

Hall, Neville. 1994. Slave Society in the Danish West Indies: St. Thomas, St. John & St. Croix. Mona: University of West Indies Press.

Hanushek, Eric A., and Ludger Woessmann. 2012. "Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation." Journal of Economic Growth 17 (4): 267–321. https://doi.org/10.1007/s10887-012-9081-x.

Highfield, Arnold. 2018. The Cultural History of the American Virgin Islands and the Danish West Indies: A Companion Guide. Christiansted: Antilles Press.

Higman, B. W. 1984. Slave Populations of the British Caribbean, 1807-1834. Baltimore: Johns Hopkins University Press.

Hippe, Ralph. 2012. "How to Measure Human Capital? The Relationship between Numeracy and Literacy." Economies et Sociétés (Paris) 46 (8): 1627–54.

Jabour, Anya. 1994. "Slave Health and Health Care in the British Caribbean: Profits, Racism, and the Failure of Amelioration in Trinidad and British Guiana, 1824-1834." The Journal of Caribbean History 28 (1): 1.

Jensen, Niklas Thode. 2012. For the Health of the Enslaved : Slaves, Medicine and Power in the Danish West Indies, 1803-1848. Copenhagen: Museum Tusculanum Press.

Jensen, Niklas Thode, and Poul Erik Olsen. 2017. "Frihet under Tvang Og Nedgang 1848-78." In Vestindien: St. Croix, St. Thomas Og St. Jan. Danmark Og Kolonierne. Edited by Poul Erik Olsen, 282–317. Copenhagen: GADs forlag.

Jensen, Niklas Thode, Gunvor Simonsen, and Poul Erik Olsen. 2017. "Reform Eller Revolution 1803-48." In Vestindien: St. Croix, St. Thomas Og St. Jan. Danmark Og Kolonierne. Edited by Poul Erik Olsen, 210–81. Copenhagen: GADs forlag.

Jensen, Peter Hoxcer. 1998. From Serfdom to Fireburn and Strike: The History of Black Labor in the Danish West Indies, 1848-1916. Antilles Press.

Juif, Dácil-Tania, and Joerg Baten. 2013. "On the Human Capital of Inca Indios before and after the Spanish Conquest. Was There a 'Pre-Colonial Legacy'?" Explorations in Economic History 50 (2): 227–41.

Krueger, Alan B., and Mikael Lindahl. 2001. "Education for Growth: Why and for Whom?" Journal of Economic Literature 39 (4): 1101–36.

Lawaetz, Eva. 1980. Black Education in the Danish West Indies from 1732 to 1853: The Pioneering Efforts of the Moravian Brethren. St. Croix: The St. Croix Friends of Denmark Society.

Lee, Jong-Wha, and Hanol Lee. 2016. "Human Capital in the Long Run." Journal of Development Economics 122: 147–69.

Leeuwen, Bas van, and Jieli van Leeuwen-Li. 2014. "Education since 1820." In How Was Life? Global Well-Being Since 1820. Edited by Jan Luiten van Zanden, Joerg Baten, Marco Mira d'Ercole, Auke Rijpma, Conal Smith and Marcel Timmer, 87–100. OECD Publishing.

Llorca-Jaña, Manuel, Javier Rivas, Ignacio Pérez, and Juan Navarrete-Montalvo. 2022. "Human Capital in Chile: The Development of Numeracy during the Last 250 Years." Economic History of Developing Regions 37 (3): 227–56.

Luster, Robert E. 1995. Amelioration of the Slaves in the British Empire, 1790-1833. Peter Lang Publishing Inc.

Maarseveen, Raoul van. 2021. "The Urban–Rural Education Gap: Do Cities Indeed Make Us Smarter?" Journal of Economic Geography 21 (5): 683–714.

Manzel, Kerstin, and Joerg Baten. 2009. "Gender Equality and Inequality in Numeracy: The Case of Latin America and the Caribbean, 1880–1949." Revista de Historia Economica-Journal of Iberian and Latin American Economic History 27 (1): 37–73.

Manzel, Kerstin, Joerg Baten, and Yvonne Stolz. 2012. "Convergence and Divergence of Numeracy: The Development of Age Heaping in Latin America from the Seventeenth to the Twentieth Century 1." The Economic History Review 65 (3): 932–60.

Meier Zu Selhausen, Felix. 2019. "Missions, Education and Conversion in Colonial Africa." In Globalization and the Rise of Mass Education, edited by David Mitch and Gabriele Cappelli, 25–59. Palgrave Studies in Economic History. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-25417-9_2.

Olsen, Poul Erik, ed. 2017. Vestindien: St. Croix, St. Thomas Og St. Jan. Danmark Og Kolonierne. Copenhagen: GADs forlag.

Pérez-Artés, María Del Carmen. 2023. "Numeracy Selectivity of Spanish Migrants in Colonial America (Sixteenth–Eighteenth Centuries)." The Economic History Review, August, ehr.13279. https://doi.org/10.1111/ehr.13279.

Prados de la Escosura, Leandro. 2022. Human Development and the Path to Freedom : 1870 to the Present. Cambridge ; Cambridge University Press.

Pritchett, Lant. 2013. The Rebirth of Education : Schooling Ain't Learning. Washington, D.C.: Center for Global Development.

Romer, Paul M. 1989. "Human Capital and Growth: Theory and Evidence." National Bureau of Economic Research Cambridge, Mass., USA.

Rosen, Sherwin. 2018. "Human Capital." In The New Palgrave Dictionary of Economics. Third Edition., 5991–6006. London: Palgrave Macmillan.

Sokoloff, Kenneth L., and Stanley L. Engerman. 2000. "History Lessons: Institutions, Factors Endowments, and Paths of Development in the New World." The Journal of Economic Perspectives, 217–32.

Span, Christopher, and James Anderson. 2005. "The Quest for 'Book Learning': African American Education in Slavery and Freedom." In A Companion to African American History. Edited by Alton Hornsby Jr, 295–311. Malden, MA: Blackwell Publishing Ltd.

Spoorenberg, Thomas. 2007. "Quality of Age Reporting: Extension and Application of the Modified Whipple's Index." Population 62 (4): 729–41.

Sveistrup, Poul Peter, and Richard Willerslev. 1945. Den Danske Sukkerhandels Og Sukkerproduktions Historie. København.

Szoltysek, Mikolaj, Radoslaw Poniat, and Siegfried Gruber. 2018. "Age Heaping Patterns in Mosaic Data." Historical Methods: A Journal of Quantitative and Interdisciplinary History 51 (1): 13–38.

Tapia, Francisco J. Beltrán, Alfonso Díez-Minguela, Julio Martinez-Galarraga, and Daniel A. Tirado-Fabregat. 2022. "Two Stories, One Fate: Age-Heaping and Literacy in Spain, 1877-1930." Revista de Historia Economica-Journal of Iberian and Latin American Economic History 40 (3): 405–38.

Tapia, Francisco J. Beltrán, and Julio Martinez-Galarraga. 2018. "Inequality and Education in Pre-Industrial Economies: Evidence from Spain." Explorations in Economic History 69: 81–101.

Tollnek, Franziska, and Joerg Baten. 2016. "Age-Heaping-Based Human Capital Estimates." In Handbook of Cliometrics, 131–54. Springer.

Turnbull, Charles W. 2009. "Aspects of Education during Slavery in the Danish West Indies." In Negotiating Enslavement: Perspectives on Slavery in the Danish West Indies. Edited by Arnold Highfield and George Tyson, 149–64. St. Croix: Antilles Press.

Ward, John Robert. 1988. British West Indian Slavery, 1750-1834 : The Process of Amelioration. Oxford: Clarendon.

———. 1989. "The Amelioration of British West Indian Slavery, 1750-1834: Technical Change and the Plough." New West Indian Guide/Nieuwe West-Indische Gids 63 (1–2): 41–58.

———. 2018. "The Amelioration of British West Indian Slavery: Anthropometric Evidence." The Economic History Review 71 (4): 1199–1226. https://doi.org/10.1111/ehr.12655.

Webber, Thomas. 1978. Deep Like the Rivers: Education in the Slave Quarter Community 1831-1865. New York: W.W. Norton.

Williams, Heather Andrea. 2005. Self-Taught: African American Education in Slavery and Freedom. University of North Carolina Press.

Wright, Robert E. 2017. The Poverty of Slavery How Unfree Labor Pollutes the Economy. Cham: Springer International Publishing.

Zelnik, Melvin. 1961. "Age Heaping in the United States Census: 1880-1950." The Milbank Memorial Fund Quarterly 39 (3): 540–73.

Göteborg Papers in Economic History

Available online at S-WOPEC: (http://swopec.hhs.se/gunhis/)

1. Jan Bohlin: Tariff protection in Sweden 1885-1914. 2005
2. Svante Larsson: Globalisation, inequality and Swedish catch up in the late nineteenth century. Williamson's real wage comparisons under scrutiny. 2005
3. Staffan Granér: Thy Neighbour's Property. Communal property rights and institutional change in an iron producing forest district of Sweden 1630-1750. 2005
4. Klas Rönnbäck: Flexibility and protectionism. Swedish trade in sugar during the early modern era. 2006
5. Oskar Broberg: Verkstadsindustri i globaliseringens tidevarv. En studie av SKF och Volvo 1970-2000. 2006
6. Jan Bohlin: The income distributional consequences of agrarian tariffs in Sweden on the eve of World War I. 2006
7. Jan Bohlin and Svante Larsson: Protectionism, agricultural prices and relative factor incomes: Sweden's wage-rental ratio, 1877–1926. 2006
8. Jan Bohlin: Structural Change in the Swedish economy in the late nineteenth and early twentieth century – The role of import substitution and export demand. 2007
9. Per Hallén Levnadsstandarden speglad i bouppteckningar. En undersökning av två metoder att använda svenska bouppteckningar för en levnadsstandards undersökning samt en internationell jämförelse. 2007
10. Klas Rönnbäck: The price of sugar in Sweden. Data, source & methods. 2007
11. Klas Rönnbäck: From extreme luxury to everyday commodity – sugar in Sweden, 17th to 20th centuries. 2007
12. Martin Khan: A decisive intelligence failure? British intelligence on Soviet war potential and the 1939 Anglo-French-Soviet alliance that never was. 2008
13. Bengt Gärdfors: Bolagsrevisorn. En studie av revisionsverksamheten under sent 1800-tal och tidigt 1900-tal. Från frivillighet till lagreglering och professionalisering. 2010
14. Ann-Sofie Axelsson, Oskar Broberg och Gustav Sjöblom (red.): Internet, IT-boomen och reklambranschen under andra hälften av nittiotalet. Transkript av ett vittnesseminarium på ABF-huset i Stockholm den 17 februari 2010. 2011
15. Staffan Granér and Klas Rönnbäck: Economic Growth and Clean Water in the Göta River. A Pilot Study of Collective Action and the Environmental Kuznets Curve, 1895-2000. 2011
16. Ulf Olsson: En värdefull berättelse. Wallenbergarnas historieprojekt 2013
17. Irene Elmerot: Skrivhandledning för doktorander i ekonomisk historia vid Göteborgs universitet. 2015

18. Tobias Karlsson and Christer Lundh: The Gothenburg Population Panel 1915-1943. GOPP Version 6.0. 2015

19. Tobias Karlsson: Pushed into unemployment, pulled into retirement: Facing old age in Gothenburg, 1923-1943. 2015

20. Stefan Öberg and Klas Rönnbäck: Mortality among European settlers in pre-colonial West Africa: The "White Man's Grave" revisited. 2016

21. Dimitrios Theodoridis: The ecological footprint of early-modern commodities. Coefficients of land use per unit of product. 2017

22. Stefan Öberg: An introduction to using twin births as instrumental variables for sibship size. 2017

23. Stefan Öberg: Instrumental variables based on twin births are by definition not valid. 2018

24. Jesper Hamark and Kristoffer Collin: Industrial wages in mid-1880s Sweden: estimations beyond Bagge's Wages in Sweden. Data, source and methods. 2019

25. Stefan Öberg: Too LATE for Natural Experiments: A Critique of Local Average Treatment Effects Using the Example of Angrist and Evans (1998) 2019

26. Jesper Hamark: Labour market conflicts in Scandinavia, c. 1900-1938: The scientific need to separate strikes and lockouts. 2020

27. Carl-Johan Gadd: Jordnaturernas fördelning i Sveriges län år 1700. En rekonstruktion,samt en jämförelse med förhållandena vid 1500-talets mitt. 2020

28. Jesper Hamark and Russel Turner: Wage distribution within the Swedish State Railways, 1877-1951: Material and methods. 2021

29. Jesper Hamark and John Lapidus: Unions, insurance and changing welfare states: The emergence of obligatory complementary income insurance in Sweden. (January) 2022 (updated version, September 2022)

30. Matteo Gomellini, Anna Missiaia & Dario Pellegrino: From Global to Local: Trade Shocks and Regional Growth in Italy During the First Globalization. 2022

31. Staffan Albinsson: Urbaniseringen av det regionala musiklivet. 2023

32. Stefania Galli, Klas Rönnbäck and Dimitrios Theodoridis: Reconstructing a slave society: Building the DWI panel, 1760-1914. 2023

33. Dimitrios Theodoridis, Klas Rönnbäck and Stefania Galli: The failed promise of freedom: Emancipation and wealth inequality in the Caribbean. 2024

34. Stefania Galli: Occupational structure in a black settler colony: Sierra Leone in 1831. 2024

35. Klas Rönnbäck, Stefania Galli, Dimitrios Theodoridis, and Kathrine Faust Larsen: The persistence of wealth: Economic inequality in a Caribbean slave colony in the very long run. 2024